2026

SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM

Draft Abstract Book

PURDUE UNIVERSITY | Office of Undergraduate Research

POSTER SYMPOSIUM

Posters sorted by program (if any) and then by the first author's last name within each session. Only presenting authors (italicized) and mentors are listed. Contributing authors and acknowledgements are listed in the abstract book online.

POSTER SESSION 1 | 10:30-11:30AM

ASPIRE REU

1000 *Ruby L Aubin; Chandler Justice;* Brandon Chase Myke Allen

1001 *Eric Huang;* Vijay Gupta; Farbod Siahkali

1002 *Adrian Rincon;* Vijay Gupta

DUIRI

1003 *Mudit Pandey;* Md Ashiqur Rahman; David Warsinger

REU for Built Environment Decarbonization

1004 *Dylan Friedman;* Jinwu Xiao; Kyubyung Kang

1005 *Julia Gloss;* Shanyue Guan; Shufan Liu

1006 *Daniel Sears Gregory; Hope Rockmore-Johnson;* Soowon Chang; Deniz Besiktepe; Heung Jin Oh

1007 Mizuki Kuno*; Amber Josfin Ramos Pineda;* Qingchun Li; Deniz Besiktepe; Soowon Chang

1008 *Sophia Sheldon;* Chengcheng Tao; Xiaoli Xiong

1009 *Nathan Daniel Weston;* sogand Hasanzadeh

PURE-PD

1010 *Madison Birgy;* Sen Lin; Jianxin Ma

1011 *Michael Blados;* Michael V Mickelbart

1012 *Allison Del Sarto;* Cankui Zhang

1013 *Hannah Flis;* Samuel Joseph Mantel; Angela Hancock

1014 *Kit Hill;* Galen Martin

1015 *Alexus Moriah Johnson;* Gyeong Mee Yoon; Jae Ho Kim

1016 *Owen Ososki;* Sergio Munoz-Gomez; Dongseok Kim

1017 *Lila Rivera;* Joe Ogas

1018 *Kayla Saopraseuth;* Stanton B Gelvin; Lan-Ying Lee

1019 *Bella Turnbull;* Chao-Jan Liao; Venkatesh P Thirumalaikumar; Athanas Guzha

1020 *Leah Wong;* Ruy Wilhelmus Johannes Kortbeek; Natalia Dudareva

SCARF

1021 *Duncan Patrick Blank;* Joe Ogas

1022 *Reuben Joshua De Dios;* Lori Hoagland

1023 *Andrew Lucas Freuman;* Kari L Clase; Stephen Robert Byrn; Daniel T Smith

1024 *Xinhui Katherine Huang;* Jinsu Hong

1025 *Sam Nelson Hutjens;* Brenna Lynn Decker

1026 *Savana Jankovic;* Mark C Hall; Emily Lynae Danzeisen

1027 *Eva Corinne Morie;* Jacob Daniel Hosen; Alexander Charles Collins

1028 *Sophia Morris;* Joseph Paul Robinson; Bartek Rajwa

1029 *Kae Nielson;* Morgan Emily Furze

1030 *Nina O'Tain;* Tingting Ju

1031 *Seojin Paek;* Xing Liu

1032 *Verasha Pomart;* Lisa S. Mydy

1033 *Tongyu Qin;* Yuan Yao

1034 *Alexandra Susan Revivo;* Amanda J Deering; Adriana Vanegas Torres

1035 *Catherine Song;* Yichao Rui

1036 *Sahana Srinivasan;* Clint C S Chapple

1037 *Austin Robert Tanabe;* Feng Wang; Su-Ling Liu

1038 *Kai Tran;* Bruce R Hamaker

1039 *Akhilesh Vigneshwaran;* Weiguo Andy Tao

SROP

1040 *Dylan Matthew Diaz;* Yu-Chin Chiu

1041 *Kiara C. Méndez Serrano;* Han Chen; Yaohua Feng

1042 *David Perez Ramos;* Patricia Marie Wolf

1043 *Emma Sullinger;* Linda S Lee; Ariana Jolie Lazo

1044 *Dannah Rose Urban;* Jennifer Chung; Thekla Morgenroth; Kira K Means

1045 *Makenna Wevick;* Jianxin Ma; Leonie Marie Trabert

1046 *Eunice Zhang;* Marcus Mann

SURF

1047 *Maria Catalina Aceros;* Fernando Aguilera De Alba; Michael G Heinz

1048 *Bolortsetseg Adiya;* Alexandra Blair Clark; Laura J Pyrak-Nolte

1049 *Minseong An;* Martin Byung-Guk Jun; Junmyoung Jang

1050 *Rishab Anand;* Tae Yoon Kim; Md Foysal Rabbi

1051 *David Felipe Arguello Patino;* Megan K Van Dyke; Yuehwern Yih

1052 *Sidharth Bhatt;* Yaguang Zhang; Fabio Andres Castiblanco Rubio

1053 *Juan I Cantarella;* Kyle Henry Jung; Marisol Koslowski; Joshua Mark Block

1054 *Logan Ray Thomas Carleton;* Laura J Pyrak-Nolte

1055 *Avery Chan;* Arezoo Ardekani; David Perez Herrera

1056 *Daniel Chi Hsien Chen Sandi;* Jun Kim; Taimoor Hasan Qazi

1057 *Brendan Edward Crump;* Ayotunde Olaoluwa Alabi; David Hibbitts

1058 *Guilherme de Souza Correa;* Luis Gerardo Romaguera-Rios; Thomas H Siegmund

1059 *Kelcie Edrea T Estrera;* Denny Yu

1060 *Hongsen Fang;* Dianyun Zhang; Yao Sun; Sai Krishna Meka

1061 *Auriani Faviola Gomez Cintron;* Agnes Doszpoly; Tamara L Kinzer-Ursem

1062 *Gabriela Gomez Langebeck;* Lori Hoagland; Cristian Andres Salinas Castillo

1063 *Nicolas Gomez Velasquez;* Jan-Anders E Mansson; Adeline Nora Ripberger

1064 *Vincent John Graciano;* Bren H Legarreta; Diane Collard; Steven F Son

1065 *Sicheng He;* Qiuyang Xiao; Li Zhan

1066 *Jamie Chanadol Henson; Kai X Keller;* Yooseung Choi

1067 *Kira Howe;* Saloni Darji; Sourish Biswas; David Thompson

1068 *Joseph Anthony Janicek;* Govindi Soba Rashmiraji Walimuni Dewage; Xindi Tang; Qiaorong Xie; Julia Laskin

1069 *Daniel Esteban Jara Moreno;* Anish Yadav; Christina W Li

1070 *Yizheng Jiang;* Denny Yu; Jingkun Wang

1071 *Brayden Kauffmann;* Tiancong Zhu; Daniel Johannes Jung

1072 *Nathan Maharaj Kharwanlang;* Chenfei Zhu

1073 *Kyungmin Kim;* Fabio Andres Castiblanco Rubio

1074 *Mary C Kirby;* Caitlin Rose Proctor; Addrita Haque

1075 *Anna Louise Kokosa;* Grigorii Aleksandrovich Rudakov; Tamara L Kinzer-Ursem

1076 *Akhil Kota;* Shraman Pal; Can Li

1077 *Emily Danielle Kushner;* Joseph Flanagan; Jihoon Park; Sudipta Mondal; Kenneth H Sandhage; Kevin P Trumble

1078 *Andre Lee;* David Iseri Inouye; Easton Luke-Earl Currie; Mingyu Kim

1079 *Sooji Lee;* Greg M Michalski

1080 *Woojun Lee;* euiwon Bae

1081 *Zonghan Lei;* Linda Nie

1082 *Ana Sofia Leiva Aldana;* D. Marshall Porterfield; Richard John Barker

1083 *Zhixin Li;* Lei Wang

1084 *Somi Lim;* Caitlin Rose Proctor

1085 *Bingyi Liu;* Chenfei Zhu

1086 *Sophia D Madrazo;* Anna Elizabeth Davis; Gabriel Jordan Lovinger

1087 *Aidan Josef Monark;* Kali Nicole Konstantinopoulos; Trevor Jaan Shoaf

1088 *Sohyun Moon;* Mahmudul Hoq; Hosop Shin

1089 *Keira Alexandra Murphy;* Paula Belmont Coelho; Andrew Whelton

1090 *Srinath Eswaran Neelamagam;* Shrikrishna Bhagirath Rajule

1091 *Natalia Nino Cocoma;* Jhon Edison Martinez; Riyi Shi

1092 *Isabel M Owens;* Shalini Iyer; Chittaranjan Das; Nuela Enebechi

1093 *Minho Park;* Martin Byung-Guk Jun; Junmyoung Jang

1094 *Yixuan Ren;* Joydeep Rakshit; Saloni Darji

1095 *Zachary Ryan Roeder;* Kendra A Erk; Evan R Williams; Matthew Kaboolian

1096 *Nasser H Sanwari;* Grigorii Aleksandrovich Rudakov; Tamara L Kinzer-Ursem; Leopold Noel Green

1097 *Rohan Ashish Shrowty;* David Warsinger; Mateo Roldan Carvajal

1098 *Udaiveer Singh;* Rajiv Ranjan; Dharmendra Saraswat

1099 *Paul Shannon Slack;* Md Rakibul Islam Prince

1100 *Daniela Solarte Rodriguez;* Lena Azimi; Guinan Guo; Melba M Crawford

1101 *Robert Scott Sorensen;* Bruno Tesini Roseguini

1102 *Nicholas Audrie Steeves;* Nickolas Richard Brauer; Jean A Chmielewski

1103 *Abhaya Sundar;* Ritwik Bhattacharya; Abhinanda Sengupta; Partha P Mukherjee

1104 *Likhita Tinga;* Aidan Damian Pantoya; Jalen Riley Macatangay; Jason John Wilkening; Alejandro H Strachan

1105 *Mai Khanh Tran; Joao Vitor Carvalho Almeida;* Jenna L Wise DiVincenzo

1106 *Emerson Waltz;* Reagan Cole Huckabee; Rajamani P Gounder

1107 *Minghan Wang;* Yifan Wang

1108 *Ryan James Williams;* Rusi P Taleyarkhan; Stepan Ozerov

1109 *Ryan Wu;* Weihang Li; Melba M Crawford

1110 *Ruoqin Rachel Yang;* Nicholas Noinaj; Laszlo Csonka

1111 *Feng Ye;* Qiuyue Xue

1112 *Kai-Xing Yue;* David Warsinger; Mateo Roldan Carvajal

1113 *Lucia X Zhang;* chongli Yuan; Han Zhao

SURF-SCALE

1114 *Seth Everette Cowan;* Rusi P Taleyarkhan; Stepan Ozerov

1115 *Conner B Stott;* Isik Gokcen Karslioglu; Timothy Matthew Jones

UREP-C/LA

1116 *Angie Ginnella Batista; Juan Pablo Rodriguez Lopez;* Dutt Jagdish Thakkar; Steven R Dunlop

1117 *Ana Maria Cifuentes Pinilla;* Christina R Ferreira; Dipak Narula

1118 *Maria Jose Suarez Monroy;* Christina R Ferreira; Maria Soledad Sepulveda; Tyler D Hoskins

Vet Scholars Summer Program

1119 *Kotoe Jodie Yoshitomi;* Sun Young Kim

Additional Presenters

1120 *Qianyue Chen;* Jan-Frederik Schulte; Yao Yao

1121 *Kym-Danny Dyah Francis;* Ismar Leonel Chew; Monique Suzanne McClain

1122 *Anne C. Lim; Sanah Kochhar;* Siqi Zhang; Sarah Eason

1123 *Carlos Alexis Ortiz Gonzalez;* Kaushik Roy

1124 *Maheen Syed;* Nikita Krishnan; Shatha Jameel Mufti; Riyi Shi

1125 *Sunny Yoon;* Brandon Keehn

POSTER SESSION 2 | 12:00-1:00PM

DUIRI

1200 *Changho Lee;* Garam Kim; Eduardo Barocio Vaca

1201 *Gia Phong Phuong;* Jose M Garcia Bravo

1202 *Ava Robinson;* Walter Daniel Leon-Salas

REU for Genetic and Biochemical Analysis of Proteins

1203 *Alan Cortes;* Vikki Marie Weake; Seth Daniel Lammert

1204 *Savannah Doty;* Kyle Aaron Cottrell; Cassandra Smoak

1205 *Kendra Eller;* Hana Hall; Geethma Lirushie Tellambure Vithanage; Kendall Cottingham

1206 *Teresa Hayden;* Majid Kazemian; An My Nguyen

1207 *Erwin Kingston;* Andrew D Mesecar; Nidhi Walia

1208 *Marlayna Little;* Humaira Gowher; Mudasir Zahoor

1209 *Christopher Powell;* Weiguo Andy Tao; Shakhzodjon Uzokboev

1210 *Kyannet Rodriguez-Cruz;* Xing Liu; Rajasi Somesh Dravid

REU in SCBB

1211 *Nycholas Contreras;* Carol B Post; Rajarshi Roy

1212 *Sebastian Cruz;* Jinho Jang; Danzhou Yang

1213 *Laura Dong;* Daisuke Kihara; Anika Jain

1214 *Roman Matamoros;* Momen Mohamed Am Al-Hindy; Zhong-Yin Zhang

1215 *Tyler Paine;* John Tesmer; Sandali Lakmini Piladuwa Gamage

1216 *Isaiah Philip;* Genki Terashi; Daisuke Kihara

1217 *Emily Truong;* Mingqing Liu; Rong Huang; Nicholas Noinaj

1218 *Anika Vaz;* Marlyn Michelle Bush; Nicholas Noinaj

SROP

1219 *Arianis Loraine Hernández Peña;* michael Wendt; Yun Li

1220 *Alexander Nikos Koron;* Jessica Hsu

1221 *Jasmine Yichen Lu;* Teri Kirby; Linh Nghiem Hai Pham

1222 *Erin Rodriguez;* Lin Tan; Kevin Zhang

1223 *Lena Yvonne Grace Rotteveel;* Yan Cong

1224 *Abner Obed Ruiz Pérez;* Cary D Troy

SURF

1225 *Md Sadat Aarik;* David Warsinger; Davide Ziviani; Md Ashiqur Rahman

1226 *Agustin Abt;* Ethan Wayne Holbrook; Alejandro H Strachan

1227 *Garv Atri;* Linlin Li

1228 *Aritra Barman;* Saghnik Saha; Ming Yu Ngai

1229 *Olivia Bell;* Craig Goergen; Benjamin Zeidler

1230 *Anushka Bhave;* Caue Sciascia Borlina; Anastasia Kouvaras Ostrowski; Ali Bramson

1231 *Cole J Burnett;* Jan-Anders E Mansson; Adeline Nora Ripberger

1232 *Emma Caron;* Riley Bradley Barta; Ganesh Brammanayagam venkatesan

1233 *Anirud Chakkarapani;* Luz Sotelo; Harshith Kumar Adepu; Davis Roy Avera

1234 *Pin-Yu Chen;* Junyuan Lu; Jingang Li

1235 *Martinos Christodoulides;* Nathaniel Liam Lazorchak; Ken Yoshida

1236 *Allison Clark;* Sergio Munoz-Gomez

1237 *William Thomas Covington;* Laura Elaine Murray-Kolb; Emily Rebekah Seiger

1238 *Sylvia Isabella Diaz;* Sarah Gustafson Wagers; Rajamani P Gounder

1239 *Abhigyan Doshi;* Pranshu Maan; Alexander V Kildishev

1240 *Pavle Duric;* Fabio Andres Castiblanco Rubio; Yaguang Zhang; Andrew Balmos; James V Krogmeier

1241 *Emma Foster;* Grigorii Aleksandrovich Rudakov; Tamara L Kinzer-Ursem; Leopold Noel Green

1242 *Akshith Garapati;* Dharmendra Saraswat; David Iseri Inouye; Rajiv Ranjan

1243 *Juan Garcia;* Hector Gomez Diaz; Mahmoud Golestanian; Lin Tan

1244 *Gabriela Garcia Cardenas;* Dylan Kenji Wainwright; Matthew Kaboolian; Hana Noell Larkins; Kendra A Erk

1245 *Medhansh Garg;* Danny Milisavljevic; Danielle Dickinson

1246 *Elijah Goodman;* Dan Jiao; Hongyang Liu

1247 *Arsh Gupta; Connor Siurek;* Daniel G Aliaga; Eric Samperton

1248 *Caleb Carr Hamilton;* Yue Meng

1249 *Ananya Hegde;* Xiaoping Bao; Jingqiao Shen

1250 *Valeria Raquel Hernandez Barboza;* Michael R Gribskov

1251 *Ana Maria Hernandez Conde;* Joaquin Goñi

1252 *Kenli Hetrick;* Matthew Louis Scarpelli; MacKenzie Coon-Haworth

1253 *Habin Jang;* Arezoo Ardekani; Elham Saberian

1254 *Mia Alexandra Jensen;* Jinyang Du; Luis Solorio

1255 *Julia Kang;* Shubh Parag Mehta; Craig Goergen; Benjamin Landis

1256 *Pataraphol Keeraswangporn;* Fabio Andres Castiblanco Rubio; Yaguang Zhang

1257 *Rohan Kelkar;* Dianyun Zhang; Yao Sun

1258 *Kai X Keller; Jamie Chanadol Henson;* Yooseung Choi; Ran Dai

1259 *Emma M Kindwall;* Nissa Larson; Linlin Li; David M Umulis

1260 *Joseph Timothy Kritenbrink;* Alex Santiago-Vargas; Dimitrios Peroulis

1261 *Caleb Eunho Lee;* Hector Gomez Diaz; Mahmoud Golestanian; Jing Gao

1262 *Yoon gi Lee;* Juan Carlos Verduzco Gastelum; Alejandro H Strachan

1263 *Anastasia Patricia Lesniewski;* Laura J Pyrak-Nolte; Alexandra Blair Clark

1264 *Guanting Li;* Leyu Liu; Zhenhua Zeng

1265 *Ailuen Liu;* Mina Carpenter; Christopher H Uyeda

1266 *Katherine Mader;* Amina Asghar; Christina W Li

1267 *Ryan Y Manley;* Vladimir M Shalaev; Alexandra Boltasseva; Arnab Banerjee

1268 *Dominic Nathaniel Muniz;* Laura Helen Blumenschein; Priyanka Balkrishna Bhovad; Ethan Michael DeVries; Jack Rearden Ferlazzo

1269 *Abhishek Manoj Nair;* Kosuke Ando; Satyaroop Patnaik; Nikhilesh Chawla

1270 *Nathan Nguyen;* Arezoo Ardekani; Prasheel Shivanand Nakate

1271 *Rebecca Rose Phelan;* Grigorii Aleksandrovich Rudakov; Tamara L Kinzer-Ursem

1272 *Caleb Jonathan Radtke; Alex Perry;* Matthew Leight; Varun Aggarwal

1273 *Rushil Ramchand;* Zheyuan Zhang; Muhammad ibtsaam Qadir; Fiona Kolbinger

1274 *Amrita Rani Raparti;* Deva Chan

1275 *Andrea Rocha Barajas;* Dhiya eddine Belkadi; Muhammad Mustafa Hussain; Min Sung Kim; Yusuf Kolawole Adebakin

1276 *Shreeya Roy;* Donghoon Lee; Karin F K Ejendal; Tamara L Kinzer-Ursem

1277 *Hiya Samanta;* Anastasia Kouvaras Ostrowski; Caue Sciascia Borlina; Ali Bramson

1278 *Fang Rui Shen;* Ali Mashhadian; Arezoo Ardekani

1279 *Connor Siurek; Arsh Gupta;* Daniel G Aliaga; Eric Samperton

1280 *Yuwen Song;* Christina W Li; Mah Gull

1281 *Colleen Ryan Squier;* Stephen Craig Mills; Christopher G Oakley

1282 *Vincent Stavig;* Erica Carlson; Matthew Davis Golden; Po-Yu Chen

1283 *Christopher Robert Stemporzewski;* Alexey Shashurin

1284 *Raveena Venkateshwaran;* Daniel Suter; Jorge Emanuel Hernandez Dominguez

1285 *Henan Wang;* Zeshu Wang; Haitong Li

1286 *Alissa Weigand;* Tonglei Li; Koushiki Basu

1287 *Katie Wilkinson;* Colton Dean Willhardt; Daniel Robert Guildenbecher

1288 *Lorelei B Xia;* Jinho Jang; Danzhou Yang

1289 *Zihan O Zeng;* Yuelin Deng; Upinder Kaur

1290 *Francine Yu He Zhang;* Nicole Elizabeth Mertens; Tuba Marjan; Taimoor Hasan Qazi

SURF-SCALE

1291 *Louis Vincent Buonaiuto;* Andrew Owen Fewell; Peter Bermel

1292 *Elisa Chen;* Linda Nie; Ellen M Wells; Carolina Gonzalez Canas; Justin Farmer

1293 *William Eunseok Jo;* Shubhra Bansal; Haohan Guo

1294 *Keegan M Kita;* Alexander Gregory Sinelli; Allen L Garner

1295 *Aryan Rauniyar; Agustin Abt;* Ethan Wayne Holbrook; Alejandro H Strachan

1296 *Luke Alexander Trahin;* Allen L Garner; Alexander Gregory Sinelli

Vet Scholars Summer Program

1297 *Teegan Acres;* Emma Dell Stapley

1298 *Katrina Mason;* Ahmed Abdelkhale Hassan

1299 *Quynh Lam Nguyen;* Harm Hogenesch

1300 *Vianca A. Rios Brito;* Michelle L Tucker

1301 *Thanya Thotakura;* Leanne Nieforth; Sarah Jean Reega

1302 *Xander L Tuttle;* Dianne Little

1303 *Cheyenne Renee Waddell;* Michael Wendt; Sydney P Quijano

Additional Presenters

1304 *Israel Adenuga; Alessandra Orr; Jolissa Abeh;* Ernest Francis Talarico, Jr.; Evan Roberts; Kathryn Stolzenbach; Corinne Zimmerman; Caitlin Gallagher

1305 *Basil Alojan;* Amanda P Siegel; Andres Tovar; Andrew Nuetzel

1306 *Saishri Bagde;* Alexandra Boltasseva; Miroslava Marinova Marinova; Kyu Ri Choi

1307 *Aarushi Gupta;* Nasreen Lalani

1308 *Thomas James Haack;* Ernest Francis Talarico, Jr.; Hassan Naji

1309 *Mia R Hannah;* Roger Nicholas Bryant

1310 *Ahmed Khan;* Hyewon Seo; Behzad Esmaeili

1311 *Olivia Lucille Kimmick; Alessia Lin Heiser;* Ahmed Abdelkhale Hassan

1312 *Jada E Laskowski;* Subhashree Subramanyam

1313 *Andrew Yicheng Li;* Andres Tovar; Amanda P Siegel

1314 *Seona James Mathew; Lorellei Estella ro Fletcher; Morgan Denae Furlow;* Daniel J Foti

1315 *Milagros Melhem Bertagni;* Andres Tovar; Amanda P Siegel; Ken Yoshida

1316 *A'Mya Murray Coleman;* Leanne Nieforth

1317 *Samuel J Patchin;* Ernest Francis Talarico, Jr.

1318 *Madeline Marie Peterson;* Lori Hoagland; Laura Elisa Garcia Giraldo

1319 *Aditya Pillai;* Viju Vijayan Pillai; Shyamkumar TS

1320 *Alvan Ramee;* Md Ashiqur Rahman; David Warsinger

1321 *Gregorio Romagnoli Oliveira;* Angeline M Lyon; Leon Filip Laskowski

1322 *Julian Leonard Smith;* Sara Elizabeth Cloft; Darrin M Karcher; Patrice E Baumhardt; Esteban Fernandez-Juricic

1323 *Esha Sury; Dhruv Upreti;* Erika Birgit Kaufmann; Ralph Martin Kaufmann

1324 *Shanell Andria Taylor;* Sara Elizabeth Cloft; Darrin M Karcher

1325 *Jacob Junjie Zhang;* Shaiv Mehra; Bradley S Duerstock

POSTER SESSION 3 | 1:30-2:30PM

DUIRI

1400 *Noah Daniel Brooks;* Tian Li

1401 *Kayla A Fischer; Eesha Khalid Faruqi;* Meera Pancholi Doran; Craig Goergen

1402 *Robert Humphreys;* Austin Rory Cooper

1403 *Prisha Marpu;* Nan Kong; Yingjie Chen; Haopeng Zhou

1404 *Amanda Nesbitt;* chongli Yuan; Xihui Zhao

SURF

1405 *Paridhi Agarwal;* Martin R Okos; Dharmendra Saraswat; Daniel N Hauersperger

1406 *Zoe Amerman;* Guang Lin

1407 *Ruhaan Batta;* Junyuan Lu; Jingang Li

1408 *Helen Sophia Brzozowski;* Kenneth H Sandhage; Joseph Flanagan; Kevin P Trumble

1409 *Nicolas Bustamante;* Li Qiao; Samarpan Farmer

1410 *Eeshwar Ram Chalasani;* Linlin Li

1411 *Anna S Chambers;* Sarah Gustafson Wagers; Rajamani P Gounder

1412 *Mihir S Chauhan;* Aniket Bera

1413 *Andrew Thomas Choung;* Amy R Reibman

1414 *John G Christian;* Ashwin Ramachandran; Raghav Ram; Shubhonil Sarkar

1415 *Wen Xun Chua;* Shaista ijaz Khan; Zhenhua Zeng; Yilin Lu; Leyu Liu

1416 *Abigail R Deaton;* Grigorii Aleksandrovich Rudakov

1417 *Renee Duan;* Andrew James Simonson; Collin Michael Queen; David Hibbitts

1418 *Rohan Joseph Eapen;* Sandro Matosevic; Tyler Parker Fritsch; Zachary Ashton Chu Leung; Soumyajit Das

1419 *Ava Fuchs;* Joseph Wallace; Olivia Nicole White; Dyann Marie Segvich

1420 *Parthav Garg;* Lei Wang

1421 *Diego Alejandro Hernandez Acosta;* Vitaliy L Rayz; Farshid Goudarzian; Grace Elizabeth Palahnuk; Defne Ekici

1422 *Rinat Ilyussizov;* Ben K D Pearce; Ishaan Madan

1423 *Juyeon Im;* Losha Dasol Jung

1424 *Leonardo Isaac de Medeiros;* Luis Sanjuan; Luis Solorio

1425 *Delfina B Jackson;* Arezoo Ardekani; Elham Saberian; David Perez Herrera; Rizwan Ullah

1426 *Dev Vishwash Joshi;* Waqas Alam; David Warsinger

1427 *Pradyunn Vikram Kale;* Micah Kurt Condie; James Michael Goppert

1428 *Abel Paul Sholey Kallely;* Aaron B Morris; Timmy Ngo

1429 *Adam Lewis Kipp;* Kevin J Webb; Hatim Bamoumen; Farhan Ishraque Zahin

1430 *Hrishikesh Murli Krishna;* Jane Ann Mondul

1431 *Yuet Ching Jolie Lai;* Zachary Kalen Kingston

1432 *Hao-Chen Li;* Haitham Kanakri; Maher E Rizkalla

1433 *Leland Li;* Can Li; PIYUSH SHARMA; Quinn Huckaba

1434 *Khanh Mai;* Ahreum Lee; Divyansh Rathore

1435 *Sri Krishna Teja Mannava;* Andres Eduardo Llacsahuanga Allcca; Leonid P Rokhinson

1436 *Vedha Masuraha;* Babak Anasori

1437 *Caden S McCollum;* Lei Wang

1438 *Sahda Mohammadu Haroon;* Xavier I Morgan-Lange; David Warsinger

1439 *Lucas Munoz;* Walter Daniel Leon-Salas

1440 *Saran S Nagubandi;* Jason Wu

1441 *Ishan Gopu Nair;* Md Ashiqur Rahman; David Warsinger

1442 *Malavika Nair;* Tejas Ravindra Kulkarni; Sadha Sivam Murugesan; Xiaoyue Zhang; Ganesh Subbarayan

1443 *Khoa Duc Khoa Nguyen;* Yu She; Zhengtong Xu

1444 *Jannah M Noshi;* Xiaoling Chen

1445 *Zoe Noznesky;* Brandon Delos Parker; Michael Earl Reppert

1446 *Evelynn Marie Papez;* Elizabeth Tarami Su; Kevin John Otto

1447 *Isaac Parks;* Xavier I Morgan-Lange; David Warsinger

1448 *Kavyaa Parmar; Atiksh Bhattacharya;* Shilo Xia

1449 *Truman Carl Parrish; Ananya Molugu;* Andy Jung; Ace Rounds

1450 *Daniel J V Pike;* Zherui Martinez-Guo; Adithya Kolisetty

1451 *Jacob Lee Prior;* Amy R Reibman

1452 *Reyam Roumeih;* Reem Khir

1453 *William James Rowe;* Yuto Tanaka

1454 *Chris Schoenherr;* Kaitlyn Amber Kondos; Amit Varma; Shivam Sharma

1455 *Leonel Baskin Sesuraj Baskin;* Matthew Thomas Tegtmeyer

1456 *Ziqi Shen;* Anubhav Dey; Ilias Bilionis

1457 *Leonor Antunes Sinogas;* Shulan Xiao; Linlin Li

1458 *Peter Robertson Skrdla;* Alex Santiago-Vargas

1459 *Aditya Srinivasan;* Shuaiqing Zhang; Yihang Zeng

1460 *Kaylani Le'mae Tomlin;* Sarah Gustafson Wagers; Rajamani P Gounder

1461 *Gabriel Torres;* Saru Bharti; Upinder Kaur

1462 *Sreeram Vengalloor Madhavan;* Niranjan Hirisave Shivaram; Russell Lee Zimmerman

1463 *Clayton Walden;* Qixin He; Bianca Shaunessy Broyles

1464 *Serena Yuanyuan Wei;* Jaewon Park; Justin Weibel

1465 *Sophie J Wilcox;* Christina Marie Boody

1466 *Ty Richard Yaguchi;* Hosop Shin; Mahmudul Hoq

1467 *Eric Y Yang;* chongli Yuan

1468 *Eloise Zambrano;* Elizabeth I Parkinson; Carson Bailey Roberts

1469 *Caleb Enos Zhang;* Alexander V Kildishev; Pranshu Maan

SURF-SCALE

1470 *Sana Azat;* Austin Jacob Pronk

1471 *Owen Chen;* Peter Bermel

1472 *Nathan Grant Clark;* Shauna Nicole Adams; Kerrie Douglas; Jill Anne Folkerts

1473 *John W Fabian;* Majid Khorsandi; Linda Nie

1474 *Olyver Fierro;* Shauna Nicole Adams; Kerrie Douglas; Jill Anne Folkerts

1475 *Richard Zhixiong Li;* Yingru Song; Jungmin Lee; Amy M Marconnet

1476 *Nadine Yifei Poon;* Matthew M Niichel

1477 *Nikhil K Raman;* Fariha Haq; Marisol Koslowski

1478 *Junyi Xiu;* Shauna Nicole Adams; Kerrie Douglas; Jill Anne Folkerts

UREP-C/LA

1479 *Harol Esteban Botero Soto;* Satish Kumar Adari; Rodrigo Salgado; Monica Prezzi

1480 *Luis Felipe Pardo Diaz;* Soowon Chang; Heung Jin Oh; Daniel Francisco Castro

1481 *Maria Alejandra Saavedra Mogotocoro;* Michael Titus

Additional Presenters

1482 *Abigail Catherine Alexander;* Marxa Figueiredo

1483 *Kaya Aypek;* Sabine Brunswicker

1484 *Gabrielle Marie Barrido;* Marxa Figueiredo; Gabriel Steven Harris; Kurt Ristroph

1485 *Jacob Bastian;* Chad C Carroll; Gordon Carl Smilanich

1486 *Akshita Bhavanishankar;* Grace Ulmer; Marcelo Invitti

1487 *Ivana Naomi Bilic;* Douglas R Schmitt

1488 *Phoebe Burrell;* Elizabeth I Parkinson; Manuela Frias Gomez

1489 *Hannah Marie Cano;* Jo Otremba

1490 *Daniel Michael Carrel;* Brady Layman; Jeffrey Edward Dick

1491 *Kaleb Caudle;* Megan Leigh Hill; Jeremy Hugh Lawrence; Md Arif Faisal; James Hoang Nguyen; Jeffrey Edward Dick

1492 *Nha Chau;* Ernest Francis Talarico, Jr.; Thach Nguyen

1493 *Hannah Everette;* Moriah Tzivia Bilenky

1494 *Karis Ge Fu;* Reeya Tanwar

1495 *Matthew Tomasz Galej;* Mary Anne Smart

1496 *Michael David Gardner;* Brian Metzger

1497 *Huda Touqeer Hussain;* Ahmed Abdelkhale Hassan

1498 *Andrea Carmen Jacobson;* Sharon A Kessler; Sowmiya Devi Venkatesan

1499 *Lucas O Johnson;* Elizabeth I Parkinson; Paisley Lilliana Jeannette; Zachary Logan Budimir

1500 *Aditya H Joshi;* Tiancong Zhu; Daniel Johannes Jung

1501 *Sai Kasturi Kamila; Melody Christine Yang;* Zherui Martinez-Guo; Adithya Kolisetty; Tyler Dillard

1502 *Ian Kim;* Seema Mattoo

1503 *Khanh Le;* Ernest Francis Talarico, Jr.; Thach Nguyen

1504 *Belinda Xintian Li;* Daniel S Elliott; Diego Esteban Garcia

1505 *Dhruva Magesh; Mateusz Wlodarczyk;* Ernest Francis Talarico, Jr.; Thach Nguyen

1506 *Aditi Magesh;* Laia Vancells Lopez; Nan Kong

1507 *Kelly Marie Makovic;* Leanne Nieforth; Sarah Jean Reega

1508 *Ashlynn R McLaughlin;* Maria Soledad Sepulveda

1509 *Noah Miller;* Pranav Ballaney; Madduri Srinivasarao

1510 *Ngoc Nguyen;* Ernest Francis Talarico, Jr.; Thach Nguyen

1511 *Thai Nguyen;* Ernest Francis Talarico, Jr.; Thach Nguyen

1512 *Ngoc Anh T Nguyen;* Ernest Francis Talarico, Jr.

1513 *Muneera Shoaib Rasheed;* Shaiv Mehra; Bradley S Duerstock

1514 *Amanda Rodriguez-Gonzalez;* Mobina Masdari

1515 *Timothy A Schmiedl; Diya Shivpuje;* Yihang Zeng; Nemanja Ninkovic

1516 *Muhammad F Shaaban;* Joseph Gerard Makin

1517 *Jayden Shah; Ngoc Anh T Nguyen;* Ernest Francis Talarico, Jr.; Thach Nguyen

1518 *Maia Stef-Praun;* Lia A Stanciu-Gregory; Zhijian Wang; Amit Kumar Barui

1519 *Korphiena Kimona Stephen;* Shaiv Mehra; Bradley S Duerstock

1520 *Devikaa Prashant Thakker;* Douglas R Schmitt

1521 *Vo Uyen;* Ernest Francis Talarico, Jr.; Thach Nguyen; Loc Vu

1522 *Tomas Vargas-Bernal;* Pablo D Zavattieri; Marie Kate Palau Andrade

1523 *Alexander Webb;* Brian Metzger

1524 *Jennifer Hyerin Yang;* Robyn Krystal De Dios; Stephanie M Gardner

1525 *Richard Z Zhang;* Linda Nie

Poster Presentation Abstract Number: 1000

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Longevity Innovations for Flight Technology (L.I.F.T.): Engineering Optimal Battery Packs for Electric Aircraft

STEM

ASPIRE REU

Authors(s):

Ruby L Aubin† (Engineering); Chandler Justice† (Utah State University)

Abstract:

This study aims to optimize the ALIA-250's battery pack model for maximum time per full charge with minimal power dissipation by ensuring that the battery pack is as lightweight, mechanical failure-resistant, conservation-friendly, and ethically responsible as possible. As electrified air travel advances towards standard use, the search for an ideal construction of commercial and cargo jet battery packs has become an important research motivation. Modeling and comparing the dynamics of various batteries under consideration for electric aircraft is the primary objective of this research project. By using a flight simulator plugin, tests of the models will alter the battery cell specifications of electrical aircraft while leaving all other technical components untouched. After manipulating these specifications, called the topology, we can compare how effectively the resulting aircraft improves with respect to flight time and distance per full charge (known as range) as well as power efficiency. Power efficiency and range are two areas of interest in this study because of two major limitations in efforts to standardize electrified air travel: firstly, short flight distances. Secondly, overheating due to unnecessary power expenditure, which causes electrical components to degrade much faster than expected. A potential objective of this project involves investigating whether alternative, sodium-ion battery chemistries perform better than traditional lithium battery chemistries in order to move beyond unethical labor practices in lithium mining. Ideally, the outcome of this study will be that these changes will benefit and improve both the future of electrified air transportation and the workforces that make it possible.

Mentor(s):

Brandon Chase Myke Allen (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1001
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Conformal Safety for Multimodal Fusion via Optimal-Transport Alignment

STEM
ASPIRE REU

Authors(s):
Eric Huang† (Engineering)

Abstract:
Multimodal fusion models combine data from different modalities to achieve better predictions than single-modality models. In real-world deployment, however, sensors fail, become perturbed, or are blocked, leaving their signals noisy or entirely missing. When this occurs, the model fuses the corrupted data as though it were trustworthy, producing outputs that are confidently wrong. As multimodal systems move into settings such as autonomous perception and clinical decision support, this becomes a genuine safety concern rather than a minor loss of accuracy.

Existing robust-fusion methods mainly address sensor corruption by estimating modality reliability and reducing the influence of degraded inputs. However, in alignment-based models, fusion also depends on whether the modalities can be coherently aligned. AlignMamba makes this dependence explicit by using optimal transport to locally align modality-specific sequences before fusion. This suggests a natural safety signal: when a sensor fails, the optimal-transport alignment should degrade, and that degradation can be calibrated to decide whether fusion remains trustworthy.

We propose a conformal safety layer for multimodal fusion under sensor failure. Starting from functioning modalities, we simulate a failure in one modality at an unknown time. We use the optimal-transport alignment cost as the nonconformity score for calibration to detect when fusion is no longer reliable. Based on this detection, we determine when a modality should be down-weighted, removed, or flagged. We evaluate this approach against vanilla AlignMamba, without explicit safety detection, and against standard failure-detection baselines.

This work turns a quantity these models already compute into a calibrated warning signal, obtained without retraining or additional supervision. A system equipped with such a signal can adapt around the

failure without additional complexity and continue operating safely in critical environments.

Mentor(s):
Vijay Gupta (Engineering); Farbod Siahkali (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1002
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Understanding the Energy Demands of AI Data Centers

STEM
ASPIRE REU

Authors(s):
Adrian Rincon† (Engineering)

Abstract:
Artificial intelligence (AI) runs on data centers, the large computing facilities that now rank among the fastest-growing consumers of electricity. Much of this demand comes from training AI models, a process that runs thousands of specialized processors at full capacity for days at a time and uses far more power than ordinary computing. As AI spreads, the electricity these facilities draw places heavy demand on regional power grids and drives up operating costs. Cooling the equipment adds to the strain, since it consumes large amounts of water, and the burden reaches the utilities and communities nearby. Researchers have proposed several ways to manage this energy use. The first predicts how much power a workload will draw so operators can measure and limit it. The second shifts flexible tasks to hours when the electricity grid is running on cleaner sources. The third adjusts how AI training jobs run on their processors so they consume less power. Each approach helps under some conditions, but the largest training jobs are difficult to pause or move, since delaying them slows work that people depend on. This project reviews the research to define the problem clearly, giving future efforts a firmer starting point for managing the energy AI requires as it continues to grow.

Mentor(s):
Vijay Gupta (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1003

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Asymmetric Polyvinylidene Fluoride (PVDF) – Graphitic Aerogel (GA) Membranes for Efficient Air Dehumidification

STEM

DUIRI

Authors(s):

Mudit Pandey† (Engineering); Ishan Gopu Nair* (Engineering); Md Sadat Aarik* (Engineering)

Abstract:

While conventional condensation dehumidification technologies are energy-intensive, membrane-based dehumidification offers a more energy-efficient alternative enabling selective water vapor removal without phase change or high energy input. Passive membrane dehumidification (PMD) is a relatively simple and efficient technology as it uses a vapor-selective membrane to separate the moisture from air with a vapor partial pressure difference between the feed and permeate air streams acting as the driving force for the removal of water vapor molecules from the air. This process eliminates the use of active components like a water vapor compressor or vacuum pump. However, the performance of the current PMD system is limited due to membranes' poor permeability owing to high mass transfer resistance associated with the hydrophilic dense layer. To solve this issue, asymmetric membranes comprising of an inherent dense layer with a porous support were fabricated using polyvinylidene fluoride (PVDF) polymer with varying graphitic aerogel (GA) filler concentrations through the nonsolvent-induced phase separation (NIPS) method, enabling the formation of a highly porous, thermally insulating support layer and a selective dense layer. Under the feed inlet temperature of 25°C and varying relative humidity (RH) between 40-60%, asymmetric PVDF-GA membranes (2.5%, 5%, 7.5% and 10% filler concentration) were tested, with 5% GA membrane resulting as the best performing membrane attributing to its optimized porosity and filler distribution. The optimized PVDF–GA membrane outperforms literature-reported membranes to date in vapor transport and dehumidification performance, highlighting its potential for energy-efficient applications.

Mentor(s):

Md Ashiqur Rahman (Engineering); David Warsinger (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1004
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Context-Enhanced Vision-Language Models for Bridge Condition Rating

STEM

NSF REU Site: Research Experience for Undergraduates for Built Environment Decarbonization

Authors(s):
Dylan Friedman† (Polytechnic)

Abstract:
Bridge inspection is a critical yet time-consuming process that relies on inspectors to individually photograph, analyze, and assign standardized National Bridge Inventory (NBI) condition ratings to different structural components. As bridge deterioration continues to rise nationwide, there is an increasing interest in using AI to assist and accelerate the bridge inspection process. This study investigates whether providing inspection photographs with additional context improves the ability of vision-language models (VLMs) to predict condition ratings consistent to inspector assessments.

An automated testing framework was developed to evaluate four input conditions: image alone, image with inspector-provided caption, image with bridge background information (material type and age), and image with both caption and background. Photographs and metadata were extracted from official bridge inspection reports and results compared with inspector-assigned NBI condition ratings as ground truth. Multiple VLMs were benchmarked to identify the most suitable model for scaling to larger datasets. Predictions are evaluated against inspector ratings using exact accuracy, within-one accuracy, and mean absolute error (MAE).

Preliminary results across 52 scorable images from three bridge reports indicate that prompt design and model selection both influence prediction accuracy, with the best-performing model achieving 59.6% exact accuracy and 90.4% within-one accuracy on the NBI 0-9 scale. This research suggests that VLMs with additional context can reduce reliance on manual assessment while maintaining rating consistency. Future work includes extending the framework to assess and evaluate variation between inspectors and identify opportunities to improve the consistency of bridge condition ratings.

Mentor(s):
Jinwu Xiao (Polytechnic); Kyubyung Kang (Polytechnic)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1005

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Development of a Machine Learning Model to Assess Indoor Air Quality Based on Measured Particulate Matter Levels

STEM

NSF REU Site: Research Experience for Undergraduates for Built Environment Decarbonization

Authors(s):

Julia Gloss† (Rochester Institute of Technology)

Abstract:

Particulate matter (PM) density is a commonly used benchmark for air quality. High levels of PM have been closely linked to adverse effects on the pulmonary and cardiovascular systems. While outdoor PM levels are commonly monitored and reported, most public spaces do not track indoor PM concentrations. Measuring indoor PM levels is a crucial step not only towards maintaining good air quality but also towards lowering the energy consumption of buildings by maximizing the efficient use of air filtration systems. This research aims to construct a low-cost, indoor PM sensor which can provide accurate, time-based data and analysis on indoor air quality. To accomplish this, a PM sensor was used in conjunction with an Arduino Uno to capture air quality data. The sensor output was then used to train a model which processes the raw data and classifies the air quality as good or bad. The model was trained on data sampled from various buildings on the Purdue campus in order to provide a well-rounded data set for the model. This research results in a monitoring system that can provide insights into current indoor air quality levels and has the potential to be used by facility management teams to inform the use of air filtration systems. Further research could be conducted to adapt this system for specialized indoor environments, such as aquatic centers or commercial greenhouses, by accounting for factors like humidity and temperature which can impact the sensor output.

Mentor(s):

Shanyue Guan (Polytechnic); Shufan Liu (Engineering|Polytechnic)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1006

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

A Comparative Life-cycle Assessment Workflow for Interpreting Divergence in Early-Stage Building Carbon Estimates

STEM

NSF REU Site: Research Experience for Undergraduates for Built Environment Decarbonization

Authors(s):
DANIEL SEARS GREGORY† (Polytechnic); Hope Rockmore-Johnson† (Engineering)

Abstract:
Early-stage carbon modeling has become increasingly common in building design, enabling environmental impact and carbon emission reduction considerations in major decisions about form, materials, and systems. However, automated estimates often convey more certainty than is warranted by underlying assumptions, as differences in life cycle scope, material sourcing, structure, and quantity can shift outputs substantially. This unstated uncertainty can mislead designers and clients who rely on these estimates for comparison of design options before major commitments are made. This study investigates how and why early-stage automated carbon modeling diverges from whole-building life cycle assessments (LCAs). As a representative comparison, we evaluate Autodesk Forma Carbon Insight's automatically generated estimates against a component-level LCA performed in Tally, an established whole-building LCA tool using Environmental Product Declarations, both applied to the same building information model. Purdue University's Knoy Hall serves as the case study for the comparison. Because both tools utilize the same underlying material database, we isolate and quantify the divergence into two primary sources: differences in life cycle scope between the tools and differences within shared stages due to differing material types, quantities, and modeling assumptions. The results contribute to a generalizable framework for identifying, quantifying, and explaining divergence in early-stage carbon estimates. These findings will guide design teams on when early-stage modeling is adequate for preliminary screening and when more detailed carbon information requiring a whole-building LCA is necessary.

Mentor(s):
Soowon Chang (Polytechnic); Deniz Besiktepe (Polytechnic); Heung Jin Oh (Polytechnic)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1007

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

A Data-Sparse Workflow for Urban-Scale Building Energy Modeling Using Large Language Models

STEM

NSF REU Site: Research Experience for Undergraduates for Built Environment Decarbonization

Authors(s):
MIZUKI KUNO† (Polytechnic); AMBER JOSFIN RAMOS PINEDA† (Polytechnic)

Abstract:
The built environment accounts for approximately 45% of global carbon emissions, which emphasizes the need for more effective tools to support building decarbonization and sustainable urban planning. Although extensive research on building energy and carbon assessment has advanced understanding at the individual-building level, urban-scale energy use and carbon emissions are not simply the aggregation of individual buildings; therefore, urban-scale building energy modeling (UBEM) is important for capturing system-level interactions across buildings, infrastructure, and urban contexts. However, traditional methods of building energy modeling are difficult to scale because they often depend on detailed building-by-building data, extensive assumptions, and manual model setup. Many parameters required for energy simulations are not publicly accessible, inconsistently recorded, or unavailable altogether. To address this gap, this research develops an AI-enabled UBEM workflow that integrates urban-scale built environment datasets and automatically translates them into simulation-ready building energy models. This study begins with OpenStreetMap (OSM) building footprints for a selected study area to generate 3D building geometry for EnergyPlus simulations. Large language models are then applied through structured prompt engineering to infer missing building attributes, including building use, construction characteristics, occupancy assumptions, and HVAC-related inputs. By producing more context-aware parameter estimates than conventional archetype-based assumptions, this workflow promotes UBEM development in data-scarce environments while maintaining reasonable modeling accuracy. This approach can advance scalable energy modeling by allowing simulation-ready inputs to be created from incomplete and heterogeneous urban data, thus supporting energy analysis in contexts where detailed building records are limited.

Mentor(s):
Qingchun Li (Polytechnic); Deniz Besiktepe (Polytechnic); Soowon Chang (Polytechnic)

Other Acknowledgement(s):
Tianle Duan (Polytechnic)

Poster Presentation Abstract Number: 1008

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Experimental and Computational Study for Optimized Sustainability-Mechanical-Hydration Kinetics of Type IL-Slag Cement Mortar

STEM

NSF REU Site: Research Experience for Undergraduates for Built Environment Decarbonization

Authors(s):
SOPHIA SHELDON† (Polytechnic)

Abstract:
Cement production accounts for 8% of global carbon emissions, and this production is set to grow with increasing urbanization, migration, and population growth. Supplementary cementitious materials (SCMs), such as ground granulated blast-furnace slag (GGBFS) or slag cement), were introduced to cut down the cement usage in the construction field. Recently, Type IL cement, which contains ground limestone, has gradually replaced traditional Type I cement as the primary cement in the U.S. market, yet its complex hydration and strength development nature has not been captured and fully understood. This research investigates the hydration heat and strength development of Type IL-Slag cement mortar both experimentally and computationally. Compressive strength tests were conducted at 1 day and 7 days (± 1 h) on the blended mortars. Hydration kinetics within the first 7 days were characterized using isothermal calorimetry. It was also found to decrease in hydration heat with increasing slag content as well as decrease in early age strength. To augment the experimental dataset, corresponding simulations based on the experimental setup were performed using the Virtual Cement and Concrete Testing Laboratory (VCCTL), and the simulation parameters were calibrated with the experimental data of Type IL cement mortar. Life cycle assessment (LCA) was also conducted to evaluate the reductions in the global warming potential (GWP) of the blended mortars. Then, the tradeoffs between mechanical properties, hydration kinetics, and the GWP were evaluated for mortars with Type IL cement and 0 to 60% of slag replacement. Optimal mixes were identified with adequate compressive strength and enhanced hydration kinetics, while minimizing GWP comparative to Type IL cement mortar. The findings contribute to the decarbonization of the construction materials sector by providing guidance for the design of sustainable mortars with slag addition.

Mentor(s):
Chengcheng Tao (Polytechnic); Xiaoli Xiong (Polytechnic)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1009

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Lean-Enabled Robotic Additive Construction

STEM

NSF REU Site: Research Experience for Undergraduates for Built Environment Decarbonization

Authors(s):
Nathan Daniel Weston† (Engineering)

Abstract:
Robotic additive construction (RAC) has recently gained attention in the construction industry for its potential to improve productivity, reduce waste, and enable design flexibility; however, the relationship between RAC and Lean Construction (LC) principles is not yet clearly established due to a lack of standardization. This study addresses this gap by conducting an exploratory investigation into how Lean construction principles can be more fully realized in robotic additive construction workflows through potential improvement mechanisms. This study primarily focuses on 5 lean principles in 3D concrete printing: improving the process, increasing value, decreasing waste, improving workflow, and providing continuous improvement. To do so, three-phase 3D printing laboratory investigations with the Micro 10 3D Potter, Hyrel3D Hydra 16, and ABB IRB 6700 printers were conducted and analyzed over time, material, and quality of each phase. Various lean tools, such as Value Stream Mapping, were used to monitor the changes in the five lean principles regarding time, material, and quality. The results demonstrated that lean principles can potentially improve efficiency and reduce waste in 3D printing processes. This study provides a standard framework for evaluating lean principles in 3D concrete printing and synthesizes findings into the Lean-Enabled Robotic Additive Construction (L-RAC) framework to advance theoretical understanding and practical implementation of RAC–LC integration and guide more effective implementation in construction projects.

Mentor(s):
sogand Hasanzadeh (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1010
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Establishing a High-Efficiency Soybean Transformation System Using Agrobacterium rhizogenes-Induced Hairy Roots

STEM
PURE-PD

Authors(s):
Madison Birgy† (PWL)

Abstract:
Agrobacterium-based plant transformation has been broadly applied for genetic engineering of multiple crop species. Using this technique, soybean (Glycine max), one of the most important and stable crops globally, has also been successfully transformed via the half-seed explant method. However, the process of regenerating transformed soybean plants using half-seeds is both costly and time-consuming. The number of regenerated plants is limited and includes false-positive transgenics. Increasing the efficiency of regeneration of transformed plants could accelerate functional genomics studies and the characterization of transgenes. Inoculation of soybean with Agrobacterium rhizogenes harboring a plasmid with the gene of interest induces transgenic hairy roots, which could serve as ideal explants for whole-plant regeneration. To determine whether hairy roots of the soybean could be used for shoot regeneration, we tested multiple media for callus induction, followed by shoot induction using soybean roots as explants. We tested multiple media and determined the two most successful, CIM1 and CIM2, for inducing calluses from the roots as explants. We determined that soybean roots from 11-day-old seedlings were able to form calluses more efficiently than 9-day-old seedlings. Meanwhile, to investigate the feasibility of using hairy roots for shoot regeneration, the soybean cotyledons were inoculated with K599. Hairy roots are expected to have formed from wounded cotyledons after 15 days. It is anticipated that these roots can be cultured on CIM1 and CIM2. Once a viable callus has formed, it will be transitioned to shoot induction media, where shoots are expected to regenerate from the callus. Establishing this novel transformation system from hairy root explants could provide a faster approach for generating transgenic soybean plants, allowing further genetic and genomic studies of the transgene to be conducted more efficiently.

Mentor(s):
Sen Lin (Agriculture); Jianxin Ma (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1011

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Using Hyperspectral Reflectance Models to Estimate Turgor Loss Point in Diverse Maize Germplasm

STEM

PURE-PD

Authors(s):

Michael Blados† (PWL)

Abstract:

Drought is a major challenge to crop production, making it important to identify crop genotypes with improved drought tolerance. One key indicator of plant drought tolerance is the turgor loss point (TLP), the water potential at which plant cells lose turgor. It is not known if TLP is correlated with drought tolerance within crop species. TLP is traditionally estimated from pressure-volume (PV) curves, which are labor intensive and impractical for high-throughput phenotyping. Estimates of TLP using a faster osmometer method are correlated with values obtained from PV curves, although the relationship is different from that reported for these two methods in dicot species. These results indicate that vapor pressure osmometry can accurately estimate TLP in grass species compared with PV curves. We are now assessing the use of hyperspectral reflectance for even faster assessment of TLP. Either of these new approaches may offer a faster alternative for assessing TLP across large numbers of genotypes, ultimately allowing for mapping of the trait. Developing rapid and accurate methods to estimate TLP could enable mass phenotyping and increase the identification and breeding of drought-tolerant crop genotypes.

Mentor(s):

Michael V Mickelbart (Agriculture)

Other Acknowledgement(s):

Nathan A Deppe (Agriculture); Alexandra May Jewell (Agriculture); Shahla Mohammadi (Agriculture)

Poster Presentation Abstract Number: 1012
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Downregulation of Sucrose Transporter (SUT1) in Tobacco Leaves

STEM
PURE-PD

Authors(s):
Allison Del Sarto† (PWL)

Abstract:
Phloem loading is important in plants because it enables the long-distance transport of sugars and other nutrients from the leaves to sink organs throughout the plant. This transport is primarily mediated by the sucrose transporter SUT1, an important membrane protein that actively loads sucrose into the phloem for distribution throughout the plant. Proper SUT1 function is necessary for maintaining carbohydrate allocation, supporting plant growth, development, and overall productivity. The objective of this study was to determine the role of the SUT1 gene in tobacco phloem loading by reducing its expression using RNA interference (RNAi). The study also aimed to determine whether the reduction of SUT1 expression would inhibit carbohydrate transport, thus providing evidence for an apoplastic phloem loading mechanism in tobacco plants. RNA was extracted from tobacco leaves, and the SUT1 gene fragment was then amplified in order to make an RNA interference vector that targeted SUT1. SUT1 RNAi transgenic tobacco plants were generated using Agrobacterium-mediated transformation. Quantitative real-time PCR confirmed the successful downregulation of SUT1 expression in transgenic tobacco plants. When compared with wild-type plants, transgenic tobacco plants showed chlorotic leaf, stunted growth, and increased soluble carbohydrate and starch accumulation in adult leaves. These results indicated that reduced SUT1 expression impaired sucrose transport in tobacco plants. These findings support apoplastic phloem loading as the primary loading mechanism in tobacco and highlight the critical role of SUT1 in carbohydrate transport. Understanding the mechanism of SUT1-mediated phloem loading provides valuable insight into plant physiology and can contribute to the development of crop improvement strategies by enhancing nutrient transport, growth, and yield.

Mentor(s):
Cankui Zhang (Agriculture)

Other Acknowledgement(s):
Yuanyuan Zhang (Agriculture); Juliana Miranda Rodriguez (Agriculture)

Poster Presentation Abstract Number: 1013

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Investigating the phenotypic and genetic basis of plagiotropy at high elevation in tropical alpine Arabidopsis thaliana

STEM

PURE-PD

Authors(s):

Hannah Flis† (PWL)

Abstract:

Alpine environments expose plants to a unique set of environmental conditions associated with high elevation. Short stature and plagiotropic growth habits are common across species growing at high elevations and are hypothesized to be adaptive responses to cold temperatures and high winds, enabling plants to stay low to the ground, buffering themselves from harsh weather conditions. Previous work in the lab has identified the genetic basis of variation in stem length associated with source elevation in Afroalpine Arabidopsis thaliana. In these lines, structural variation affecting gene expression and gibberellic acid biosynthesis among accessions decreases stem length in accessions growing at higher elevation. Here we investigate traits relevant to plagiotropic growth forms including bolting angle, branch architecture, stem reorientation, and gravitropic responses in replicate accessions of A. thaliana spanning elevational gradients across five mountain ranges in Ethiopia. We conducted genome-wide association studies (GWAS) to identify loci responsible for plagiotropic growth, discovering multiple distinct strategies these A. thaliana accessions use to maintain prostrate growth. We additionally built species distribution models to investigate the environmental conditions associated with plagiotropic growth in A. thaliana. These results have important implications for better understanding the genetic basis of adaptation to extreme environmental conditions across species.

Mentor(s):

Samuel Joseph Mantel (Agriculture); Angela Hancock (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1014

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Silencing of Mutator Element in Maize

STEM

PURE-PD

Authors(s):

Kit Hill† (PWL)

Abstract:

Plant genomes have large numbers of parasitic genes called transposons (“jumping genes”), which cause damage each time they replicate or “jump”. Currently, there are many known transposons. Selection to replicate occurs at the level of each transposon while there is also selection to prevent replication at the host organism level. Maize is an excellent model system for viewing transposon behavior because it has several active transposons. The most active transposon in the maize genome is the Mutator element. Certain transposons’ expressions can be seen in an organism’s phenotype, or appearance. To see silencing of the Mutator element, our lab uses a reporter allele of the Mutator element called Les 28. By comparing both the phenotypes and genotypes of multiple families of maize with known genetic backgrounds, we hope to answer: What causes the silencing of Mutator?

Mentor(s):

Galen Martin (Agriculture)

Other Acknowledgement(s):

Chao Cai (Libraries)

Poster Presentation Abstract Number: 1015

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Crosstalk between ethylene biosynthesis and autophagy in response to stress

STEM

PURE-PD

Authors(s):

Alexus Moriah Johnson† (PWL)

Abstract:

Ethylene is the gaseous plant hormone produced when a plant undergoes abiotic stressors, such as salinity, drought, and the accumulation of heavy metals. Autophagy is a conserved degradative pathway that recycles cellular components under stress, has been linked to ethylene biosynthesis, but the direction of this relationship and its consequences for plant physiology remain unresolved. This project uses Arabidopsis thaliana to test how autophagy affects ethylene production and signaling during stress. We compare wild-type A. thaliana and two autophagy-deficient mutants, atg5 and atg7. Seedlings were treated with NaCl or with mannitol to mimic salinity and water stress. Ethylene released by these seedlings was measured using gas chromatography. Total RNA was then extracted from the same seedlings, and quantitative Polymerase Chain Reaction (qPCR) was used to measure the expression of ethylene-related genes. This shows whether changes in ethylene biosynthesis outputs are matched by changes in gene expression, as well as whether autophagy-deficient mutants respond differently than the wild-type. Together, these experiments will help determine whether autophagy affects how much ethylene a plant produces, how the plants respond to ethylene gas, and whether this depends on types of stress involved. Soil salinity and drought pose major threats to the yield in essential crops; the outcome of this research may potentially serve as a guide for future efforts to improve salt and drought tolerance in vital crops.

Mentor(s):

Gyeong Mee Yoon (Agriculture); Jae Ho Kim (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1016
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Tracking algal endosymbiont loss in Paramecium bursaria after cycloheximide treatment

STEM
PURE-PD

Authors(s):
Owen Ososki† (Purdue University)

Abstract:
The symbiotic relationship between the ciliate Paramecium bursaria and microalgae Chlorella represents a classic model of endosymbiosis. In this endosymbiotic relationship, the host provides nitrogen, carbon dioxide, and protection, while receiving maltose and oxygen derived from algal photosynthesis. This exchange allows P. bursaria to thrive in oligotrophic environments. Therefore, culturing symbiont-free (aposymbiotic) strains is essential for understanding the mechanisms of endosymbiosis for P. bursaria and its symbionts. Here, we observed the progression of P. bursaria bleaching using algal protein synthesis inhibitor cycloheximide. Host cultures were treated with cycloheximide and maintained under controlled conditions. Progression towards P. bursaria becoming aposymbiotic was monitored via light microscopy to track algal cell counts, cell structure, and the degradation of perialgal vacuoles (PV). Mapping the specific bleaching timeline establishes a standardized protocol for culturing aposymbiotic hosts, enabling future experimental investigations into the evolutionary and ecological mechanisms of the P. bursaria and Chlorella endosymbiotic relationship.

Mentor(s):
Sergio Munoz-Gomez (Science); Dongseok Kim (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1017
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Investigating the Role of HTA8 in PKL-Dependent Chromatin Regulation and Development in Arabidopsis Thaliana

STEM
PURE-PD

Authors(s):
Lila Rivera† (PWL); Blaine Andrew Wagner* (Agriculture|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Joe Ogas (Agriculture)

Other Acknowledgement(s):
Jiaxin Long (Agriculture)

Poster Presentation Abstract Number: 1018

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Myosin XI-K Knockdown Effects on Agrobacterium T-DNA Integration into the Arabidopsis Genome

STEM

PURE-PD

Authors(s):

Kayla Saopraseuth† (PWL)

Abstract:

Agrobacterium processes T-DNA from a resident Ti-plasmid and transfers the resulting T-strands to plant cells, where they can integrate into the plant genome. Agrobacterium uses secreted bacterial effector proteins to help T-DNA move inside the plant cell. One effector, VirD2, binds to the 5′ end of T-strands and presumably protects them from 5’ degradation. VirE2 is a single-strand DNA-binding protein proposed to coat T-strands, protecting them from nuclease degradation in the plant, but its exact role remains unclear. Myosin XI-K is a motor protein that transports cargo along actin filaments in plant cells. VirE2 moves along actin filaments to the nucleus. Reducing myosin XI-K expression using an inducible RNAi construct reduces VirE2 movement within the plant cell, which may limit T-strand movement toward the nucleus and potentially affect transformation. This study investigates whether VirE2 movement within plant cells affects how much of the T-strand integrates into the plant genome. If VirE2 protects T-strands from 3′ nuclease degradation, then reduced VirE2 movement could affect whether the T-strand reaches the nucleus intact or becomes truncated before integration. Our test T-DNA contains hptII, a hygromycin resistance gene used to identify transformed plant cells. It also contains Venus and mCherry reporter genes located near the 3′ end of the T-strand. Testing transgenic plants for the Venus and mCherry genes can indicate whether the integrated T-strand remained complete or lost its 3′ end. We grew tobacco plants in which myosin XI-K knockdown was induced or not induced, infected them with an Agrobacterium strain containing T-DNA with the test genes, and regenerated plants under hygromycin selection. DNA was extracted from these plants and tested by PCR for hptII, Venus, and mCherry sequences. These results will clarify the extent of T-strand truncation and the mechanism by which VirE2 contributes to T-strand protection and movement within the plant cell.

Mentor(s):

Stanton B Gelvin (Science); Lan-Ying Lee (Science)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1019

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Mapping the RLCK Interactome in Tomato Immunity Using Proteomics

STEM

PURE-PD

Authors(s):

Bella Turnbull† (PWL)

Abstract:

Understanding the molecular mechanisms behind plant immunity is critical to the development of biotic stress resilient crops. Among the sophisticated strategies plants have developed to resist infection and disease, receptor-like cytoplasmic kinases (RLCKs) play a critical role in fine tuning the plant immune response. RLCKs participate in immune signaling through their protein-binding partners, often by phosphorylation. Previous research studies RLCKs as individual signaling molecules, interacting with only one or two immunity-related proteins identified through in vitro experiments. Based on our detailed characterization of RLCK genetic mutant plants, we decided to challenge this rationale hypothesizing that RLCKs have an underlying global role in regulating plant immunity.

Here, we employ an untargeted proteomics approach to gain insights into RLCK's function in immunity towards necrotrophic pathogens. By inoculating tomato plants overexpressing RLCK-HA with necrotrophic pathogens, tissues showing the disease phenotype will be harvested. The eluents from immunoprecipitation (IP) with HA-antibody beads will be subjected to mass spectrometry (MS) analysis. The RLCK-HA interactors will be identified as potential, previously unknown, immunity-specific substrates associated with RLCKs. Furthermore, a phospho-enrichment protocol carried out on RLCK-HA peptides will uncover RLCK-mediated global phosphorylation. Integrating these two datasets will reveal (i) RLCK interactors upon infection, (ii) the phosphorylation status of RLCK, and (iii) the RLCK-mediated phosphorylation landscape globally. Although results are pending, studying RLCK interactors in infected tomato species helps identify condition-specific RLCK substrates. Further experiments will validate interactors through a FRET (Förster resonance energy transfer) approach and in vitro pulldown assays. Upon confirming candidates, the RLCK interactome will provide a guide for designing stress-resilient tomatoes.

Mentor(s):
Chao-Jan Liao (Centers & Institutes); Venkatesh P Thirumalaikumar (Agriculture); Athanas Guzha (Agriculture)

Other Acknowledgement(s):
Chao Cai (Libraries); Tesfaye D Mengiste (Agriculture)

Poster Presentation Abstract Number: 1020

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Regulation of terpene biosynthesis in Nicotiana tabacum by an isopentenyl diphosphate transporter

STEM

PURE-PD

Authors(s):

Leah Wong† (PWL)

Abstract:

Terpenes or terpenoids are a large group of organic compounds responsible for the scents, flavors, and pigments found in plants and play important roles in various biological processes including photosynthesis, respiration, growth, defense and pollinator attraction. Since plant terpenoids are ubiquitously exploited by various commercial industries, terpenoid regulation also has significant implications for optimizing products used by humans. The precursor molecules of all terpenoids are the five-carbon isopentyl diphosphate (IPP) and its stereoisomer dimethylallyl pyrophosphate (DMAPP). Both are synthesized via two distinct and compartmentally separated pathways: the mevalonate (MVA) pathway distributed over the cytosol, ER, and peroxisomes, and the methylerythritol phosphate (MEP) pathway localized in plastids. Despite both pathways functioning independently, previous research has shown crosstalk between the two by way of IPP exchange. Although biochemical evidence of a plastid-localized IPP exists for over two decades, the protein has never been identified. We recently discovered a yet uncharacterized transmembrane protein localized in the inner membrane of tobacco chloroplast (Nicotiana tabacum) binding IPP in vitro. To confirm transport activity, the protein was expressed in yeast cells followed by the isolation of mitochondrial membranes used in transport assay. These established the protein as an IPP transporter, designated as IPPT. Generated tobacco NtIPPT RNAi knockdown lines have reduced levels of chlorophylls and carotenoids, particularly in young developing leaves, indicating the importance of crosstalk between the MVA/MEP pathways during development. Additionally, stable transgenic lines overexpressing IPPT were created to investigate the physiological effect on enhanced crosstalk. This work thereby significantly contributes to our understanding of the regulatory mechanisms driving terpene biosynthesis and its effect on plant physiology.

Mentor(s):
Ruy Wilhelmus Johannes Kortbeek (Agriculture); Natalia Dudareva (Agriculture)

Other Acknowledgement(s):
Chao Cai (Libraries)

Poster Presentation Abstract Number: 1021

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Functional analysis of putative chromatin assembly factors in Arabidopsis

STEM

SCARF

Authors(s):
Duncan Patrick Blank† (Agriculture)

Abstract:
[Abstract Redacted]

Mentor(s):
Joe Ogas (Agriculture)

Other Acknowledgement(s):
Jacob Ryan Fawley (Agriculture); Jiaxin Long (Agriculture)

Poster Presentation Abstract Number: 1022

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Utilizing Biochar and AMF Partnerships to mitigate Heavy Metal Contamination in Soil

STEM

SCARF

Authors(s):

Reuben Joshua De Dios† (Agriculture|Engineering)

Abstract:

Heavy metal contamination in soil due to urban pollution has increased worldwide, making food safety and human health a greater concern as soil degradation reduces the availability of fertile land. Co-applying AMF and biochar as soil amendments could help address this challenge. AMF is a naturally beneficial microscopic soil fungus that reduces stress and boosts nutrient uptake and water access; biochar acts as a carbon soil supplement and fungal habitat. Biochar is also known to raise soil pH and other soil properties, thereby reducing heavy metals being taken up by plants in the soil. Past studies have illustrated that the combined application of AMF and biochar has improved plant yield and growth even in poor soil conditions. However, what kind of biochar matches AMF the best in the presence of heavy metals is unknown. Identifying the best biochar type will greatly impact crop feasibility in contaminated soils. The goal is to determine which biochar best encourages AMF growth under contaminated soil conditions using cilantro as a model crop. Five experimental groups included three different types of biochar paired with AMF, a negative control (no biochar and no AMF), and a positive control (no biochar but AMF present). Using cilantro (N = 30) and AMF as biological indicators of heavy metal stress, we compared Mycorrhizal root colonization intensity, arbuscular richness measuring the density of arbuscules within colonized root portions, and crop yield and heavy metal uptake. We discovered that wood-based porous biochar was the most effective inoculant for AMF growth even under heavy-metal-contaminated soil conditions, extending benefits beyond poor soil quality. Since this experiment was done in a highly controlled environment and only with cilantro plants, future studies should explore whether these experimental results apply to the field and if the benefits extend to different crops.

Mentor(s):

Lori Hoagland (Agriculture)

Other Acknowledgement(s):
Mine Rouxna van der Berg (Agriculture)

Poster Presentation Abstract Number: 1023
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Investigating Solvent and Processing Effects on ROY Polymorph Crystallization for Pharmaceutical Intermediate Purification

STEM
SCARF

Authors(s):
Andrew Lucas Freuman† (Agriculture|Engineering); Bailey Elizabeth Freese‡ (Engineering|Vet Med); Annalise Irene Coyne‡ (Agriculture|Engineering|JMHC); Jose Luis Melendez‡ (Agriculture|Engineering)

Abstract:
Polymorph control is a challenge in drug discovery because the crystalline form of an active compound or intermediate can influence purity, stability, solubility, and manufacturability. This study focused on crystallization of ROY, a polymorphic compound and key intermediate associated with olanzapine synthesis, to identify experimental conditions that promote formation of purer, reproducible crystals.

ROY crystallization was tested under a range of solvent and processing conditions. Experiments included solvent evaporation using multiple solvents and solvent mixtures, antisolvent approaches, decanting and non-decanting procedures, heated, room-temperature, cooled, dry, and moist evaporation environments, and varying concentration and saturation levels. Additional trials examined supersaturation, melting crystals followed by ice-bath cooling, heating and flash cooling, controlled cooling, and seeding effects using both crystal and flake seeds. Some resulting solids were evaluated by microscopy and X-ray crystallography to compare crystal morphology, color, apparent purity, and polymorphic outcome.

Although final results have not yet been obtained, the experiments are expected to show that slower evaporation rates tend to favor yellow ROY crystals, which are the most stable crystal form. However, the project has not yet produced fully purified or consistently reproducible crystals, indicating that crystal purity likely depends on multiple interacting variables rather than one condition alone.

This work demonstrates how crystallization can be used as a strategy for improving compound purification and formulation during drug discovery. Establishing reliable methods for producing pure ROY crystals may

provide insight into how pharmaceutical intermediates can be isolated and characterized more effectively. Future work will connect this chemical approach to phage bioinformatics by using PHEONA to analyze bacteriophage genomes.

Mentor(s):
Kari L Clase (Agriculture|Engineering); Stephen Robert Byrn (Pharmacy); Daniel T Smith (Pharmacy)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1024

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Development and scale-up of a standardized in vitro swine digestion model to evaluate nutritional value of feed ingredients

STEM

SCARF

Authors(s):

Xinhui Katherine Huang† (Agriculture)

Abstract:

The in vitro digestion assay is a time- and cost-efficient tool for evaluating feed ingredient digestibility in monogastric animals. However, researchers have used their own procedures modified from Boisen methods (Boisen and Fernandez, 1995; Boisen, 1997). The objective of this project was to develop and validate a standardized, scaled-up in vitro digestion procedure to accommodate larger sample sizes representative of feed ingredients. Two in vitro digestion methods, Method A (4 g, 2 h pepsin & 4 h pancreatin) and Method B (4 g, 6 h pepsin & 18 h pancreatin), were compared using 39℃ water bath incubation to mimic stomach (pH 2) and small intestinal digestion (pH 7). Undigested residues were filtered, dried, and weighed to determine in vitro digestibility of dry matter (IVDDM). Both methods were then scaled up to 5, 6, 7, and 8 g samples to evaluate the effect of increasing sample size on IVDDM. Method B consistently showed higher IVDDM than Method A for both corn and soybean meal (SBM). Average IVDDM was 75.6% vs. 63.5% for corn and 82.9% vs. 79.4% for SBM (Methods B and A, respectively). The IVDDM of corn and SBM for 5, 6, 7, and 8 g samples under Method A were lower than those of Method B. As sample weight increased from 5 to 8 g, IVDDM for corn decreased numerically using Method B, whereas IVVDM for SBM remained relatively stable. The apparent in vivo ileal DM digestibility of corn ranged from 69 to 78%, which was within the range of IVDDM values determined by Method B using 7- and 8-g samples. However, the apparent in vivo ileal DM digestibility of SBM ranged from 68 to 79%, which was within the range of IVDDM values obtained using Method A but was lower than the IVDDM values obtained using Method B. In conclusion, Method B appears more suitable for evaluating the IVDDM of corn, whereas Method A is more suitable for SBM. Further optimization of the in vitro digestion method is warranted to account for differences in nutrient composition among feed ingredients.

Mentor(s):
Jinsu Hong (Agriculture)

Other Acknowledgement(s):
Jinyoung Lee (Agriculture)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1025
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Wasps of West Lafayette: Collection, Curation and Identification

STEM
SCARF

Authors(s):
Sam Nelson Hutjens† (Agriculture)

Abstract:
This research aims to further record the diversity of the Ichneumonidae wasp family of Hymenoptera in and around West Lafayette, IN. Ichneumonid wasps are largely understudied across the USA relative to their group's predicted diversity. Using a combination of hand collecting, Malaise trapping and sheet black-lighting, the lab is building a campus-wide survey of insects. A rough sort is first used to pull out all Hymenopteran (the classification Order level containing ant, bees, and wasps) specimens from the recently collected materials. These specimens are then properly curated by pinning and point mounting, letting the insects dry, then properly labeling with locality and time-of-collection information. At a later date, each specimen will be identified to the family level and databasing their collection data into an accessible online repository. Identified Ichneumonid wasps will be further classified down to tribe at a minimum, then to genus, and species to further understand their diversity and distribution patterns. Specimens which are difficult to identify using available keys will utilize a new online AI tool developed by Ichneumonid taxonomist Dr. Brandon Claridge to assist in identification.

Mentor(s):
Brenna Lynn Decker (Agriculture)

Other Acknowledgement(s):
Lucas David Grindley (Agriculture)

Poster Presentation Abstract Number: 1026

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Using a yeast-2-hybrid assay to optimize the auxin inducible degron system

STEM

SCARF

Authors(s):

Savana Jankovic† (Agriculture)

Abstract:

Inducible protein degradation systems are powerful tools for characterizing protein function. They enable rapid degradation of specific target proteins of interest on demand to generate a loss-of-function state. One of the most commonly used is the auxin-inducible-degron (AID) system, which uses the natural mode of action of the plant hormone, auxin, to trigger protein degradation in diverse eukaryotic species. Our lab is trying to use AID as a platform for novel drug target identification in mouse models of infectious diseases caused by eukaryotic pathogens like fungi. In this context, auxin serves as a universal surrogate “drug” to identify proteins important for infection. Despite the fact that the AID system works well in many species, the system components have never been optimized for this type of application in mouse infections. The goal of my project is to use a yeast-2-hybrid (Y2H) interaction assay to optimize different AID system components to achieve optimal performance of the system in mice infected with engineered AID pathogen strains. I will start by systematically screening different TIR1 F-box protein orthologs and auxin-binding IAA degron domains from the rice plant Oryza sativa for high affinity auxin-dependent interaction. I will also use high affinity TIR1-IAA pairs to compare the potency of different synthetic auxin analogs. Once improved components are identified by Y2H, AID performance will be tested in a representative fungal pathogen of humans, Candida albicans. Current efforts are focused on building the required Y2H constructs and validating the colorimetric reporter assay, after which I will perform the full screens. Identifying optimized components is expected to enable a novel strategy for identifying new drug targets for combatting problematic fungal, and other eukaryotic, pathogens.

Mentor(s):

Mark C Hall (Agriculture); Emily Lynae Danzeisen (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1027

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

The Influence of Drought Conditions on Freshwater Mussel Movement in Indiana Rivers

STEM

SCARF

Authors(s):

Eva Corinne Morie† (Agriculture|Engineering); Alexis M Howat* (Agriculture)

Abstract:

Indiana is inhabited by more than 60 species of freshwater mussels, making it a global hotspot for mussel biodiversity. This diverse community has been adversely impacted by human activity. Indiana was historically home to around 80 species of freshwater mussels. Of the remaining species, ten are now listed as federally endangered or threatened and most of these are limited to a specific river or stream network. Unionid mussels play a critical role in freshwater ecosystems by filtering and improving water quality, cycling nutrients, supporting food webs, and creating habitat. However, freshwater mussels are considered to be among the most highly imperiled freshwater organisms in the world. The exact environmental factors contributing to their decline have yet to be discovered, but hydrological changes are implicated. As Indiana experiences more frequent periods of extreme precipitation and drought events, shifts in hydrologic regime could be detrimental to Indiana's mussel population since they have limited mobility, patchy distribution, and complex reproductive strategies. This study investigates how mussel health, using non-federal listed surrogate species, responds to water quality and drought events in the Wabash and Tippecanoe River. In collaboration with the Indiana Department of Natural Resources, field and lab experiments were conducted to assess mussel movement, behavior, and stress response under drought conditions. We expect that the results will help inform municipally relevant management practices that can be instituted to better protect Indiana's federally listed freshwater mussel species from the effects of climate change.

Mentor(s):

Jacob Daniel Hosen (Agriculture); Alexander Charles Collins (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1028

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Decreased Raman Spectroscopic Carotenoid Bands Indicate Oxacillin-Induced Stress in Staphylococcus aureus

STEM

SCARF

Authors(s):

Sophia Morris† (Agriculture|JMHC)

Abstract:

Antimicrobial susceptibility testing is an extremely time-consuming process that spectral approaches measuring phenotypic responses may remediate. Raman spectroscopy offers a label-free method for rapid phenotypic testing of bacterial colonies that may ultimately reflect the biochemical changes caused by antibiotic-driven stress. In this pilot study, Staphylococcus aureus and oxacillin were used to assess the feasibility of using carotenoid-associated Raman bands to serve as markers. Oxacillin was added to tryptic soy agar at a concentration of 1 µg/mL and applied to the Petri dish by creating a slanted agar slope, establishing an antibiotic concentration gradient across the plate. A ThermoFisher Bigfoot cell sorter deposited single S. aureus cells onto the plate in a grid pattern and allowed them to grow into individual colonies. After 24 hours, Raman spectroscopy was used to measure bands associated with bacterial carotenoids, specifically at 1157 and 1528 cm^{-1}, which are attributed to C–C and C=C stretching modes of carotenoid pigments such as staphyloxanthin. A reduction in these bands might indicate stress or altered pigment production due to the presence of the antibiotics. Further trials will be required to identify if these methods garner the same results with other bacterial species and antibiotic classes and concentrations. A goal of this study is to determine if these results can be tied to established methods of antimicrobial testing.

Mentor(s):

Joseph Paul Robinson (Engineering|Vet Med); Bartek Rajwa (Other)

Other Acknowledgement(s):

David Perez Herrera (Science); Brianna N Corman (Vet Med)

Poster Presentation Abstract Number: 1029

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Nonstructural Carbohydrates as Signatures of Local Adaptation in a Bur Oak Common Garden

STEM

SCARF

Authors(s):

Kae Nielson† (PWL); Bison R Lowe‡ (Agriculture); Daniel Angel Torres‡ (Agriculture); George Alexander Hufendick‡ (PWL); Grace Louise Amburgey‡ (Science|JMHC); Lydia Jane Sullivan‡ (Agriculture); Norah Kaye Snyder‡ (Agriculture); Veronica Grace Nguyen‡ (PWL)

Abstract:

As the climate continues to change, tree populations must acclimate or adapt to novel conditions, but the pace of change may outstrip their capacity to do so, increasing the risk of population decline or forest dieback. Nonstructural carbohydrates (NSCs), primarily soluble sugars and starch, serve as the tree's main carbon currency to support growth and metabolism as well as to buffer against environmental stress, and stored reserves can be indicative of relative fitness and resilience. However, relatively few studies have explored local adaptation of NSC reserves, but this knowledge is critical for determining population risk and informing effective forest management. Here, we used Quercus macrocarpa (bur oak) to assess whether whole-tree NSC reserves are locally adapted by exploring whether native range climate influences NSC storage in a common garden. Bur oaks were established in three common gardens (northern garden in Minnesota, middle garden in Illinois, and southern garden in Oklahoma) with seeds from 60 maternal families that were collected across the latitudinal gradient near the common garden sites. We sampled leaves, twigs, trunks, and roots from 178 trees in the middle garden (Illinois) to quantify sugar and starch concentrations. We hypothesized that northern populations will have reduced NSC storage in the middle common garden compared to the middle and southern populations due to maladaptation to the hotter climate of the middle common garden. Data collection is on-going to test this hypothesis. Understanding how trees are adapted to their local climate can help predict responses to the stressors associated with global change and inform forest management.

Mentor(s):

Morgan Emily Furze (Agriculture)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1030
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Smart Capsule Microbiome Profiling to Map Weaning Adaptation and Improve Swine Gastrointestinal Health

STEM
SCARF

Authors(s):
Nina O'Tain† (Agriculture); Sarabeth Grace Hargarten* (Agriculture); Sierra J Kingsford* (Agriculture); Grace Mae Kraemer* (Agriculture)

Abstract:
Current commercial weaning practices, typically performed between 3 and 4 weeks of age, expose piglets to substantial physiological stress before their intestinal barrier, immune system, and gut microbiome have fully matured. This abrupt transition increases susceptibility to post-weaning diarrhea, intestinal dysfunction, poor growth performance, and mortality. The first two weeks after weaning represent a critical window for intestinal adaptation, and successful adaptation during this has lasting consequences for the piglet health and growth performance. As piglets transition from sow's milk to a solid-feed diet, the small intestine undergoes rapid physiological and microbial adaptations that promote nutrient digestion, immune development and microbial colonization. Characterizing these dynamic changes is essential for understanding post-weaning intestinal health and identifying factors that influence subsequent growth performance. However, the small intestinal environment remains poorly characterized due to limitations of existing sampling methods. Fecal samples may not accurately represent the small intestine, whereas sampling following euthanasia prevents repeated measurements within the same animal. Consequently, there is a need for minimal invasive technologies that enable repeated characterization of the small intestine in living animals. The objective of this study is to evaluate the feasibility of using an ingestible sampling capsule to collect small intestinal digesta for longitudinal assessment of the intestinal environment throughout the post-weaning period. The findings in this study could guide the development of nutritional and management strategies to improve piglet health, performance, and welfare.

Mentor(s):
Tingting Ju (Agriculture)

Other Acknowledgement(s):
Brian T Richert (Agriculture); Rahim Rahimi (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1031
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Comparison of CAND1 and CAND2 Dissociation Rates from CUL2

STEM
SCARF

Authors(s):
Seojin Paek† (Agriculture)

Abstract:
Ubiquitination is an important cellular process that is responsible for protein turnover and activity in human cells. Cullin-2-RING ubiquitin ligases (CRL2s) are enzymes that carry out this ubiquitination process as well as other essential cellular functions. CRL2 has been linked with cancer and cardiovascular diseases, including through its regulation of the degradation of HIF1α, a transcription factor that helps cells respond to low-oxygen conditions. Because of how the dysregulation of HIF1α has been involved with cancer and cardiovascular disease, proper regulation of CRL2 activity is essential. Previous work has shown that CAND1, a regulatory protein that is crucial in controlling Cullin-RING E3 ubiquitin ligase complexes, acts as an inhibitor of CRL2 activity. CAND1 and CAND2 are both capable of binding to CUL2. This poses a question about how CAND2, CAND1's sibling protein that has a very similar molecular structure, affects CRL2 activity. CAND2 has been implicated in cardiac muscle development and cardiovascular diseases, but its function has not been clearly uncovered yet. In this project, I will compare the dissociation rate of both CAND1 and CAND2 on CUL2 by using a dissociation assay. Based on preliminary observations that CAND2 exhibits weaker binding properties and lower substrate receptor exchange efficiency on CUL1 than CAND1, I expect CAND2 to have a faster dissociation rate than CAND1, meaning it would be comparably less stable than the CAND1-CUL2 protein complex. Through the investigation of binding kinetics between CAND2 and CUL2, this study will provide insight into the function of CAND2, ubiquitin ligase regulation, and pathways that are relevant to cardiovascular diseases.

Mentor(s):
Xing Liu (Agriculture)

Other Acknowledgement(s):
FNU Chaganzhana (Agriculture)

Poster Presentation Abstract Number: 1032
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Structural Insights into a Plant-Derived Antihypertensive Cyclic Peptide

STEM
SCARF

Authors(s):
Verasha Pomart† (Agriculture)

Abstract:
Plants produce a variety of compounds, known as natural products, and many of these chemicals have bioactivity in humans. My work focuses on how a unique class of plant-derived cyclic peptides aids in lowering blood pressure. Prior work revealed that two plant-specific macrocyclic peptides demonstrated antihypertensive activity by inhibiting the human proteases renin and angiotensin-converting enzyme (ACE). However, it remains unknown how these cyclic peptides and proteins interact. Our goal is to investigate the structure of these proteins and plant macrocycles by X-ray crystallography for atomic-level detail. We use two parallel workflows for our work: (1) bacterial protein expression of renin and ACE, and (2) generate a unique cyclic peptide in plants. In the first workflow, Escherichia coli cells were transformed with plasmids containing either the renin or ACE genes. We investigated our expression for soluble protein, however both proteins were insoluble aggregates in E. coli. We are currently optimizing our strategy of denaturing and refolding renin and ACE prior to purification. During this time, we pursued the second workflow to generate the cyclic peptide, Lyciumin I. Lyciumins are 8 amino acids in length and are cyclized by a carbon-nitrogen bond between glycine and tryptophan. They are derived from a class of plant proteins that the Mydy lab studies. After the peptide is cyclized, unknown protease(s) in the plant cleave it from a longer polypeptide chain to result in the final product. We transformed Agrobacterium tumefaciens with our gene of interest and then infiltrated this bacteria into a wild relative of tobacco for macrocyclic peptide production. We harvested the leaves after one week, and they are ready for compound verification, extraction, and purification. Understanding how these plant natural products interact with renin and ACE will contribute to the development of macrocyclic-based therapeutics and inform further protease inhibition studies.

Mentor(s):
Lisa S. Mydy (Agriculture)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1033
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Optimizing the preparation of solubilizer in antiviral formulations

STEM
SCARF

Authors(s):
Tongyu Qin†

Abstract:
[Abstract Redacted]

Mentor(s):
Yuan Yao (Agriculture)

Other Acknowledgement(s):
Jingxian An (Agriculture)

Poster Presentation Abstract Number: 1034
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Effectiveness of Household Sanitizers for Reducing Salmonella enterica serovar Newport on Fresh Produce

STEM
SCARF

Authors(s):
Alexandra Susan Revivo† (Agriculture)

Abstract:
Produce is highly susceptible to bacterial contamination, contributing to foodborne outbreaks caused by human pathogenic bacteria. Contamination occurs from pre- to post-harvesting, therefore safe and clean handling of fruits and vegetables, paired with proper washing at home, is advised to help reduce the risk of foodborne illnesses. This study aimed to determine the effectiveness of washing procedures using hot water treatment and free available chlorine in the reduction of Salmonella enterica on tomatoes and cucumbers. Produce samples were spot inoculated with 109 CFU/mL of Salmonella Newport and dried for 2 hours. The samples were washed using four treatments: non-treatment control (NTC), water treatment control (WTC), hot water at 60° C (HWT), and free available chlorine at 25 ppm (FAC), at contact times of 5, 15, 30, and 60 seconds. After wash treatments, samples were homogenized, serially diluted, and plated on XLD agar using the spread plate method. Results of colony formation varied by produce type, wash treatment, and contact time. The HWT for 60 seconds yielded the greatest log reductions, achieving 4.091 log CFU/g in tomatoes and 2.118 log CFU/g in cucumbers, and the FAC for 60 seconds yielded 2.625 log CFU/g in tomatoes and 1.537 log CFU/g in cucumbers. These results indicate that temperature and contact time influence pathogen reduction on produce, with HWT for 60 seconds being the most effective method. Additionally, HWT at 30 seconds resulted in 2.236 log CFU/g and 1.681 log CFU/g log reduction in cucumber and tomatoes, respectively. Based on these findings, washing fresh produce at home in hot water or a chlorine solution can reduce bacterial load on the produce surfaces and lower the risk of foodborne illnesses.

Mentor(s):
Amanda J Deering (Agriculture); Adriana Vanegas Torres (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1035

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Long-term Cereal Rye Cover Cropping Improves Soil Microbial Activity in Corn-Soy Systems

STEM

SCARF

Authors(s):

Catherine Song† (Agriculture)

Abstract:

Conventional corn soy rotation systems in Indiana can negatively impact biological activity and nutrient retention in soils through disruption of physical aggregates and reducing organic biodiversity. This project studied how corn soy rotation systems with long-term cereal rye (Secale cereale L.) cover crops impacted soil biological characteristics in southeastern Indiana's silty poorly drained soils. Previous studies showed that after 10 years, cereal rye cover cropping increased soil organic carbon and aggregate stability. The impact of cereal rye on nutrient cycling and microbial activity in southeastern Indiana soils can be crucial in measuring the ability of cover crops to mitigate soil degradation caused by long-term agricultural use. Different nitrogen application rates were also studied to assess the use of cover crops in increasing nutrient retention in reduced N environments. Samples were taken from 0-15cm in the Southeastern Purdue Agricultural Center (SEPAC). Treatments with 4 replicates include. No cover crop/Normal N rates, No cover crop/Low N rates, Cover crop/Normal N rates, Cover crop/Low N rates. B-Glycosidase, N-acetyl-B-glycosaminidase, acid phosphatase, and potentially mineralized carbon were measured to understand biological dynamics. Overall, cover cropping and nitrogen application rate had no significant impact on BG, NAG, P, and PMC. However, there is a slight trend that indicates cover crops with normal nitrogen have slightly higher levels of BG, NAG, and P than no cover crops with normal nitrogen, indicating high carbon, nitrogen, and phosphorus activity. Normal nitrogen treatments also tend to have increased BG, NAG, and P when compared to low nitrogen for both cover and no cover. These findings suggest that in the long term, cover cropping can play a significant role in improving soil microbial activity and nutrient cycling within corn soy rotation systems in southeast Indiana.

Mentor(s):

Yichao Rui (Agriculture)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1036

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Evaluating the role of coniferyl alcohol and pinoresinol in lateral root density in Arabidopsis thaliana

STEM

SCARF

Authors(s):
Sahana Srinivasan† (Agriculture); Chase Taylor Hearn‡ (Agriculture)

Abstract:
[Abstract Redacted]

Mentor(s):
Clint C S Chapple (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1037

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Heterologous Expression and Functional Characterization of Arabidopsis thaliana AGO1 and AGO4 in Gene Silencing

STEM

SCARF

Authors(s):

Austin Robert Tanabe† (Agriculture|Engineering|JMHC)

Abstract:

Cells within a multicellular organism share an identical genome, yet they have distinct identities and functions through temporal and spatial regulation of gene expression. Eukaryotes have evolved conserved small RNA-guided silencing pathways that act in a sequence-specific manner to selectively silence genes or precisely regulate gene expression. Central to these pathways are ARGONAUTE (AGO) proteins, which bind small RNAs to form programmable silencing complexes that recognize complementary target sequences. Upon target recognition, AGO proteins direct gene silencing through a variety of mechanisms, including transcript degradation, translational repression, and epigenetic modification of chromatin. While AGO proteins are conserved across eukaryotes, they associate with distinct classes of small RNAs and have diversified to execute specialized silencing functions. Understanding how different AGO proteins recognize targets and engage distinct silencing mechanisms is therefore fundamental to uncovering the molecular principles that govern genome regulation and defense against transposable elements. Here, we used a baculovirus expression system to produce recombinant Arabidopsis thaliana AGO1 and AGO4 proteins, the core effectors of post-transcriptional gene silencing (PTGS) and transcriptional gene silencing (TGS) pathways, respectively. By reconstituting AGO-small RNA complexes in vitro and measuring their interactions with target RNAs, we will determine the shared and specialized molecular mechanisms that underlie AGO-mediated gene silencing. These studies will provide insights into how AGO proteins have evolved to regulate gene expression at both the post-transcriptional and transcriptional levels.

Mentor(s):

Feng Wang (Agriculture); Su-Ling Liu (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1038

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Dietary Fibers Suppress Clostridioides difficile in In Vitro Human Fecal Fermentation

STEM

SCARF

Authors(s):

Kai Tran† (Agriculture)

Abstract:

Clostridioides difficile is an opportunistic pathogen that causes serious gastrointestinal infections when the gut microbiome is disrupted; commonly due to antibiotic therapy. Current research shows dietary fibers have a positive effect on reducing the intensity of C. difficile infections, but the fibers were generally chosen based on what was available on the market, and an important detail was left out: different bacteria species utilize dietary fibers differently. Previous research from our laboratory showed that there are fibers with low specificity, meaning much of the gut microbiome can digest them with various effects, and there are fibers with high specificity--only a certain group are able to use them. We also found that certain fiber mixtures have a synergistic effect, meaning they have a much bigger influence on shaping the gut microbiome than their individual components. In a past study from our laboratory, it was hypothesized that, after antibiotic treatment, certain dietary fibers are effective at suppressing C. difficile and fiber mixtures have an even stronger effect than their comprised individual fibers. Different dietary fibers were chosen based on their chemical structures such that other bacteria in the gut microbiome can utilize them, while C. difficile cannot. Candidate fibers and fiber mixtures were tested in single C. difficile culture and in vivo with a pooled stool sample, with a simulated disrupted gut microbiome created using antibiotic and C. difficile inoculation. One fiber mixture showed positive synergistic suppression of C. difficile in in vitro fermentation, showing the potential of designing fibers for suppression of pathogens. In the current study for SCARF, the consistency of the fiber mixtures' effectiveness in C. difficile suppression is being tested across ten donors. Techniques include RNA extraction, RT-qPCR, DNA extraction, and 16S rDNA sequencing.

Mentor(s):

Bruce R Hamaker (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1039

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

2-Dimensional Proteome Profiling for in-depth Tracking of Drug Interactions

STEM

SCARF

Authors(s):

Akhilesh Vigneshwaran† (Agriculture); Nathaniel Merrick Miller‡ (Agriculture); Yi Kai Liu‡ (Agriculture)

Abstract:

Many small molecule drugs remain poorly understood and have off-target actions that contribute to unintended side effects. Drug-induced conformational changes can increase stability and are detectable using bottom-up Mass Spectrometry (MS). These proteome changes can be uncovered through methods such as TPP (Thermal Proteome Profiling), SIP (Solvent Induced Precipitation), and LiP (Limited Proteolysis). These methods work by treating proteome samples with a drug and exposing the proteome to denaturation conditions or protease to identify the shift in stability of affected proteins. Understanding how drugs affect the proteome enables the uncovering of additional targets and can accelerate the design of new drug molecules. While these methods alone can be effective at revealing potential drug-protein interactions, performing these protocols in series remains unexplored. We present a novel linked protocol combining TPP, SIP and limited proteolysis (LiP) to better expose affected proteins. Further analysis of the protein precipitate is often limited by the separation method, and recent developments using a solid matrix to assist with precipitation (Matrix-Assisted Precipitation Screening) improve upon previous standard TPP and SIP workflows. Additionally, the implementation of beads in stability-based methods can minimize variance and increase compatibility with high-throughput automated workflows. Based on our preliminary data using LC-MS/MS, the TPP-SIP linked workflow significantly reduced the number of quantifiable proteins and created a more specific candidate pool compared to the SIP workflow alone when treated with rapamycin. Furthermore, our target protein is enriched in Rapamycin-treated bead samples relative to controls, along with other possible off-target sites, which warrants further investigation.

Mentor(s):

Weiguo Andy Tao (Agriculture|Science)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1040
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Can rewarding task-switching increase cognitive flexibility?

STEM
SROP

Authors(s):
Dylan Matthew Diaz† (PWL)

Abstract:
Cognitive control enables us to flexibly switch between tasks, although doing so is effortful and costly: laboratory studies consistently show that switch trials produce slower responses and more errors than repeat trials. When given the freedom to choose, people also tend to repeat the task they have just performed rather than switch to a different one. Braem (2017) recently found that participants rewarded for task switches showed greater subsequent voluntary switching than participants rewarded for task repetitions. One interpretation is that participants learned an association between reward and switching, making them more willing to switch later. However, because that study compared separate groups of participants, it remains unclear whether participants learned a general preference for switching or a specific association between reward and a particular control operation. Here, we tested whether rewards can shape specific cognitive control operations—switching versus repeating—by manipulating reward contingencies within individuals. In Experiment 1, using behavioral measures, we found that participants learned the specific association between individual items and the rewarded control operation (switch or repeat). Surprisingly, however, this learning produced larger switch costs for switch-rewarded items than for repeat-rewarded items. In Experiment 2, we extend this work to the neural level using EEG recordings and cross-validated multivariate pattern analysis which reads patterns of neural activity. This will allow us to test whether distinct brain states track these reward conditions and predict the slowdown we see in behavior. Together, this work refines how we understand reward's role in balancing mental stability against flexibility, and shows that this tuning can occur locally, item by item, and within individuals.

Mentor(s):
Yu-Chin Chiu (HHS)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1041
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Evaluating Consumer Acceptance of Aquaponically Grown Lettuce Following Exposure to an Informative Label

Social Science
SROP

Authors(s):
Kiara C. Méndez Serrano† (PWL)

Abstract:
Aquaponics, which combines aquaculture and hydroponics, has been gaining attention for its significant improvements in resource efficiency, productivity, and environmental impact compared to traditional farming. However, there is little to no information on consumers' inclination to order aquaponically grown produce in meals. This study aims to assess consumers' prior experiences with aquaponically grown foods and evaluate the effects of an informative label about aquaponics on consumers' willingness to consume and pay for aquaponically grown lettuce. To address this, we analyzed a subset of aquaponics-related questions from a larger U.S. consumer survey assessing factors influencing consumers' food ordering decisions. A total of 896 participants completed the aquaponics-related questions and were included in the analysis. The data obtained were cleaned in Microsoft Excel and imported into RStudio for descriptive and statistical analysis and data visualization. Preliminary findings indicate that 36% of participants had previously purchased aquaponically grown produce, and 76% were willing to switch from regular lettuce to aquaponically grown lettuce before being exposed to an informative message on aquaponics. After viewing the message, 87% of participants who had previously purchased aquaponic produce were willing to switch from regular to aquaponically grown lettuce, while 40% of participants who had not previously purchased aquaponic produce or were unsure whether they had were willing to make the switch. Among participants willing to switch, 80% were willing to pay more than 13% above the original price for aquaponically grown lettuce. Overall, our data suggest that consumers are willing to purchase aquaponically grown produce and that informative messages may increase their acceptance and willingness to pay for such produce, highlighting the potential of targeted messages to promote consumer acceptance of innovative food production systems.

Mentor(s):
Han Chen (Agriculture); Yaohua Feng (Agriculture)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1042

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Utilizing a SIM assay to access microbial Cysteine metabolism and its role in colorectal cancer

STEM

SROP

Authors(s):

David Perez Ramos† (PWL); Apekshya Chhetri‡ (HHS); Ariana Moffitt‡ (HHS); Jellie Corduroy‡ (HHS)

Abstract:

1David R. Pérez-Ramos, 2Apekshya Chhetri, 2Jellie Corduroy, 2Ariana Moffitt and 2Patricia G. Wolf 1University of Puerto Rico, Rio Piedras Campus 2Nutritional Sciences, Purdue University

Colorectal cancer (CRC) is one of the leading causes of cancer related deaths in the United States. Previous work by our lab suggests that microbial metabolites produced by the gut microbiome contribute to CRC development and progression. Among these metabolites, hydrogen sulfide (H_2S) is generated through microbial cysteine amino acid metabolism, and high levels of H2S have been associated with increased genotoxicity. [SP1.1]Abundant in Western diets due to high consumption of red and processed meats, Cysteine serves as a major substrate for microbial H_2S production.[SP2.1] Previous studies have reported an abundance of genes for cysteine metabolism in CRC patients; however, gene abundance alone does not indicate the amount of H_2S produced by gut microbes. Therefore, this study evaluates[SP3.1] in vitro H_2S production using Escherichia coli as a model organism and a colorimetric detection assay. Cultures were grown in a Sulfide-Indole-Motility (SIM) [SP4.1]medium supplemented with either 8 mM cysteine, 8 mM tryptophan, or a combination of both. We monitored bacterial growth by measuring optical density at 600 nm (OD600), while H_2S production was assessed through colorimetric changes in the culture medium. Furthermore, we optimized the assay by determining the incubation time required for reliable color development. The findings from this study will provide insight into microbial H_2S production and support future investigations of microbial sulfur metabolism and its potential role in colorectal cancer.[

Mentor(s):

Patricia Marie Wolf (HHS)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1043

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Exploring Mechanisms of PFAS Plant Uptake: Diffusion

STEM

SROP

Authors(s):

Emma Sullinger† (PWL); Hannah Grace Forsythe‡ (Agriculture)

Abstract:

Per- and polyfluoroalkyl substances (PFAS) are a class of synthetic organic chemicals defined by a carbon-fluorine backbone that provides extreme resistance to thermal, chemical and biological degradation, earning them the designation of “forever chemicals”. Although widely used in industrial and consumer applications, PFAS have been linked to adverse human health outcomes, raising concerns about their accumulation in agricultural systems. Land application of biosolids is a major pathway for PFAS introduction into agricultural soils, where the chemicals can persist, migrate, and ultimately move through food webs.

Understanding PFAS transport in soil is critical for evaluating crop exposure; however, relatively little research has examined the mechanisms by which plants accumulate PFAS. One factor influencing PFAS mobility is diffusion-driven movement from soil to soil porewater. Once in the porewater, PFAS can be sorbed and pass through root tissues and then be taken into the above ground plant tissues through transpiration or active transport. In the case of root vegetables or tubers, the edible portions of the plant are in direct contact with the soil and soil porewater.

Potatoes (Solanum tuberosum), a common staple in the international diet, are uniquely vulnerable to PFAS exposure due to potatoes containing storage organs (tubers) that are in direct contact with soil. In this study, organic gold potatoes (n=5) were grown in pots amended with varying levels of PFAS concentration (none, low, and high). Potatoes were harvested at one-week intervals over three weeks. Following collection, each potato was peeled, and peel and core tissues were analyzed separately for PFAS. This work will provide insight into the magnitude of diffusion-driven PFAS transport into edible below ground plant tissues, which is needed to develop management strategies for safe food production on PFAS-contaminated agricultural land.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
Linda S Lee (Agriculture|Engineering); Ariana Jolie Lazo (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1044
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Combating Anti-Transgender Misinformation with Psychological Interventions

Social Science
SROP

Authors(s):
Dannah Rose Urban† (PWL)

Abstract:
In recent years, misinformation surrounding the transgender community has increased anti-trans sentiment and has contributed to the passage of restrictive and discriminatory legislation. Our project aims to investigate the prevalence of anti-trans beliefs among the general public and identify strategies to decrease prejudice against transgender people. In Study 1, we will measure level of belief in and willingness to share anti-trans misinformation as well as investigate individual factors that increase susceptibility. We hypothesize that greater political conservatism, younger age, and lower Cognitive Reflection Test (CRT) scores will be positively correlated with susceptibility to anti-trans misinformation. In Study 2, we will investigate the effectiveness of inoculation and debunking in reducing vulnerability to misinformation and improving attitudes towards trans people. We hypothesize that both techniques will be effective in achieving these goals compared to when there is no intervention. Further research should focus on the long-term effectiveness of these interventions and their potential to reduce prejudice towards other marginalized groups that are targeted by misinformation.

Mentor(s):
Jennifer Chung (HHS); Thekla Morgenroth (HHS); Kira K Means (HHS)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1045
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Modulating MicroRNA Expression to Elucidate Their Roles in Soybean Nodulation Using a Hairy Root System

STEM
SROP

Authors(s):
Makenna Wevick† (Unknown)

Abstract:
[Abstract Redacted]

Mentor(s):
Jianxin Ma (Agriculture); Leonie Marie Trabert (Agriculture)

Other Acknowledgement(s):
Runze Guo (Agriculture)

Poster Presentation Abstract Number: 1046

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Exposure to Online Content and the Perceived Violence of Religious Outgroups

Social Science

SROP

Authors(s):

Eunice Zhang† (Wellesley College); Corey Peter Resweber* (Liberal Arts)

Abstract:

Whether a religious group is perceived as violent or peaceful has profound consequences, ranging from personal prejudice to state policy to deadly hate crimes. In particular, previous research has established that Muslims and atheists are the two religious groups that are least accepted by Americans, with Muslims often being viewed as a physical threat while atheists pose a moral one. Furthermore, literature on Christian nationalism and group identity suggests that religious identities have become bundled together with discourse surrounding immigration and Diversity, Equity, and Inclusion (DEI), even as these topics do not explicitly revolve around religion. In this study, we investigate whether and how perceptions of religious group violence are impacted by exposure to inflammatory online content and the implications that such messaging might have on religious identities. We conduct a survey experiment where treated participants are exposed to hate speech and violence-provoking X (Twitter) posts about immigration and DEI. Both before and after exposure, respondents rated nine religious groups (Protestant, Catholic, LDS/Mormon, Jewish, Muslim, Buddhist, Hindu, agnostic, and atheist) on a peaceful-to-violent scale, allowing us to examine whether this exposure changes participants' views on how violent different religious traditions are. Initial findings suggest that exposure to violence-provoking posts about immigration significantly increases weekly religious attenders' perceptions of Muslims as violent, even though treatments did not explicitly reference Muslims. As hateful content and misinformation increasingly characterize today's online information environment, our insights shed light on how such content shapes and reshapes religious identity and attitudes towards religious outgroups.

Mentor(s):

Marcus Mann (Liberal Arts)

Other Acknowledgement(s):
Sean T Boylan (Liberal Arts)

Poster Presentation Abstract Number: 1047

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Standardized histological protocol to characterize cochlear synaptopathy in chinchillas after noise or blast exposure

STEM

SURF

Authors(s):

Maria Catalina Aceros† (Engineering)

Abstract:

Service members are exposed to a wide range of damaging acoustic environments, from continuous noise to brief high-intensity blast overpressure. As a result, hearing injuries are among the most common service-related disabilities in U.S. veterans. Service members often report difficulty understanding speech in noisy environments despite having normal audiometric hearing, a condition known as hidden hearing loss. Conventional clinical assessments, such as the audiogram, cannot detect functional changes induced by subtle structural changes in the cochlea associated with hidden hearing loss. Therefore, animal models are essential to correlate functional deficits with anatomical changes to better understand the underlying mechanisms of injury. Here, we developed a standardized histological protocol to quantify cochlear synaptopathy in cochlear whole mounts from chinchillas previously exposed to continuous noise or single blast overpressure. The protocol includes euthanasia, harvesting, fixation, decalcification, immunohistochemistry, microdissection, and confocal microscopy imaging. This protocol ensures that cochlear anatomy is preserved to enable researchers to quantify hair cell loss and synapse colocalization (pre-synaptic ribbons and post-synaptic glutamate receptors). Overall, this protocol will be applied across the laboratory to correlate functional auditory responses with structural damage in normal hearing and hearing impaired chinchillas. By developing a standardized protocol, we are able to provide reproducible and repeatable methodology to support more comprehensive studies.

Mentor(s):

Fernando Aguilera De Alba (HHS); Michael G Heinz (Engineering|HHS)

Other Acknowledgement(s):

Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1048

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Impact of Surface Mineralogy on Calcite Precipitation on Yates Amphibolite: A Combined X-ray CT and SEM-EDS Approach

STEM

SURF

Authors(s):

Bolortsetseg Adiya† (Science)

Abstract:

Mineral carbonation—the precipitation of carbonate minerals on silicate rock surfaces— is a key factor in long-term geothermal reservoir management, but the spatial controls (i.e., pore geometry versus surface mineral distributions) governing where precipitation initiates and grows remain poorly understood. Amphibolite, a calcium- and magnesium-rich metamorphic rock, is a candidate substrate for this process, yet little is known about whether pre-existing calcite influences where subsequent nucleation occurs. It is unclear whether calcite nucleation preferentially occurs at or near pre-existing calcite or distributes independently of prior mineralogy. Amphibolite samples (5 mm x 5mm x 1mm) were scanned using 3D X-ray tomography and SEM-EDS before reaction, then submerged in a 30 mM sodium bicarbonate/15 mM calcium chloride solution to promote calcite precipitation. After submersion for several weeks, both scans were repeated. CT scans were acquired with a 6-12 micrometer voxel resolution, the threshold at which calcite precipitation is resolvable based on prior work. CT data assess surface roughness and growth by segmenting calcite-corresponding intensity values (cross-referenced against mineral standards), volumetrically comparing before/after scans, and computationally quantifying elevation changes. SEM-EDS elemental maps are processed through a custom Python pipeline to generate color-coded phase maps supplementing the CT data. The combined approach is expected to yield paired before-and-after datasets capturing 3D topographic and elemental evidence of new growth, allowing spatial correlation between measured growth and pre-existing calcite locations. This work will clarify whether existing calcite acts as a nucleation site for further precipitation, offering insight into surface-level controls on mineral carbonation.

Mentor(s):

Alexandra Blair Clark (Science); Laura J Pyrak-Nolte (Science)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1049

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Acoustic Detection of Tool Changes in CNC Milling via Deep Learning

STEM

SURF

Authors(s):

Minseong An†

Abstract:

Tool change events in CNC milling are important indicators of machine operation and can provide useful information for monitoring machining processes, tool usage, and production status. However, conventional monitoring approaches often rely on direct sensing methods, such as vibration or force sensors mounted on the spindle or workpiece, or on manual operator observation. These methods can increase hardware complexity, require additional maintenance, and delay the detection of tool-related events. This study investigates whether tool change events can be detected using only acoustic data collected during CNC milling, reducing the need for contact-mounted mechanical sensors. Audio recordings were captured during CNC operation and used to train a convolutional neural network (CNN) to classify sound segments associated with tool change events based on their acoustic signatures. By treating tool change detection as an audio-based pattern recognition problem, the proposed approach leverages the distinct sound patterns generated during tool swapping or engagement. Preliminary results show that the CNN can detect tool change occurrences from sound data alone, indicating that acoustic signals contain sufficient discriminative information for this task. These findings support the feasibility of low-cost, non-contact acoustic monitoring for CNC machining and provide a foundation for future work on tool-type classification and real-time tool condition monitoring in industrial CNC systems.

Mentor(s):

Martin Byung-Guk Jun (Engineering); Junmyoung Jang (Engineering)

Other Acknowledgement(s):

Junyoung Oh (Engineering); Yonghyun Lee (Engineering); Yuseop Sim (Engineering)

Poster Presentation Abstract Number: 1050
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Computational Investigation of Actin Cytoskeleton in Plant Cells

STEM
SURF

Authors(s):
Rishab Anand† (Engineering)

Abstract:
The actin cytoskeleton is a highly dynamic filamentous network that supports morphogenesis, intracellular transport, and mechanical integrity across both animal and plant species. Although extensive work has elucidated regulatory mechanisms of actin organization in animal cells, our understanding of how plant cells assemble and maintain their distinct actin architectures remains limited. In particular, the molecular processes that drive the formation of long, dynamic actin bundles—prominent structures in plant cells—are not well understood. This project investigates how actin filaments, crosslinking proteins (ACPs), and myosin motors collectively govern bundle formation using agent-based computer simulations. Parameter studies with variations in parameters controlling actin dynamics are performed. Then structural properties of bundles are quantitatively analyzed to compare with experimental observations. The role of myosin motor activities is further evaluated systematically. Together, these results will clarify how filament dynamics, crosslinking, and motor activity interact to regulate the emergence and stability of actin bundles in plant cells.

Mentor(s):
Tae Yoon Kim (Engineering); Md Foysal Rabbi (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1051
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Identifying Fatigue Indicators in Cyclists' Bodies Over Time: A Kinematic and Subjective Multi-Modal Pilot Study

STEM
SURF

Authors(s):
David Felipe Arguello Patino† (Engineering); Adam James Sullivan‡ (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Megan K Van Dyke (Engineering); Yuehwern Yih (Engineering)

Other Acknowledgement(s):
Jorge Enrique Neira Garcia (Engineering)

Poster Presentation Abstract Number: 1052
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

A Speech Command Interface and Sensing Pipeline for Agricultural Vehicles

STEM
SURF

Authors(s):
Sidharth Bhatt†

Abstract:
By 2050, the UN projects the global population will reach roughly 9.7 billion, up from 8.2 billion today. Agricultural employment fell from 43% of the workforce in 1991 to 26% in 2020 (International Labour Organization). Fewer farm workers will need to feed a larger population, and autonomous tractors could help close that gap. An autonomous tractor needs a fast, natural way for a farmer to take control or teach it to drive. Natural language is the most intuitive way to give directions, yet turning speech into safe motion requires connecting many separate systems. This research develops a reliable voice-command interface for an Ackermann-steered robot car, which provides an ideal testbed for self-driving farm vehicles. Independent hardware-level tests confirm the car's camera, LiDAR, microphone, and motors function correctly. A recording and replay pipeline captures synchronized audio, video, and LiDAR data with timestamps. Voice Activity Detection (VAD) and a speech-to-text model continuously transcribe speech. An LLM then interprets each transcript to extract the intended command. It publishes the result as a ROS 2 message from a fixed vocabulary that drives the control interface. Simultaneous localization and mapping (SLAM) first builds a map of the space. Using the Nav2 stack, the robot then localizes itself on that map, plans a path, and course-corrects around obstacles when traveling between two points. This study integrates speech, sensing, and navigation so a spoken command can safely change the robot's motion, providing a reusable dataset and recommendations for future agricultural driving research.

Mentor(s):
Yaguang Zhang (Agriculture); Fabio Andres Castiblanco Rubio (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering); Saru Bharti (Agriculture); Anugunj Naman (Engineering); Andrew Balmos (Engineering)

Poster Presentation Abstract Number: 1053
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

FractureTAU: A Spatiotemporal-Attention Deep-Learning Surrogate for Long-Horizon Fracture Forecasting in Microstructures

STEM
SURF

Authors(s):
Juan I Cantarella† (Engineering)

Abstract:
Predicting how cracks nucleate and spread through a material's internal microstructure is central to designing tougher, safer materials, but the high-fidelity physics simulations that capture this behavior are slow and computationally expensive. Machine learning surrogates promise to forecast fracture evolution far faster, but they struggle to stay accurate when asked to predict many time steps ahead: small per-step errors accumulate and the predicted crack pattern drifts away from reality. A prior convolutional-recurrent (ConvLSTM) model established that fracture forecasting is learnable, but left open whether a modern spatiotemporal architecture, together with a training procedure matched to how the model is used, could deliver stable long-horizon predictions, and which of those two factors matters more. This study introduces FractureTAU, a deep-learning surrogate that pairs a convolutional encoder-decoder with a temporal-attention module, and evaluates it head-to-head against the ConvLSTM baseline under an identical rollout protocol on the same dataset of 16 simulated microstructures. Each model forecasts successive fracture maps by repeatedly feeding its own predictions back as input, the regime where accumulated error does the most damage. FractureTAU outperformed the baseline on late-rollout accuracy, raising the per-frame F1 score from 0.58 to 0.86 and winning on all 16 test cases. A controlled ablation showed the improvement was driven primarily by training the model on its own rollout, not by the attention module alone. These results demonstrate that a carefully trained surrogate can forecast microstructural fracture with substantially higher long-range accuracy, and that rollout-aware training is the decisive lever.

Mentor(s):
Kyle Henry Jung (Engineering); Marisol Koslowski (Engineering); Joshua Mark Block (Engineering)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1054

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Comparing Single and Double Transmission Methods for Determining Seismic Wave Velocities in Rock

STEM

SURF

Authors(s):

Logan Ray Thomas Carleton† (Science)

Abstract:

Understanding the elastic constants of rock is critical for evaluating mechanical properties, developing accurate numerical models, and predicting seismic wave velocities in the Earth's subsurface. Although various methods exist for assessing these constants, most research has focused on artificial materials with limited degrees of anisotropy. However, many natural rocks are inherently anisotropic due to their formation processes and mineral composition. This study compares two distinct analysis techniques to determine if the elastic constants derived from one method can accurately predict the compressional and shear wave velocities measured by the second. The first method is double transmission, which utilizes a single, water-coupled, 10 MHz ultrasonic transducer to send and receive waves through a thin rock disk across a range of incident (+/- 35 degrees) and azimuthal (0-180 degree) orientations. A custom MATLAB code uses arrival-time differences to fit the elastic constant tensor. These constants are then applied to standard equations to predict velocities, which are compared against data from a second measurement method involving direct wave transmission through a core at various azimuthal angles. While this single transmission method cannot measure at the exact same orientations as the direct transmission setup, it provides sufficient velocity data to validate the double transmission predictions. We analyze the agreement between the measured single transmission velocities and the predicted values across cores under several different conditions. The results define the specific conditions under which these two methods are interchangeable, offering insights that could be extended to rocks at varying depths or of different compositions.

Mentor(s):

Laura J Pyrak-Nolte (Science)

Other Acknowledgement(s):

Kyungsoo Han (Science)

Poster Presentation Abstract Number: 1055
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Evaluation of the In Situ Raman Detection Limit for Bacterial Colonies

STEM
SURF

Authors(s):
Avery Chan† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Arezoo Ardekani (Engineering); David Perez Herrera (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1056

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Modulation of Mechanical, Injectable and Degradation Characteristics of MMP Cleavable Microgels to Advance Tissue Repair

STEM

SURF

Authors(s):

Daniel Chi Hsien Chen Sandi† (Engineering)

Abstract:

Traumatic tissue injuries cause scarring and functional deficits with no standardised treatment Although chemically crosslinked hydrogels show promise for muscle loss repair as bulk and granular scaffolds, their non-degradable nature limits cell infiltration and long-term healing. This has motivated the development of degradable hydrogels that support scaffold degradation via cell-secreted proteases, while preserving mechanical integrity prior to cell invasion. Given different crosslinkers introduce complex interdependencies among stiffness, injectability, porosity and degradability, this work characterises these relationships in bulk and granular norbornene-modified hyaluronic acid (NorHA) hydrogels to establish a tuning framework. We hypothesise granular microgels degrade faster than bulk gels due to greater surface area and porosity. Non-degradable NorHA is crosslinked with dithiothreitol (DTT), while degradable hydrogels use protease-cleavable peptides. Microgels were fabricated via microfluidic devices and jammed to obtain granular hydrogels. Crosslinking efficiency and its relation to stiffness were characterised via uniaxial compression testing,;porosity via fluorescence and confocal microscopy, injectability by oscillatory shear rheology, and degradation via mass loss and uronic acid release. Hydrogels are expected to maintain their morphology and injectability independent of crosslinker type, with protease-degradable microgels preserving the advantages of non-degradable hydrogels. Crosslinking efficiency and polymer weight should serve as independent variables to tune degradation rates. Micro and microporosity, along with surface area, are expected to dictate the rate of collagenase-mediated degradation, revealing how microgeometric differences between bulk and granular systems govern this process. This lays the groundwork for dynamic hydrogel systems that degrade responsively to cell-secreted proteases and evolve spatially to support tissue repair.

Mentor(s):
Jun Kim (Engineering); Taimoor Hasan Qazi (Engineering)

Other Acknowledgement(s):
Tuba Marjan (Engineering); Nicole Elizabeth Mertens (Engineering); Keira Vesy (Engineering); Dean Evan Stornello (Engineering)

Poster Presentation Abstract Number: 1057

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Experimentally Probing Mechanistic Differences in Toluene Methylation with Methanol and Dimethyl Ether within H-MFI zeolite

STEM

SURF

Authors(s):

Brendan Edward Crump† (Engineering)

Abstract:

As the world shifts away from its reliance on fossil fuels, key industrial chemicals derived from petroleum refining will need to be sourced through alternative methods. One such chemical is para-xylene (p-X), an important precursor in the synthesis of polyethylene terephthalate (PET) plastics, produced via selective methylation of toluene with methanol or dimethyl ether (DME) over an acid catalyst. Prior work has shown that H-MFI zeolite, a porous Brønsted acid catalyst, is the most effective option for this reaction, and that confinement of H+ sites within MFI's channel and intersection voids controls p-X selectivity through differential stabilization of xylene transition states. However, the mechanistic distinctions between methanol and DME as methylating agents in H-MFI remain poorly understood. This work contrasts methanol and DME methylation of toluene across two reaction characteristics: the sensitivity of methylation rates to acid strength, and the impact of transition-state confinement on p-X selectivity. MFI zeolites with varied acid strength and controlled H+ siting within channel versus intersection voids will be synthesized and evaluated for toluene methylation with methanol, with rate and selectivity trends compared against prior work on DME methylation under analogous conditions. Preliminary results on MFI show methanol methylation rates roughly 100x lower than those reported for DME under comparable reaction conditions, consistent with the hypothesis that methanol's protic character drives stronger competitive adsorption at H+ sites than DME, thereby suppressing turnover rates. These comparisons will reveal how methylating agent identity governs the interplay among acid strength, confinement, and p-X selectivity within H-MFI.

Mentor(s):

Ayotunde Olaoluwa Alabi (Engineering); David Hibbitts (Engineering)

Other Acknowledgement(s):

Sarah Gustafson Wagers (Engineering); Waire Olawolu (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1058

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

A Semi-Automated Pipeline for Generating Finite Element Models of Plant Cells from Confocal Microscopy

STEM

SURF

Authors(s):

Guilherme de Souza Correa† (Engineering)

Abstract:

This work is part of a larger project correlating the signal of the BRK1 protein in confocal microscopy with out-of-plane cell wall stresses computed from Finite-Element Analysis (FEA) models with simulated turgor pressure. For this, a fast and reliable image-to-model pipeline is needed for time efficiency and reproducibility. This research develops a set of tools and protocols to streamline the creation of FEA models for a single layer of plant cells. This will improve the speed and quality of future plant cell mechanical analyses. Confocal images of cell walls were acquired using either a single optical slice, when anticlinal walls appeared near-vertical and all cells of interest fell in one plane, or a maximum z-projection when cells occurred at varying heights. The software Fiji converted these images into one-pixel-wide wall outlines. A custom MATLAB script then segmented each image into spline coordinates for every wall segment — a wall between two tricellular junctions — and wrote these coordinates into a Python script. The Python script ran in the finite-element software ABAQUS to generate a sketch of all splines. A three-dimensional shell was created for each cell and assembled into a model of the full cell patch. To assess accuracy, the original membrane marker image (PIP2A-mCher) was overlaid with the final one-pixel-wide outline on separate magenta and green channels. Their overlap, seen as a white signal, confirmed the outline coincided with the cell wall across 10 test images. On average, the pipeline generated a complete model in 20 minutes, compared to 60 minutes for manual segmentation across 10 samples. This pipeline offers an accurate, reproducible, and substantially faster alternative to manual segmentation, lowering the barrier to mechanical modeling of plant tissue more broadly.

This work was supported by NSF Award 2452449 (PI D. Symanski, Co-PI T. Siegmund)

Mentor(s):
Luis Gerardo Romaguera-Rios (Engineering); Thomas H Siegmund (Engineering)

Other Acknowledgement(s):
Daniel B Szymanski (Agriculture); Tanner James Ballance (Agriculture); Eileen L Mallery (Agriculture); David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1059

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Analysis of Closed-Loop Communication to Predict Non-Technical Skills Amongst Surgical Teams in Operating Rooms

STEM

SURF

Authors(s):

Kelcie Edrea T Estrera† (Science); Yizheng Jiang‡ (Engineering)

Abstract:

Non-Technical Skills (NTS) consist of four categories: situation awareness, decision-making, communication and teamwork, and leadership. NTS contribute to successful surgical and clinical outcomes by improving clinical results by 57% and patient safety by 82%. The Non-Technical Skills for Surgeons (NOTSS) framework evaluates surgeons' NTS through expert observation, often making assessment labor-intensive. However, communication provides a feasible alternative because good NTS events depend on adequate communication to cultivate shared understandings and optimal coordination. Closed-loop communication (CLC), a three-step verbal exchange consisting of call-out (CO), check-back (CB), and confirmation (CL), recognizes these observable coordination behaviors and correlates positively with team performance. Because CLC provides structured, interpretable communication behaviors, it offers a foundation for automated NTS assessment. Yet, CLC's relationship with surgeons' NTS remains unevaluated. This research analyzes whether CLC-based communication can predict surgeons' NTS using intraoperative communication data. Audio recordings from 13 cases, involving 13 attending surgeons within varying specialties, were transcribed and coded to quantify CLC behaviors. Two coders reached consensus on CLC coding to reduce bias. Communication features were then examined for their ability to predict each NTS category. Preliminary results showed that CLC-based communication predicted leadership and situation awareness, but not communication and teamwork and decision-making. Specifically, surgeon response rate (%) was higher during good leadership NTS events, whereas surgeon CB (%) was lower for good situation awareness NTS events. These results support CLC as a foundation for predicting NTS categories and developing AI assisted tools for automated NTS assessment, post-operative feedback, and communication-focused coaching.

Mentor(s):
Denny Yu (Engineering)

Other Acknowledgement(s):
Varun Aggarwal (Engineering); Jingkun Wang (Engineering); Peiran Liu (Engineering)

Poster Presentation Abstract Number: 1060

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

A Real-Time Digital Twin Framework for Temperature Monitoring and Feedback Control in Automated Fiber Placement

STEM

SURF

Authors(s):

Hongsen Fang† (Engineering); Rohan Kelkar* (Engineering)

Abstract:

Automated Fiber Placement (AFP) is a method used to manufacture composite laminates by depositing prepreg tows under controlled infrared heating and compaction. Although there exist mature, validated process parameters, the actual material temperature may deviate from the heater setpoint due to variations in placement speed, local heat transfer conditions, and heat accumulated from previously deposited tows. As such, these deviations can lead to insufficient bonding or overheating, increasing the risk of material permanently bonding to the mold surface and reducing manufacturing robustness. Existing methods currently rely on offline simulations that are based on a combination of preset heater parameters and iterative experiments. However, it should be noted that these approaches cannot directly capture the real-time local thermal state during deposition, limiting timely process correction and defect prevention. Our work presents a digital twin framework based on a 12-channel temperature acquisition and control system. Temperature histories were measured using Type-K thermocouples and MAX31856 interface modules and collected using a Teensy 4.1 microcontroller. The measured temperature profile was compared with a prescribed target temperature profile, and the resulting deviation was used to adjust heater power and heating duration. Experimental validation demonstrated synchronized 12-channel acquisition and heater adjustment based on temperature error. This framework enables more precise control of the heat source, helping prevent the initiation and further growth of thermally induced defects. The resulting digital twin also provides a foundation for real-time process monitoring and optimization. Further improvements include investigating machine-learning methods for predicting the full temperature field and correcting heater parameters under changing deposition conditions and complex tool geometries.

Mentor(s):
Dianyun Zhang (Engineering); Yao Sun (Engineering); Sai Krishna Meka (Engineering)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1061

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Tiam1 as a candidate mediator for Calcium-dependent actin remodeling events in the egg-to-embryo transition

STEM

SURF

Authors(s):

Auriani Faviola Gomez Cintron† (Engineering)

Abstract:

Calcium (Ca2+) regulation is fundamental for cellular homeostasis. In mammalian eggs, cytosolic calcium mediates the phenomenon known as egg activation – a series of developmental events following fertilization. Ca2+ ions exert their effects through calcium-dependent effector molecules such as Ca2+/Calmodulin-dependent kinase II (CaMKII). In mice, the knockout of the gamma isoform (CaMKIIγ) causes female infertility due to egg activation defects. T-cell lymphoma invasion and metastasis 1 (Tiam1) is a known CaMKII downstream effector that is phosphorylated by CaMKII in biological systems such as neurons. Tiam1 activates small GTPases that regulate actin cytoskeleton organization. Yet, no role has been identified for Tiam1 in mammalian eggs. Current results suggest Tiam1 varies over meiosis development and early embryos, prompting further analysis of protein expression. Here, we investigate (a) the expression of Tiam1 in mouse egg and embryo lysates, and (b) Ca2+- dependent phosphorylation of Tiam1 in early embryos using Phos-TAG assay for differential separation of proteins based on their phospho-state. Immunoblotting was used to detect Tiam1 and Pan-actin (control) proteins in oocyte lysates in prophase I, in vitro matured (IVM) metaphase II, and Ca2+ ionophore activated eggs and expression levels were analyzed. We hypothesize Phos-TAG assay results to show higher phosphorylation of Tiam1 in embryos compared to unfertilized eggs. Future studies include: (1) analysis of microscopic images to quantify the spatial and temporal localization patterns of Tiam1 and CaMKIIγ in early embryos, and (2) a plasmid design of recombinant Tiam1 as a control for protein expression studies. This work aims to identify factors that contribute to infertility and assist in reproductive technologies.

Mentor(s):

Agnes Doszpoly (Engineering); Tamara L Kinzer-Ursem (Engineering)

Other Acknowledgement(s):

Andres Catalino Castillo Jimenez (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1062

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Molecular and Physiological Characterization of a Trichoderma Isolate from Peru

STEM

SURF

Authors(s):

Gabriela Gomez Langebeck† (Agriculture)

Abstract:

Trichoderma species are a group of widely distributed filamentous fungi recognized for their role in biocontrol and plant growth promotion, due to their mycoparasitism activity towards a broad range of fungi and their potential to induce systemic resistance. While this genus has been extensively studied, strains isolated from underexplored environments can show unique physiological traits against pathogens affecting local crops. This study aimed to molecularly characterize a Trichoderma isolate obtained from the phyllosphere of faba bean crops (Vicia faba) in a local plot at the Colca Canyon in Arequipa, Peru, and test in vitro the plant growth promotion (phosphate solubilization, biofilm formation, siderophore, xylanase and metallothionein production), and antagonistic traits against the foliar pathogen Botrytis cinerea and the soilborne Fusarium oxysporum f. sp. radicis-lycopersici (FORL). The isolate identification was performed using ITS amplicon sequencing via WideSeq. A preliminary result of Trichoderma viride as a close match was obtained, as well as positive siderophore production, evidenced by halo formation in plate assays, positive xylanase activity, inducible metallothionein expression under heavy metal stress and low biofilm formation supported by adherence below 1.3%. Additionally, in vitro antagonism assays showed that at 48 hours of growth there was a high antagonistic activity against Botrytis cinerea, where the Trichoderma strain from Arequipa showed a percentage inhibition of radial growth of 69.2%, followed by Trichoderma reesei with 40.35%. In contrast, antagonism against Fusarium oxysporum was not evidenced due to the slower growth rate of this pathogen. These results show that this strain has a broad range of plant growth promotion and stress tolerance traits, making it a good candidate for further studies aiming for more sustainable crop management strategies.

Mentor(s):

Lori Hoagland (Agriculture); Cristian Andres Salinas Castillo (Agriculture)

Other Acknowledgement(s):
Mine Rouxna van der Berg (Agriculture)

Poster Presentation Abstract Number: 1063

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Development of a Comfortable, Breathable, Cut-Resistant Hockey Neck Guard

STEM

SURF

Authors(s):

Nicolas Gomez Velasquez† (Engineering); Cole J Burnett‡ (Engineering)

Abstract:

Skate blade neck lacerations represent a rare but potentially fatal hazard in ice hockey. High-profile cases, including the death of NHL player Adam Johnson, have brought this issue into the national spotlight, prompting governing bodies such as USA Hockey and the National Hockey League (NHL) to introduce neck guard mandates for various player categories. However, existing commercial neck guards are often rigid, bulky, and restrictive, causing thermal discomfort and limiting range of motion. This project aims to develop a next-generation, comfortable, wearable, cut-resistant neck guard through a human-centered design approach. Cut-resistant composites of thermoplastic elastomer (TPE) and knitted aramid fabric (Kevlar®) were fabricated via polymer impregnation and evaluated for cut resistance using ASTM F2992 (TDM-100 method). Constituent materials were tested for air permeability using ASTM D737 at a reduced pressure differential of 25 Pa, with airflow recorded in L/m²/s. Twelve Kevlar® variants and nine TPE configurations were assessed across two outer shell fabrics and two 3D spacer mesh thicknesses. Preliminary results indicate that an interlock knit Kevlar® paired with perforated 10 Shore A TPE provides favorable breathability and structural integration, and that a poly-spandex shell paired with a 3 mm spacer produces the highest stack permeability. Selected materials will be integrated into a neck-formed prototype using heat-forming and stitching. This work establishes preliminary design guidance for a comfortable and breathable cut-resistant hockey neck guard. Further research should explore integrating this neck guard into a breathable base-layer shirt to improve stability and promote player adoption.

Mentor(s):

Jan-Anders E Mansson (Engineering); Adeline Nora Ripberger (Engineering)

Other Acknowledgement(s):

Jorge Enrique Neira Garcia (Engineering)

Poster Presentation Abstract Number: 1064
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Geometric Control of Drug Release in Additively Manufactured Dosage Forms Using Vibration-Assisted Printing

STEM
SURF

Authors(s):
Vincent John Graciano† (Engineering)

Abstract:
Personalized medicine is of growing interest, particularly in application to geriatric and pediatric patients, where comorbidities are of greater concern by likelihood and severity, respectively. The development of polypills—pills composed of multiple medications—aims to address these challenges through increased adherence and formulation flexibility. An important consideration regarding polypills is the necessity to control the release rates of multiple drugs within a singular pill independently. Additive manufacturing (AM) utilizes complex internal geometries which can alter surface area and dissolution kinetics, therefore customizing the release rate. Historically, applications of AM to pharmaceuticals have utilized fused deposition modeling (FDM) and inkjet-based printing processes, both of which are limited by viscosity. To expand the application of AM in pharmaceutical development, this research evaluates the use of vibration-assisted printing (VAP) to reduce formulation constraints with higher viscosity and increased API concentration that can prove beneficial to drug release control within polypills. Initial pill production consisted of printing dosage forms of varying infill pattern and density, the effects of which will be analyzed via dissolution testing and then used to develop a predictive model to estimate drug release behavior. The dissolution results obtained from this study will be used to demonstrate the efficacy of VAP printing by developing a model to predict dissolution behavior through geometric manipulation. These findings will direct the development of a polypill in which distinct dissolution rates are achieved by geometry rather than formulation. Overall, this study seeks to support the use of VAP for designing pharmaceutical dosage forms with tunable behavior and increased API loading capacity.

Mentor(s):
Bren H Legarreta (Engineering); Diane Collard (Engineering); Steven F Son (Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1065

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

An Intelligent, High-Throughput Microfluidic Sorter for Drosophila melanogaster Embryos

STEM

SURF

Authors(s):

Sicheng He† (Science); Ayush Ashok Khondge‡ (PWL); Nolan H Nguyen‡; Qingyang Sun‡ (Engineering); Elizabeth Renee Murotani‡ (Science); Bosco Lee‡; Aaron W Berntsen‡ (Engineering|JMHC); Lucas Bin Fan Wu‡ (Unknown)

Abstract:

Drosophila melanogaster remains a cornerstone model organism for biomedical research, with thousands of distinct strains actively maintained across global laboratories. However, continuous manual stock transfer is laborious and susceptible to genetic drift or mutation accumulation. While embryo cryopreservation offers an ideal long-term storage solution, survival rates heavily depend on selecting embryos at a precise, optimal developmental stage. To automate this selection, we developed an automated microfluidic sorting prototype that leverages computer vision and machine learning to evaluate embryo morphology in real time. Embryo images are captured under transmitted light illumination using a CMOS camera. Upon identifying a non-ideal developmental stage, a voltage pulse is applied to a piezoelectric actuator, generating an acoustic wave that deflects the target embryo into a waste channel, while preferred embryos continue to collection. In validation tests, the integrated machine learning algorithm achieved a stage-classification accuracy of 92% with an inference latency of just 40 ms. Furthermore, the piezo-acoustic actuation mechanism reliably deflected embryos with a minimal recovery delay of 100 ms between consecutive triggers. This interdisciplinary platform demonstrates a robust, high-throughput solution to automate the tedious and error-prone process of embryo sorting, representing a critical step forward for automated repository management in fruit fly research.

Mentor(s):

Qiuyang Xiao (Engineering); Li Zhan (Engineering)

Other Acknowledgement(s):

Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1066
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Micro-Morphing Aerial Vehicle for Passive Controlled Descent

STEM
SURF

Authors(s):
Jamie Chanadol Henson† (Engineering); Kai X Keller† (Engineering)

Abstract:
The applications and scalability of micro–aerial vehicles (MAVs) remain a significant challenge due to constraints on mass, power, controllability, and environmental conditions. While conventional solutions rely on active propulsion and complicated sensors, this results in limitations on endurance and scalability. This research addresses the problem of achieving controlled descent and autonomous guidance in a sub–0.1 kg MAV using a primarily passive flight control system and morphing wing mechanisms.

The proposed approach explores a micro-morphing aerial vehicle that transitions between distinct aerodynamic configurations to bias descent speed and improve landing accuracy without continuous thrust. The vehicle leverages a simple, low-power morphing actuation mechanisms capable of transitioning between gliding flight and autorotation. State estimation and performance evaluation are initially conducted using external vision systems in a controlled indoor environment, allowing isolation to study aerodynamics effects due to wing morphing independent of onboard sensing.

Expected outcomes include demonstrated controllability of downrange drift during descent, improved robustness to wind disturbances, and increased endurance compared to actively controlled MAVs. Future work will focus on higher altitude testing, integration of more advanced onboard sensors, and utilization of scalable manufacturing techniques. The results aim to inform the design of low-power, reliable MAV platforms in contested and resource-limited environments.

Mentor(s):
Yooseung Choi (Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1067

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Development of an Efficent, Synthetic Pathway for Large Scale Atipamezole Manufacturing

STEM

SURF

Authors(s):

Kira Howe† (Science)

Abstract:

Atipamezole is a pharmaceutical drug that is used to reverse anesthesia for cats and dogs. Its potential applications in human medicine are currently under investigation. In order to increase the domestic production of Atipamezole, efficient and scalable synthesis is needed. Previous research has found two potential pathways to making Atipamezole. The first option is to start with the Imidazole ring and build the molecule in seven steps. The second option has two distinct pathways, including two starting materials for each one. Utilizing principles from both of the previous pathways, a new synthesis pathway for Atipamezole has been formed. This pathway only requires one starting chemical and can create atipamezole in five steps. Reaction progress and product identity were evaluated using observations, reaction mass, and various analytical techniques including NMR, HPLC, and TLC. In order to quantify efficient production, the percent yield of each reaction was also calculated. This experiment seeks to demonstrate the theoretical pathway as a simplified approach for the domestic production of Atipamezole. To date, the first step of the overall synthesis is complete, and the second step is nearing completion.

Mentor(s):

Saloni Darji (Science); Sourish Biswas (Centers & Institutes); David Thompson (Science)

Other Acknowledgement(s):

David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1068
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Development of an AI-Assisted Workflow for Automated Analysis of Untargeted Nano-DESI Mass Spectrometry Imaging Data

STEM
SURF

Authors(s):
Joseph Anthony Janicek† (Science)

Abstract:
Mass spectrometry imaging (MSI) generates large and complex datasets that require labor-intensive analysis, especially in untargeted experiments where each detected m/z value must be assigned to a molecular formula. This project aims to develop an automated, AI-assisted workflow to simplify and accelerate MSI data analysis. As a first step, Python-based pipelines are being developed to automate key stages of the analysis, including peak extraction, data filtering, and molecular formula assignment. These pipelines will be subsequently converted into modules for an agentic AI system that orchestrates the analysis of MSI data. The AI will be trained using these modules alongside a mass spectrometry database containing reference m/z values and corresponding molecular formulas. After training, the AI agent will be used to analyze new nano-DESI MSI datasets, assigning molecular formulas to detected peaks by referencing the database, therby substantially reducing manual effort and accelerating data analysis.

Mentor(s):
Govindi Soba Rashmiraji Walimuni Dewage (Science); Xindi Tang (Science); Qiaorong Xie (Science); Julia Laskin (Science)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1069

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Evaluation of platinum-tin and platinum-copper alloy catalysts for chemoselective hydrogen addition.

STEM

SURF

Authors(s):

Daniel Esteban Jara Moreno† (Science)

Abstract:

Catalysts are essential for manufacturing pharmaceuticals, fuels, and many everyday products because they make chemical reactions faster and more efficient. However, many catalysts also promote unwanted reactions that reduce product yield, increase costs, and generate chemical waste. Developing catalysts that produce the desired product more selectively while maintaining high activity remains an important challenge. Even small improvements in catalyst performance can make industrial processes more sustainable by reducing energy consumption and waste. This study investigates whether modifying the surface of platinum-based catalysts containing tin or copper can improve reaction selectivity without reducing catalyst activity. Cinnamaldehyde, a naturally occurring compound found in cinnamon oil, was selected as a model molecule to evaluate catalyst performance. Platinum-tin and platinum-copper alloy catalysts were synthesized and evaluated through hydrogen addition reactions. Reaction conditions, including temperature, pressure, concentration, and catalyst loading, were varied to optimize catalyst performance. Reaction products were purified and analyzed by gas chromatography to compare product distributions. Preliminary results showed that the platinum-tin catalyst exhibited high selectivity toward cinnamyl alcohol, the desired product of the hydrogen addition reaction. Gas chromatography confirmed that the platinum-tin catalyst favored the formation of cinnamyl alcohol over undesired products, demonstrating its potential for selective catalytic applications. These findings improve the understanding of how modifying platinum alloy catalysts influences reaction selectivity while preserving catalytic activity. This knowledge may contribute to the development of more efficient and sustainable catalysts for industrial chemical processes, helping reduce waste and improve the production of valuable chemicals.

Mentor(s):

Anish Yadav (Science); Christina W Li (Science)

Other Acknowledgement(s):
Jorge Enrique Neira Garcia (Engineering)

Poster Presentation Abstract Number: 1070

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Speech-Based Assessment of Acute Fatigue in Surgical Team Members

STEM

SURF

Authors(s):

Yizheng Jiang† (Engineering); Kelcie Edrea T Estrera‡ (Science)

Abstract:

Surgical team members' fatigue can influence team performance. While previous studies have focused on fatigue related to sleep quality and sleep duration, fatigue accumulated during the workday is important to examine. Current fatigue assessment often relies on subjective self-report or direct observation, making it subjective and difficult to scale. Prior studies have shown that speech may be a feasible marker of mental fatigue, but its application in real-life surgical settings remains limited. Thus, this study aims to test whether speech can serve as a valid measure for differentiating acute fatigue induced by surgical workday load. This study develops a speech-based analysis pipeline to evaluate pre- and post-case speech recordings from surgical team members. Audio recordings were collected from 8 participants across 22 surgical case pairs. At each time point, participants completed three standardized speech tasks: sustained vowel phonation, "pa-ta-ka" diadochokinetic repetition, and controlled sentence reading. Each task targeted different speech domains: sustained vowel features reflected vocal quality and phonatory stability; DDK features reflected speech motor coordination and rhythm; and sentence reading features reflected connected speech fluency, rate, and pausing. Extracted measures included pitch, intensity, jitter, shimmer, harmonics-to-noise ratio, phonation duration, DDK rate, rhythm variability, reading duration, articulation rate, and pause measures. Recordings were segmented using automated preprocessing and manually reviewed for audio quality, segmentation errors, duplicate recordings, channel issues, background noise, and microphone artifacts. Pre-to-post changes will be analyzed using mixed-effects models accounting for repeated observations within participants and surgical cases. This pipeline may support objective assessment of acute surgical fatigue and inform future feedback tools for clinician wellness and communication-focused training.

Mentor(s):

Denny Yu (Engineering); Jingkun Wang (Engineering)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1071

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Optimization of Wafer-Scale $MoSe_2$ Growth via Molecular Beam Epitaxy

STEM

SURF

Authors(s):

Brayden Kauffmann† (Science); Aditya H Joshi‡ (Engineering)

Abstract:

The modern world has been shaped by semiconductor materials, with silicon being the most prominent. To continue Moore's Law, the semiconductor industry will need to explore materials beyond conventional silicon, and atomically thin materials are a promising direction for enabling further device miniaturization. $MoSe_2$ is a semiconducting transition metal dichalcogenide that has a layered crystal structure and a direct bandgap in its monolayer phase, making it promising for optoelectronics. This project aims to optimize the wafer-scale growth of singly oriented $MoSe_2$ by using molecular beam epitaxy. Thin films of $MoSe_2$ will be synthesized using molecular beam epitaxy on a-plane (11-20) sapphire. A-plane sapphire was chosen as the substrate because previous studies have shown that this surface can promote singly oriented MoSe2 growth. The quality of the films will be optimized by controlling the growth temperature and fluxes. These tunable parameters control how the MoSe2 nucleates and grows. By systematically varying them, we plan to identify the optimal growth conditions. To understand the growth, multiple characterization methods have been deployed. Reflection high-energy electron diffraction has been used to confirm the lattice constant of MoSe2 of 3.29 Å, and it has shown that current films are in-plane disordered. X-ray photoemission spectroscopy has shown that the current flux ratio produces the correct 1 Mo : 2 Se stoichiometry for MoSe2. Atomic force microscopy has been used to image the surface morphology of the samples, which is used to observe defects and measure roughness. This project has shown that crystalline MoSe2 can be grown. The next step is to eliminate in-plane disorder from the films. Once singly oriented MoSe2 is achieved, it will have promising applications in many types of devices.

Mentor(s):

Tiancong Zhu (Science); Daniel Johannes Jung (Science)

Other Acknowledgement(s):

David Matthew Czerwonky (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1072
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

AudioFix: Bridging the Expertise Gap in Acoustic Fault Diagnosis with Multimodal AI

STEM
SURF

Authors(s):
Nathan Maharaj Kharwanlang† (Engineering)

Abstract:
Mechanical faults in systems such as automobiles and 3D printers routinely produce sounds such as grinding, clicking, or knocking. While experienced mechanics can interpret acoustic cues, everyday users struggle to verbalize unfamiliar sounds and determine their underlying cause. Large Audio Language Models show promise in general audio reasoning, yet lack the domain-specific knowledge required for reliable machine failure diagnosis. To address this, we present AudioFix, a multimodal AI system that helps non-expert users diagnose auditory anomalies in mechanical systems using only a mobile phone. AudioFix consists of an offline annotation pipeline and an online diagnosis pipeline. The offline pipeline processes user-recorded videos with a vision-language model (VLM) and an LLM to extract visual context, temporally localize anomalous sounds, and build a structured database linking faults to observable system states. The online pipeline matches incoming audio against the database to ground an LLM agent that identifies the faulty component, characterizes the failure, and recommends corrective actions. To mitigate errors in LLM-based diagnosis, AudioFix surfaces candidate interpretations for user verification and requests additional input when evidence is insufficient. We evaluate AudioFix through three complementary studies. A multi-hop RAG QA study benchmarks the offline pipeline performance against VLM only and Detect Any Sound Model baselines. An ablation study examines the contribution of each online pipeline component to diagnostic accuracy. A user study with 18 participants evaluates usability, task performance, and cognitive load. We expect that AudioFix will outperform all baselines and meaningfully narrow the expertise gap in acoustic fault diagnosis.

Mentor(s):
Chenfei Zhu (Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1073
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Route-Aware and Uncertainty-Aware Traversability Planning for Safe Detours and Route Rejoining in Agricultural Field Autonomy

STEM
SURF

Authors(s):
Kyungmin Kim† (Engineering|Science)

Abstract:
Autonomous driving in urban environments often relies on structured lanes and well-defined road boundaries. Agricultural vehicles instead operate around crop rows, uneven terrain, and visually open areas that may still be unsafe. This project develops a route-aware and uncertainty-aware planning framework for a utility terrain vehicle that can detect hazards, avoid unsafe route segments, and return to a prescribed global route.

The system combines SegFormer-B0 semantic segmentation with LiDAR-based obstacle detection. It also uses vehicle pose, route progress, and segmentation confidence to construct a local traversability costmap. The costmap represents safe ground, uncertain terrain, vegetation, crop-sensitive areas, and obstacles. The planner identifies unsafe route segments and generates a local detour around them. It then selects a forward rejoining point and guides the vehicle back to the prescribed route. When perception confidence is low or no safe detour is available, the vehicle performs a LiDAR-based safety stop.

To date, we have integrated a QGIS-based route follower with Pure Pursuit control and Dataspeed Drive-by-Wire. We have also implemented LiDAR-based safety stopping and real-time camera segmentation on the UTV. The route follower was improved so that it can locate the vehicle near the middle of a route without restarting from the first waypoint. Field camera data was labeled and used to fine-tune the segmentation model for agricultural environments.

We are now integrating confidence-weighted costmap fusion with local detour generation and route-rejoining logic. The completed system will be evaluated through low-speed field tests and ROSbag replay. Evaluation will examine mission completion, successful route rejoining, crop intrusion, unsafe approaches, false stops, detour distance, and required human intervention. This work moves agricultural autonomy

beyond simple hazard stopping toward safe route recovery under uncertain perception.

Mentor(s):
Fabio Andres Castiblanco Rubio (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1074
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Assessment of Pseudomonas Fluorescens as a Non-Pathogenic Model Invader in Plumbing Systems

STEM
SURF

Authors(s):
Mary C Kirby†

Abstract:
Much is still unknown about the mechanics of invasion into multi-species natural biofilms. An easily traceable invader is useful to explore these dynamics. While planktonic pathogenic organisms are easy to recognize, non-pathogenic organisms often give more insight into the methods of invasion. Pseudomonas Fluorescens, a non-pathogenic bacterium commonly found in soil or freshwater systems, is a potential organism to research invasion dynamics due to its auto-fluorescent abilities. This study follows the growth of Pseudomonas Fluorescens as a model invader alongside natural bacteria found in a model mineral water (Evian). The investigation utilized one-centimeter lengthwise sections of polyethylene and vinyl piping suspended in jars containing 80% nutrient solution and 20% microbe-infested solution to simulate plumbing networks. Three different scenarios included jars with only Evian, both Evian and Pseudomonas Fluorescens, and simply Pseudomonas Fluorescens; all observed with flow cytometry. Pseudomonas Fluorescens was tracked with natural fluorescence fingerprints on no-dye flow cytometry samples, as well as through culturing. Pseudomonas Fluorescens persisted in competitive environments with Evian microbes, and alone; eventually consolidating into biofilms on all pipe materials. However, there were also difficulties with tracking. Thus, Pseudomonas Fluorescens can be used as a model invader in premise pipe systems, though optimization through this work and other experiments is required. Future research will elucidate invasion behavior with non-invasive rapid techniques.

Mentor(s):
Caitlin Rose Proctor (Engineering); Addrita Haque (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1075

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Functionalization of DNA tetrahedra for in vitro testing of siRNA delivery across the Blood-Brain Barrier

STEM

SURF

Authors(s):

Anna Louise Kokosa† (Science|JMHC); Megan Webb‡ (Agriculture)

Abstract:

Drug delivery to the brain is severely limited due to the presence of the highly selective Blood-Brain Barrier (BBB). One potential delivery system is DNA nanostructures, such as tetrahedra (TDN), which are favorable for drug delivery due to their biocompatibility, cost efficiency, and simpler assembly. However, hydrophobic/hydrophilic and electrostatic interactions between DNA and the cell membrane limit cellular uptake of the TDN and cargo. Other delivery systems which used or delivered DNA have shown that functionalization with cholesterol, cationic lipids (DOTMA/DOTAP), or cationic polymers (DEAE-Dextran) can enhance adhesion to the cell membrane or promote cellular uptake. Our work used a large TDN with six full turns between vertices to test this functionalization, giving it the potential to carry large amounts of cargo or deliver large molecules. Cholesterol was covalently bound to the DNA while the cationic lipids and polymers attach electrostatically. The functionalized TDN were then introduced to HEK293 (human embryonic kidney) cells as an initial test and HBEC-5i (human cerebral microvascular endothelial) cells as a closer approximation of the BBB. The cells were stained with the fluorescent dyes Hoechst (nuclei) and DiO (cellular membrane) while fluorescent dye Cy3 was attached to the DNA strands in order to visualize the TDN. The siRNA was similarly visualized using fluorescent dye Cy5.5. The cells were incubated with functionalized TDN for 1 hour and observed using confocal microscopy. The results suggest that functionalization of TDN increases their uptake by and/or adhesion to both HEK293 and HBEC-5i cells. This supports the idea that functionalized TDN are a feasible drug delivery system for biomedical applications. Future steps include testing other types of functionalization and use of a more physiologically relevant transwell BBB model.

Mentor(s):

Grigorii Aleksandrovich Rudakov (Engineering); Tamara L Kinzer-Ursem (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1076
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Learning-Based Projection Methods for Nonconvex Constrained Optimization

STEM
SURF

Authors(s):
Akhil Kota† (Engineering)

Abstract:
Neural networks have been used to solve optimization problems, but if a prediction violates the constraints of the problem, it becomes unreliable. This is particularly challenging with nonconvex constraints since the feasible region can have a complex shape. As a result, direct projection can be very costly. This research studies how to correct neural network predictions to ensure they are reliable and within constraints, even for nonconvex cases.

We developed a projection-based method that creates a simpler, local approximation of a constraint around an anchor point. The original prediction is then projected onto this approximation. Since the choice of the anchor point influences the quality of the approximation, our main focus is on how to select a suitable anchor point. We tested three methods on a nonconvex unit-circle benchmark. These methods include using the raw neural network prediction as the anchor, learning the anchor with a neural network, and a method that utilizes the constraint's geometry to shift the anchor closer to its boundary. All three methods are differentiable, allowing end-to-end training.

We assess the methods using different metrics, primarily prediction error and constraint violation before and after projection. These metrics indicate if the final output is feasible and whether the projection helps or overshoots the correction. Initial experiments show that the projection step can eliminate constraint violations, and the choice of anchor significantly impacts accuracy and feasibility. For engineering and scientific challenges where feasibility is required, this work takes a step toward more dependable neural network optimization methods.

Mentor(s):
Shraman Pal (Engineering); Can Li (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1077
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Creating Connected Pathways in Iron: Engineering Interconnected Porous Networks Through Magnesiothermic Reduction

STEM
SURF

Authors(s):
Emily Danielle Kushner† (Engineering); Helen Sophia Brzozowski* (Engineering)

Abstract:
Raney iron is a porous iron catalyst similar to Raney nickel and other skeletal metal catalysts. Although less widely used than other Raney metals, Raney iron has a range of industrial applications, particularly in hydrogenation and Fischer–Tropsch synthesis. Because catalytic performance increases with surface area, significant research focuses on producing metal catalysts with controlled porosity. This work investigates a new method for producing porous iron through the magnesiothermic reduction of iron oxide, which offers greater control than previously explored approaches. The first phase of research began with the Iron powder being oxidized in a tube furnace to produce a 5–10 um thick surface layer consisting primarily of FeO. The oxidized powder was then reduced in a mixed bed with magnesium at temperatures greater than 600C, producing particle surfaces containing Fe and MgO. The MgO was selectively removed using acetic acid, leaving a porous iron surface. X-ray diffraction confirmed complete reduction of the oxide layer and successful removal of MgO. The second phase of this research will determine the specific surface area (SSA) of the porous iron using Brunauer–Emmett–Teller analysis to quantify porosity. It is expected that lower reduction temperatures will minimize sintering, resulting in higher SSA. Consequently, reduction at 600C for sufficient time is expected to produce the highest surface area and, therefore, the greatest catalytic performance.

Mentor(s):
Joseph Flanagan (Engineering); Jihoon Park (Engineering); Sudipta Mondal (Engineering); Kenneth H Sandhage (Engineering); Kevin P Trumble (Engineering)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1078

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Teaching AI to See Past Style: A Reproducible CAPTCHA-Style Tool for Curating Invariant Image Pairs

STEM

SURF

Authors(s):

Andre Lee† (Engineering); Akshith Garapati‡ (Engineering)

Abstract:

Prevalent vision foundation models learn a broad understanding of images, yet classifiers fine-tuned on them tend to make incorrect predictions in new settings by exploiting spurious correlations: patterns that hold in training data but fail when settings change. Geometric Robustness via Invariant Training (GRIT) offers a data-driven remedy. From a small set of invariant pairs (image pairs sharing a semantic label but differing in spurious, domain-specific traits), GRIT identifies parts of the model's image recognition reflecting style rather than subject and constrains a final classifier to ignore them. Accuracy depends critically on the number and semantic consistency of invariant pairs, yet no scalable, reproducible method exists for sourcing them. Automated pairings are often semantically inconsistent, while ad-hoc manual curation lacks structure for reproducibility and data transparency. We developed a browser-based, CAPTCHA-style annotation application, demonstrated on the PACS benchmark of 9,991 images, four domains (e.g., photo, sketch), and seven classes (e.g., dog, house). The application presents reproducible, auditable rounds of randomly selected anchor images beside grids of same-class, different-domain candidates. A human curates cross-domain invariant pairs (e.g., a dog photo and dog sketch); the application logs response times, annotations, and metadata to reconstruct each choice. We present a functional, reproducible collection pipeline and an initial set of 1,000 human-validated invariant pairs from PACS (3x3 grid), with response times across grid sizes. Invariant pair evaluations within GRIT are expected to demonstrate superior classification accuracy (average and worst-group) over baselines. A human-supervised CAPTCHA provides a scalable, auditable source of semantically consistent invariant pairs and ground truth for validating automated pair curation, accelerating development of model reliability in novel scenarios.

Mentor(s):
David Iseri Inouye (Engineering); Easton Luke-Earl Currie (Engineering); Mingyu Kim (Engineering)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1079

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Air Quality Modeling: Incorporating Stable Isotopes into the US-EPA CMAQ Air Quality Model

STEM

SURF

Authors(s):

Sooji Lee† (Science); Samin Sanjana‡ (Science)

Abstract:

The change in oxygen isotope abundances (delta-18O), which reflect subtle variations in oxygen atom weight, of nitrate in rainwater and fine particles provide key constraints on how the atmosphere chemically transforms nitrogen oxide pollutants (NOx) emitted by vehicles and industry. However, existing 3D atmospheric models cannot follow each individual oxygen atom through chemical reactions, making it impossible to directly simulate these isotope values and connect them to the underlying chemistry and observed delta-18O in atmospheric nitrates. Here we develop a new isotope-tracking chemical mechanism for the Community Multiscale Air Quality (CMAQ) model, starting with NOx-focused chemistry and progressively expanding to a broader set of atmospheric reactions, that explicitly distinguishes light oxygen (16O) from heavy oxygen (18O) through every reaction step, including both daytime and nighttime chemistry and the conversion of NOx into gaseous nitric acid (HNO3) and then into particles. To maintain computational efficiency while conserving isotope and mass balance, we limit each molecule to at most one heavy oxygen atom. The mechanism was validated in a stepwise progression, first testing core NOx chemistry and then expanding to additional species, across single-cell box, full-column, and 3x3 grid simulations, confirming isotope conservation and numerical stability at each stage. This is the first time oxygen isotopes have been tracked atom by atom in a 3D atmospheric model, unlike previous approaches that estimated isotope values indirectly, offering a new tool to connect isotope measurements with atmospheric oxidation chemistry and emission source identification.

Mentor(s):

Greg M Michalski (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1080
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Design, analysis, and fabrication of elastic light scattering system for airborne particulate matter

STEM
SURF

Authors(s):
Woojun Lee† (Engineering)

Abstract:
Airborne particles pose significant health and environmental risks because small suspended matter can penetrate deep into the respiratory system and vary rapidly with location and time. Although commercial particle sensors exist, the relationship between optical layout, detector sensitivity, noise, and measurable scattering response remains important to understand for compact sensing systems. This project investigates whether a controlled light source and single photodetector can produce a repeatable electrical signal from scattered light caused by particles passing through a defined sensing volume. The system was developed by selecting an LED source and positioning a regular photodiode and avalanche photodiode (APD) to measure and compare their sensitivity. Measurements are planned under dark, clean-air, and particle-present conditions to separate scattering response. Output voltage, noise level, and signal ratio will be analyzed to evaluate sensitivity. The work connects optical alignment, detector biasing, circuit design, and fabrication into one experimental platform, providing a practical basis for studying particulate detection and comparing standard photodiode and APD performance in low-light measurement conditions. Expected outcomes include design guidelines for component selection, enclosure geometry, and future calibration workflows.

Mentor(s):
euiwon Bae (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1081
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

ML-Based Unsupervised Segmentation of Synchrotron XRF Data to Identify Metal Patterns in AD and Healthy Brain Tissue

STEM
SURF

Authors(s):
Zonghan Lei† (Science|JMHC)

Abstract:
Metals have long been linked to neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease, yet the microscopic processes connecting metal buildup to brain cell damage and neuropathology remain poorly understood. Investigating these relationships requires mapping the complex chemical microenvironment of diseased tissues. Synchrotron micro-X-ray fluorescence (μXRF) is an advanced technology to map multiple-metals and trace elements with nanoscale resolution. This research presents a framework that uses unsupervised machine learning to automatically group high-resolution synchrotron μXRF imaging data for concentration mapping of over 20 elements into biologically meaningful categories. We implemented a clustering algorithm on high-dimensional data derived from human tissue samples. This algorithm grouped thousands of micrometer scale individual pixels for human brain tissue into distinct chemical signatures based on their unique elemental compositions. These calculated categories were then projected back onto spatial coordinates to create color-coded maps, visually revealing the distribution of the tissue's underlying chemistry. Our framework successfully identifies complex elemental combinations, pinpoints localized toxic heavy metal buildups, and uncovers recurring patterns for diseased and normal tissue across samples. By transforming raw, highly complex data into an easy-to-read map of elemental distribution patterns, this methodology provides a scalable approach to discovering new biomarkers and advancing our understanding of the association of brain metal deposition and neurodegenerative diseases.

Mentor(s):
Linda Nie (HHS)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1082

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

In-Situ Pharmaceutical Production Platform with Mycoponic™ : Environmental Optimization of Pleurotus Exudate Yield

STEM

SURF

Authors(s):

Ana Sofia Leiva Aldana† (Agriculture|Engineering)

Abstract:

Fungal exudation in Pleurotus ostreatus is an underexplored process with value for pharmaceutical biomanufacturing and natural product discovery. Previous exudate analyses identified lovastatin, ergothioneine, and ergocalciferol, suggesting fungal exudates may concentrate medically relevant compounds. However, the environmental triggers of yield and metabolite concentration remain poorly understood. This project aims to improve fungal pharmaceutical production by identifying conditions that promote exudate formation in Mycoponics™. Using P. ostreatus, this study will evaluate how culture age and humidity affect exudate production. Mycoponics™ enables non-destructive growth and repeated exudate harvesting from a single ceramic culture. A 2 × 2 factorial design will compare mature five-month-old tubes with newly inoculated tubes under dry humidity, 30–60% RH, or high humidity, 80–99% RH. Sixteen tubes will be used across four conditions, with four replicates per condition. All treatments will remain under fixed dark conditions, controlled temperature, controlled CO_2, and active gas exchange, since exudophore-like morphologies have been observed under dark conditions with gas exchange. Exudate production will be monitored daily by measuring total exudate volume per tube and normalizing output to daily nutrient media input. Delivered media, consumed media, and recovered exudate will be compared to assess how P. ostreatus manages water under humidity treatments. Measurements include wet biomass, target compound concentration, qualitative morphology, and 3D scan-derived mycelial volume every two weeks or at the final 6–7 week endpoint. Density will be calculated from wet mass and 3D volume. DESI-MS will explore fungal exudate chemistry and identify drug-relevant compounds. By optimizing exudate yield and purity, this work may support pharmaceutical production, controlled-environment biomanufacturing, agricultural biotechnology, and future in-situ medicine production.

Mentor(s):
D. Marshall Porterfield (Agriculture|Engineering); Richard John Barker (Agriculture|Engineering)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1083
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Exploring the Existence of Atmospheric Blocking's Precursor Patterns with Physics-Informed Explainable AI

STEM
SURF

Authors(s):
Zhixin Li† (Science)

Abstract:
Atmospheric blocking refers to persistent, large-scale high-pressure systems that stall the normal eastward march of midlatitude weather, prolonging extreme events such as heat waves, cold spells, and floods. Despite their societal impact, forecasting when blocking will begin remains difficult, and the atmospheric signals that precede blocking onset are poorly understood. Recent machine learning models can predict blocking but act as black boxes, leaving open whether they capture physically meaningful precursors. This study asks whether robust, interpretable precursor patterns exist for blocking onset, and whether they differ among the main blocking types: ridge, trough, and dipole. To create a clean testbed, we generate long simulations from an idealized two-layer quasi-geostrophic model that captures the essential dynamics of the midlatitude atmosphere. Blocking events are detected and classified using a local wave activity method. We then train a convolutional neural network to predict blocking onset from earlier atmospheric fields and apply explainable AI methods, including gradient-weighted class activation mapping (XGradCAM) and layer-wise relevance propagation, to reveal the spatial patterns the model relies on for each blocking type. Across ridge, trough, and dipole blocking, the model consistently identifies same-sign vorticity anomalies as the dominant precursor, indicating that the organization of like-signed rotation is a shared ingredient of block formation. This work provides a physically interpretable framework for diagnosing blocking precursors and predictability limits in an idealized setting, offering guidance for interpreting and ultimately improving blocking forecasts in the real atmosphere.

Mentor(s):
Lei Wang (Science)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1084
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Tracking and Evaluating Beneficial Microbial Establishment in Hydroponic Systems

STEM
SURF

Authors(s):
Somi Lim† (Agriculture|Engineering)

Abstract:
Hydroponic systems efficiently recycle water and nutrients, but their interconnected water systems can facilitate the rapid spread and establishment of undesirable microorganisms. Beneficial microbial inoculants have the potential to promote plant growth, suppress pathogens, and improve microbial stability. However, there is limited understanding of how to effectively introduce and maintain beneficial microorganisms in hydroponic systems. Current direct inoculation methods may require repeated applications to maintain beneficial microorganisms over time. As an alternative, biofilm-coated materials and biofilters could provide a more sustained source of beneficial microorganisms within hydroponic systems.

To evaluate these strategies, a reliable method is needed to determine whether detected microbial cells originate from the inoculum or from the existing background community. This enables evaluation of appropriate inoculation concentrations and microbial establishment within filter-based systems. A small-scale Kratky lettuce system was established as a simplified hydroponic model. Pseudomonas fluorescens, an autofluorescent plant-beneficial microorganism, was inoculated into the nutrient solution. Microbial abundance was monitored using flow cytometry to evaluate bacterial growth and the feasibility of tracking the introduced organism. Plant growth was also monitored to assess potential inoculation effects. In parallel, a Brita granular activated carbon (GAC) filter was tested in a recirculating setup to evaluate bacterial establishment and persistence within the filter.

This study is expected to identify an appropriate microbial inoculation concentration for evaluating plant growth-promoting effects and to support the development of methods for tracking introduced microorganisms in hydroponic water systems. Overall, this work may provide a foundation for developing and assessing microbial seeding strategies in hydroponic production.

Mentor(s):
Caitlin Rose Proctor (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1085
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

CoReason: Human-Agent Co-Reasoning in AR-Assisted Physical Tasks

STEM
SURF

Authors(s):
Bingyi Liu† (Engineering|Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Chenfei Zhu (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1086
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Synthesis of novel ligands to improve reactivity and selectivity of organometallic reactions through electric field catalysis

STEM
SURF

Authors(s):
Sophia D Madrazo† (Science)

Abstract:
Ligands are organic molecules that attach to a metal catalyst to control and improve its reactivity and are ubiquitous in organic synthesis due to their applicability to nearly any metal-catalyzed reaction. One shortcoming of current ligands is limited ability to control chemical selectivity, the ability to favor one potential product over others, in certain reaction classes. This limits the utility of ligands in fields where selectivity is critical, such as the pharmaceutical and agrochemical sectors. According to preliminary computational studies and literature precedent in simple redox reactions, electric fields have the potential to control chemical selectivity in a variety of complex organic reactions. We propose to address the challenge of selectivity by designing and synthesizing charged ligands for transition metal catalysts so we can custom-fit electric fields to a wide variety of organic reaction classes.

We have developed synthetic pathways for an initial suite of thirteen ligands based on known transformations. These thirteen ligands are based on installation of charge tags on two common and versatile ligand structures: pybox and salen. So far, we have synthesized eight out of the thirteen ligands and are refining the synthetic approaches to the remaining five. Upon completion, we will apply these ligands to different reaction systems that employ pybox and salen ligands but show little to no selectivity. We will use NMR and fluid chromatography to quantify the percent conversion of starting material to product and the ratio of different kinds of products formed from reactions using the ligands. This will allow us to explore and demonstrate efficacy of the ligands and to gain insight into their mechanisms of action. This knowledge could expedite the reaction design process in the pharmaceutical and agrochemical sectors and allow for broader application of ligands in industrial processes.

Mentor(s):
Anna Elizabeth Davis (Science); Gabriel Jordan Lovinger (Science)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Other Acknowledgement(s):
Maison Claire Hardin (Science); Kelton James Radefeld (Science); David Matthew Czerwonky (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1087
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

A Tuberculosis Infection and Treatment ODE Model Investigating the Pharmacodynamics of Inhaled Antibiotics on Human Granuloma

STEM
SURF

Authors(s):
Aidan Josef Monark† (Engineering)

Abstract:
Tuberculosis (TB) remains the deadliest infectious disease worldwide. Despite the existence of antibiotics that significantly lower mortality, drug resistant Mycobacterium Tuberculosis (Mtb), a large design space for treatment, and antibiotic toxicity all remain pertinent challenges to TB treatment. Recent research has provided promising evidence that inhaled formulations of TB antibiotics may more effectively target TB infection lesions in the lungs compared to standard oral dosing; however, little is known about how the immune cell populations, drug concentration, and Mtb bacterial burden change with an inhaled antibiotic treatment regimen. We investigated these outcomes by adapting an ordinary differential equation (ODE) model to quantify the cell levels, cytokine concentrations, and antibiotic concentrations throughout an Mtb infection lesion treated with inhaled antibiotic therapy. We found that the ability of antibiotics to eradicate extracellular bacteria was a strong contributor to infection sterilization, and that the ability of antibiotics to kill bacteria living in macrophages does not significantly affect the treatment outcome. This work enhances our understanding of inhaled antibiotic efficacy at the TB pulmonary site of infection. Further research into inhalable antibiotic drug delivery devices and later clinical trials are necessary future steps to see this treatment option come to fruition.

Mentor(s):
Kali Nicole Konstantinopoulos (Engineering); Trevor Jaan Shoaf (Engineering)

Other Acknowledgement(s):
Lipi Roy (Engineering); Elsje Pienaar (Engineering)

Poster Presentation Abstract Number: 1088
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Selective Delamination of Lithium-Ion Battery Cathodes Using Mild Alkaline System for Direct Recycling

STEM
SURF

Authors(s):
Sohyun Moon† (Engineering)

Abstract:
Direct recycling of lithium-ion batteries (LIBs) is a less destructive recycling route that aims to recover active materials while preserving their original crystal structure and activity. However, current approaches are still challenged by unknown degradation history, low purity, and complex separation processes that may damage electrochemical performance. In this project, an alternative cathode recovery method using a synergistic mild alkaline approach was investigated for selectively delaminating lithium-ion battery cathode materials from aluminum current collectors, thereby reducing the need for harsh chemical treatment and complete material resynthesis. Sodium citrate was used to create a weakly alkaline environment through hydrolysis, which can disrupt the aluminum oxide layer and expose the underlying aluminum foil while in combination to chelate the dissolved aluminum species, which leads to effective aluminum dissolution evidenced by hydrogen gas evolution and aluminum-containing salt formation. The results show that the optimal condition was a saturated sodium carbonate/sodium citrate mixture at a 4:6 ratio, treated at 90°C with a 10 g/L solid-to-liquid (S/L) ratio, which dissolved the aluminum layer from commercial cathodes within one hour. The active layers were collected and grounded into more uniform particles through short ultrasonication, then dispersed in acetone to separate active particles from carbon black and PVDF-rich particles. The collected active layer mixture also showed potential for reuse without complete component separation. This approach shows potential as a cheap, environmentally friendly, and selective recycling method for all aluminum current collector cathodes.

Mentor(s):
Mahmudul Hoq (Engineering); Hosop Shin (PWL)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1089
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Evaluating Biofilm-Contaminant Interactions in Water Distribution Systems After Emergencies and Disasters

STEM
SURF

Authors(s):
Keira Alexandra Murphy† (Engineering)

Abstract:
Wildfires and other incidents can cause contaminants to enter water distribution systems, posing risks to public health. Contaminants such as ash, which may include inorganic and organic compounds, can enter these systems, and their persistence and removal can likely be complicated by biofilm present on pipe walls. Limited knowledge in this area impedes the development of appropriate safety protocols and efficient allocation of resources for post-incident infrastructure recovery. This study uses a literature review to identify the contaminants commonly present in fire pollutants, characterize contaminant fate and transport within water distribution systems influenced by biofilm, and then develops a simulated drinking water distribution system to evaluate biofilm-contaminant interactions. The literature indicates that fire-produced ash can contain asbestos, metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). Literature suggests that particulate contaminants will adsorb on biofilms in a size-dependent manner. VOCs can potentially diffuse into biofilms based on their physicochemical properties, such as hydrophobicity and polarity. A simulated water distribution system was conducted to test these mechanisms by growing biofilm under controlled conditions to assess contaminant interactions. Findings are expected to inform monitoring protocols for water systems following natural disasters, thus supporting more effective public safety measurements during post-incident recovery.

Mentor(s):
Paula Belmont Coelho (Engineering); Andrew Whelton (Engineering)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1090
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Bringing Low-Light 3D Reconstruction Online: Toward Real-Time Visual SLAM for Drones

STEM
SURF

Authors(s):
Srinath Eswaran Neelamagam† (Science)

Abstract:
Autonomous 3D reconstruction in low-light conditions is important for applications such as search and rescue, security, and defense. Existing visual SLAM systems depend on well-lit imagery. However, they perform poorly in the dark, as visual features become unreliable due to high sensor noise. Recent work (Dark3R) showed that LoRA adaptation of the MASt3R vision transformer enables 3D reconstruction in low-light, but Dark3R operates only in offline batch mode, which requires all images upfront. This is incompatible with real time deployment on a robot. What remains unknown is whether this low-light capability can be brought online into a real-time SLAM system and deployed on resource-constrained hardware such as drones. Our research question is which reconstruction backbone provides the best tradeoff between low-light reconstruction accuracy and inference speed for edge deployment. As a first step, we confirmed that reconstruction degrades in low light using the Dark3R dataset, where camera pose translation error increases 4.7× from 1/500s exposure to 1/3200s exposure. We then merged Dark3R's low-light LoRA weights into the base MASt3R model and integrated the result into MASt3R-SLAM, a real-time SLAM pipeline. In preliminary tests on self-captured indoor scenes across three measured brightness levels, the merged low-light model recovered scene geometry that the base model failed to reconstruct in the dark, while running at equivalent speed. This study will systematically compare reconstruction accuracy, inference speed, and deployment feasibility across backbones, including optimization for computers such as the NVIDIA Jetson, in order to recommend the most viable low-light SLAM pipeline for drone deployment. The expected outcome is a real-time low-light visual SLAM system deployable on drones that autonomously maps 3D environments.

Mentor(s):
Shrikrishna Bhagirath Rajule (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1091
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Investigating Acute Responses to Mild Blast Traumatic Brain Injury in an in vitro Human Tau-Expressing Neuronal Model

STEM
SURF

Authors(s):
Natalia Nino Cocoma† (Vet Med)

Abstract:
[Abstract Redacted]

Mentor(s):
Jhon Edison Martinez (Engineering); Riyi Shi (Vet Med)

Other Acknowledgement(s):
Nikita Krishnan (Engineering); Casey Erin Adam (Vet Med); Man Chen (Engineering); Jorge Enrique Neira Garcia (Engineering)

Poster Presentation Abstract Number: 1092

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Exploring the Structure and Function of Ceg14, a Legionella pneumophila Effector Protein, and its Binding Partners

STEM

SURF

Authors(s):

Isabel M Owens† (Science)

Abstract:

Legionella pneumophila is the bacterium responsible for Legionnaires' disease, potentially fatal pneumonia in immunocompromised individuals. To infect host cells, the bacterium secretes over 330 effector proteins that hijack host cellular processes. One such effector, Ceg14, is an actin-activated ATPase. Additionally, L. pneumophila secretes a regulatory protein, LegA11, which has been shown to inhibit Ceg14's enzymatic activity. This research investigates the mechanism by which Ceg14 is activated by actin and inhibited by LegA11. Recent structural studies in the Das lab, using cryo-EM, identified several regions of Ceg14: a flexible loop region within the enzyme and the C-terminal helix as being important for actin engagement. We hypothesized that total or partial deletions of this loop region would likely impact the enzymatic activity potentially by impairing the protein's ability to bind actin and subsequent activation. To investigate this, we evaluated multiple Ceg14 constructs, including loop deletion, loop truncations, charge-reversal mutations, and C-terminal truncation to test the role of these structural elements on the activity of the Ceg14. We recombinantly expressed these different constructs of Ceg14 in E. coli followed their purification using Ni2+-affinity chromatography. The purified proteins were evaluated for their ATP hydrolysis activity by High-Performance Liquid Chromatography (HPLC). Given that wild-type Ceg14 is toxic to yeast cells, yeast toxicity assays were also performed to evaluate their effect on yeast cells. Preliminary results show that these loop mutations not only abrogated yeast toxicity but also affected the protein's ability to hydrolyze ATP suggests that both the flexible loop and the C-terminal helix of Ceg14 play a critical role in actin binding and therefore Ceg14 activation. Together, these experiments provide a deeper understanding of the structural dynamics between Ceg14 and its binding partners.

Mentor(s):

Shalini Iyer (Science); Chittaranjan Das (Science); Nuela Enebechi (Engineering)

Other Acknowledgement(s):
Dhanapala Mudiyanselage Jayamini C Gunaratne (Science); Laura Mae Sanford (Pharmacy)

Poster Presentation Abstract Number: 1093

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Physics-Incorporated Digital Twin for Internal and External Weld Feature Prediction in Friction Stir Spot Welding

STEM

SURF

Authors(s):

Minho Park† (Engineering)

Abstract:

Friction stir spot welding (FSSW) is a solid-state process in which a rotating tool generates frictional heat and mechanical pressure below the melting temperature for joining overlapping sheets. Tool rotation, plunging, dwelling, and retraction determine the final internal and external weld characteristics, including pinhole morphology and weld zone area. However, conventional post-weld cross-sectional micrograph measurements capture only the final surface or a single internal plane and cannot show the real-time three-dimensional evolution of weld geometry, limiting transient interpretation of process parameter influence on joint formation and weld quality. Therefore, this study develops a Unity-based digital twin framework that calibrates experimental FSSW process and geometric data to predict developments in pinhole geometry and cross-sectional weld zones. Spindle speed, plunge depth, and dwell time were mapped to the virtual process-controlled tool motion, while measured weld geometry informed transient mesh deformation of overlapping plates from tool rotation and translation. The finalized model linked real world data with simulation outputs via user interface (UI) to compare predicted and actual weld features. Predictions showed approximately 90% similarity to experimental weld data, reproducing key internal and external features. Modular scripts and GPU-based deformation processing reduced CPU workload by approximately 37%, enabling stable real time operation on high performance workstations and standard office laptops. The framework advances FSSW digital twins beyond visual reproduction and toward experimentally and physically informed weld features. Future integration with live machine data and sensor signals will enable continuous model updating, real time quality monitoring, and adaptive process parameter optimization.

Mentor(s):

Martin Byung-Guk Jun (Engineering); Junmyoung Jang (Engineering)

Other Acknowledgement(s):

Du Ju Lee (Engineering); Jongwoo Han (PWL)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1094

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Extraction and Purification of Elastin-Like Polypeptides for Layer-by-Layer Nanoparticle-Mediated mRNA Delivery

STEM

SURF

Authors(s):

Yixuan Ren† (Science); Hayden Schneider* (Science|JMHC); Steven Quocviet Phan* (Pharmacy)

Abstract:

The current nucleic acid delivery vehicles have safety and manufacturing problems. Our new Layer-by-layer nanoparticles (LENN) have gained attention as a versatile delivery method, because they can improve mRNA targeting, stability and be easily stored. Elastin-like polypeptides (ELP) is one of the components of LENN allowing to target tumor cells. To identify the ELP variant with the highest targeting and retention efficiency, this study purified four different ELP variants and evaluated their properties for future tumor cell studies. The Four ELP variants, labeled as F, H, V and W were expressed in E. coli. and extracted with different combinations of organic solvents. The proteins were subsequently purified using size-exclusion chromatography. Gel electrophoresis was run to evaluate protein purity and verify the molecular weights. Preliminary purification and characterization indicate successful ELP, with gel electrophoresis analysis demonstrating protein bands corresponding to the expected molecular weights. Ongoing work is focused on optimizing protein extraction solvent and purity to generate enough for downstream nanoparticle formulation and in vitro cell studies. The successful extraction, purification, and characterization of these ELPs establishes an essential foundation for the development of LENN nanoparticles for mRNA delivery. By producing well-characterized protein components, this work supports future studies evaluating nanoparticle assembly, cellular delivery, and the therapeutic potential of mRNA-based treatments for bladder cancer.

Mentor(s):

Joydeep Rakshit (Science); Saloni Darji (Science)

Other Acknowledgement(s):

David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1095

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Characterization of Strain Acquisition in Thermoreversible Acrylic Gels Using Rheo-Particle Image Velocimetry

STEM

SURF

Authors(s):

Zachary Ryan Roeder† (Engineering)

Abstract:

Soft materials, such as polymer melts, gels, colloidal suspensions, and biological tissues, derive their mechanical behavior from the balance of stored and dissipated deformation energy. Rheology provides the foundational backbone for characterizing this behavior, and informs both fundamental structure-property relationships and industrial processing decisions. While conventional rheological techniques, such as small-amplitude-oscillatory-shear, are effective for understanding linear viscoelasticity, they often prove insufficient when attempting to understand real-world material behavior in the transient nonlinear regime. Recovery rheology addresses this gap by decomposing the total strain experienced by a material into recoverable and unrecoverable components. This framework has proven valuable both for characterizing and modeling complex yield-stress fluids in oscillatory shear, yet recovery measurements thus far have lacked the visual component required to observe heterogeneity during material recovery. In this work, particle image velocimetry (PIV) was used to visualize the recoverable strain acquired in PMMA-PnBA-PMMA triblock copolymer gels during constant rotational shear. This method successfully elucidated recovery in the triblock gel and revealed the presence of heterogeneities during fracture. To our knowledge, this represents the first application of PIV for the visual characterization of recovery events, marking a step forward in the field of recovery rheology through the addition of flow visualization.

Mentor(s):

Kendra A Erk (Engineering); Evan R Williams (Engineering); Matthew Kaboolian (Engineering)

Other Acknowledgement(s):

Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1096

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Characterization of Dual dsDNA tetrahedra assembly conditions

STEM

SURF

Authors(s):

Nasser H Sanwari† (Engineering|Science); Rebecca Rose Phelan* (Engineering)

Abstract:

The high selectivity of the blood-brain barrier makes it difficult to deliver drugs and other therapeutics to the brain for neurological disorders. Nanoparticles have shown great promise in crossing the BBB due to their size. In particular, DNA tetrahedra (TDN) nanoparticles show great promise due to their biocompatibility, programmability, structural stability, and ability to carry cargo. TDNs are commonly assembled through the annealing of separate but partially complementary DNA strands in an aqueous buffer containing magnesium acetate. The aim of this study is to discover how magnesium concentration, DNA concentration, circularization of the central DNA strand, and annealing regime affect the assembly yield of the TDN. In order to characterize these factors, a dual double stranded DNA (dsDNA) tetrahedra was used. Both linear and circularized TDNs were prepared with magnesium acetate concentration from 0 to 80 mM and DNA concentration from 50 to 800 nM. Additionally, three separate annealing regimes, ranging from only 5 minutes at 95 C to slow annealing in a boiling beaker over 72 hours, were tested on all TDN samples. Once prepared, the samples were loaded into an native polyacrylamide gel and allowed to run for 2 hours at 80 V. The yield was measured using FIJI imaging software. The results of this study found that the highest yield of the TDN occurs with a circularized central strand that slowly anneals over 72 hours. Additionally, as DNA concentration was lowered and magnesium acetate concentration was increased, TDNs formed at a higher yield. The methods used in this project can also be used to optimize yield of other TDN structures.

Mentor(s):

Grigorii Aleksandrovich Rudakov (Engineering); Tamara L Kinzer-Ursem (Engineering); Leopold Noel Green (Engineering)

Other Acknowledgement(s):

David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1097

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Characterization of the Separation via Reverse Osmosis in Chemicaloric Refrigeration Cycles

STEM

SURF

Authors(s):

Rohan Ashish Shrowty† (Engineering)

Abstract:

With heating and cooling buildings accounting for roughly 35% of U.S. energy consumption, chemicaloric refrigeration has recently been proposed as a promising high-efficiency alternative to traditional HVAC vapor compression cycles. Traditional vapor compression cycles, while relatively simple to construct, are inefficient at scale and rely on refrigerants with extremely high global warming potentials. By contrast, chemicaloric cycles rely on solvent-solute interactions such as endothermic dissolution or freezing point depression to increase the coefficient of performance (COP). Electrodialysis (ED) has been proposed in the past for separating the ion mixture, the critical step for cycle operation. However, Reverse Osmosis (RO) has demonstrated higher efficiency among a broader range of applications.

Here, we characterize the performance of RO separation for application within a chemicaloric refrigeration cycle. A baseline solution of distilled water and NaCl was first used to validate an RO test cell used for experimentation. Permeate flux and salt rejection were determined for multiple membranes and working fluids as key indicators of membrane separation performance. A test system was also built to continuously operate RO in a cyclical manner, allowing for long-term performance testing.

This experimental setup provides a systematic method to identify the optimal working fluids, salt concentrations, and operating pressures needed to prevent membrane compaction or scaling. Ultimately, this work validates the feasibility of RO integration within chemicaloric cycles and informs material selection for future lab-scale chemicaloric prototypes.

Mentor(s):

David Warsinger (Engineering); Mateo Roldan Carvajal (Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1098
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

A Foundation Model Approach to Crop Monitoring and Agroecosystem Analytics

STEM
SURF

Authors(s):
Udaiveer Singh† (Agriculture|Engineering)

Abstract:
Earth observation satellites collect images of crops across millions of acres, but satellite images alone cannot directly reveal important crop conditions such as biomass, water stress, or growth stage. Obtaining this information traditionally requires labor-intensive field measurements that are expensive, time-consuming, and difficult to collect at large scales. This limits the ability to monitor crop health and forecast yields early in the growing season.

This work presents a framework that teaches an Earth observation foundation model, trained on satellite and climate observations, how crops grow without requiring field measurements during deployment. Instead of manually collecting crop measurements, the Agricultural Production Systems sIMulator (APSIM) is used during training to automatically generate estimates of leaf area index, aboveground biomass, water stress, yield and phenological stage for corn and soybean. These simulated crop variables act as automatically generated training labels, allowing the model to learn the relationship between satellite observations and crop physiology. Once trained, the foundation model operates using only satellite imagery and climate observations.

To support this approach, a county-level multimodal dataset covering Iowa, Illinois, and Indiana from 2017 to 2023 was curated by combining optical and radar satellite imagery, climate variables, and USDA county yield records across 934 corn and 929 soybean county-years. The trained foundation model is then fine-tuned for early-season yield forecasting with USDA yield labels as ground truth. Evaluated using R2, RMSE, and Pearson correlation under a leave-one-year-out protocol, the framework consistently outperforms a satellite-only baseline, with the largest improvements at the earliest prediction dates. This approach enables scalable, interpretable crop monitoring and earlier yield forecasting without requiring field measurements or crop simulation during deployment.

Mentor(s):
Rajiv Ranjan (Agriculture|Engineering); Dharmendra Saraswat (Agriculture|Engineering)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1099
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

A Color-Sensing Tactile Sensor for Combined Shear and Normal Force Detection in Robotic Applications

STEM
SURF

Authors(s):
Paul Shannon Slack† (Engineering|Science)

Abstract:
Robots that physically interact with their environment, such as those used for grasping and manipulation, rely on tactile sensing to avoid damaging objects or losing grip. However, most existing tactile sensors are limited to detecting normal force and cannot detect shear force, even though shear is critical information for detecting slip and adjusting grip in real time. Optical tactile sensors capable of better force sensing typically rely on full camera imaging systems, which are bulky and constrain where they can be integrated on a robot. This research aims to develop a compact tactile sensor that detects both shear and normal force by pairing a color-detecting chip with a material that changes color under applied force, offering a smaller alternative to camera-based optical sensors. The current phase of the project is focused on sensor design and validating the underlying sensing function. The color-detecting chip has been tested by presenting it with different colored objects and confirming that the chip correctly identifies and outputs the color it observes. This validates the core sensing function ahead of integrating a force-responsive, color-changing material into the sensor. Future work will identify and characterize a suitable color-changing material and calibrate the sensor's color output against known applied shear and normal forces. This research works toward a compact tactile sensor capable of distinguishing shear and normal force, which could improve robotic manipulation by enabling smaller, more versatile tactile sensing across a robot's body.

Mentor(s):
Md Rakibul Islam Prince (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1100

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Using UAV-Based Hyperspectral and LiDAR to Estimate Leaf Area Index in Maize

STEM

SURF

Authors(s):

Daniela Solarte Rodriguez† (Engineering)

Abstract:

Leaf Area Index (LAI), the total leaf surface area per unit ground area, is a key input for crop growth models that predict biomass and yield. The most consistent LAI measurements come from direct, destructive sampling, which is labor-intensive and impractical for repeated monitoring across large fields. Prior studies have shown that structural (LiDAR) and spectral (hyperspectral) data fusion from Unmanned Aerial Vehicles (UAVs) can predict LAI with accuracy comparable to non-destructive field measurements, offering a scalable alternative to destructive sampling. However, it remains unclear how well this approach generalizes beyond the conditions under which it was originally developed. This study implements an existing UAV-based framework using hyperspectral reflectance data with LiDAR-derived structural features on new short-stature and tall-stature hybrids during the 2026 growing season. This project will evaluate whether hyperspectral and LiDAR features can support robust, scalable LAI estimation beyond the conditions under which the original model was developed. Field data are being collected at Purdue's Agronomy Center for Research and Education (ACRE) on these two hybrids. Ground-reference LAI is measured at each major growth stage with a handheld plant canopy analyzer (LAI-2200C) and destructive sampling with a leaf area meter (LAI-3100C), while UAV-based hyperspectral and LiDAR data are collected weekly over the same plots. Vegetation indices and structural features extracted from the imagery will be used to train and cross-validate a Support Vector Regression model, following the framework developed in 2023. This will determine whether the model can reach accuracy consistent with previous work when applied to different hybrids, nitrogen rate and growth stages and, answer the question of whether a single translation model can be applied across breeding and management conditions or whether condition-specific recalibration is needed.

Mentor(s):
Lena Azimi (Engineering); Guinan Guo (Engineering); Melba M Crawford (Agriculture|Engineering)

Other Acknowledgement(s):
Pramod Sunil Parande (Engineering); Jorge Enrique Neira Garcia (Engineering)

Poster Presentation Abstract Number: 1101
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Peri-wound Microvascular Function and the Feasibility of Heat Therapy in Patients with Neuroischemic Foot Ulcers: Pilot Study

STEM
SURF

Authors(s):
Robert Scott Sorensen† (HHS)

Abstract:
[Abstract Redacted]

Mentor(s):
Bruno Tesini Roseguini (HHS)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1102
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Synthesis of Dual-Action Inhibitors of HDAC-III and HIV Protease

STEM
SURF

Authors(s):
Nicholas Audrie Steeves† (Science)

Abstract:
New HIV infections number up to 32,000 people per year, primarily in rural locations with little access to medication. While HIV is largely treatable, consistent access to the antiretroviral therapies (ART) that prevent immune system destruction are bounded by geographical location and health care factors and require lifelong dosing to remain effective. This is largely due to a 'latent reservoir' of HIV-infected cells in the body that cannot be targeted by the immune system. Therefore, developing drugs that decrease this reservoir are steps to a lifelong cure for HIV.

We targeted both a viral life cycle protein, HIV Protease, and an expression protein, HDAC-3, to prevent new infections while forcing the reservoir out of hiding. We based initial structural components on the motifs of ART drugs, particularly Amprenavir and Darunavir, which are HIV Protease inhibitors. Then, these motifs were linked with various structures for HDAC inhibition and tested. We evaluated the efficacy of our designed compounds through two main metrics: how effective the molecules are at suppressing protein activity, (IC50), and through our collaborators at IU Indianapolis, the percentage of uninfected cells in culture that became infected after exposure to drug-treated infected cells (% Transmission).

We found that certain motifs have significantly stronger effects on cells: a double-ring structure, a linker, and consistent amino-acid like structures decrease IC50 and % Transmission.

This research works to create dual-action molecules from old models that tackle new horizons in providing cures. Moving forward, in vivo models are being prepared for two end molecules to test efficacy and toxicity in animal models to further the possibility of human use.

Mentor(s):
Nickolas Richard Brauer (Science); Jean A Chmielewski (Science)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1103
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Role of Moisture on the Thermal Stability of Sodium-Ion Batteries

STEM
SURF

Authors(s):
Abhaya Sundar† (Engineering|Science)

Abstract:
Sodium-ion batteries offer a cost-effective alternative for grid-scale energy storage applications, driven by the abundant availability of sodium resources. Among the different cathode candidates for sodium-ion batteries, layered oxide cathode materials are promising due to their wide operating voltage windows and higher energy densities. However, layered oxide cathode materials are susceptible to material degradation and sodium leaching on exposure to ambient moisture. The influence of moisture on the thermo-electrochemical stability of sodium-ion batteries employing layered oxide cathodes remains largely unexplored. This study focuses on investigating the electrochemical performance and thermal degradation behavior of sodium-ion batteries employing sodium iron manganese oxide cathode and hard carbon anode, for cathodes subjected to varying degrees of moisture exposure before cell assembly. Through a combination of electrochemical, surface and thermal analyses, the research aims to elucidate the mechanisms by which moisture affects cathodic structural integrity, electrode-electrolyte interphase evolution during cell operation and the corresponding implications for the thermal stability of the cell.

Mentor(s):
Ritwik Bhattacharya (Engineering); Abhinanda Sengupta (Engineering); Partha P Mukherjee (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1104
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

The Impact of Colliding Deflagration Waves

STEM
SURF

Authors(s):
Likhita Tinga† (Engineering)

Abstract:
Shock-induced energy localization in energetic materials can lead to the formation of hotspots with the potential to ignite and grow into a deflagration. This reactive phenomenon is rarely an isolated occurrence, resulting in a multitude of deflagrations that subsequently grow and collide. These points of collision are not well understood but are critical to the confluence of reactive heating that contributes to the buildup of a detonation. This work characterizes the collision of deflagration waves through reactive molecular dynamics. Utilizing the MD software LAMMPS, we induce colliding deflagration waves in a 20nm by 5 nm by 5 nm block of the energetic material HMX. Then, using a Python script, we analyze the thermodynamic qualities of the system. Through the examination of this event, we characterize the physical and chemical phenomenon that surrounds it. In conclusion, we reveal the interactions of colliding deflagration waves and their thermodynamic qualities at the molecular level through MD simulations.

Mentor(s):
Aidan Damian Pantoya (Engineering); Jalen Riley Macatangay (Engineering); Jason John Wilkening (Engineering); Alejandro H Strachan (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1105
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Extending Gradual C0 to Support a Wider Variety of Programs

STEM
SURF

Authors(s):
Mai Khanh Tran† (Engineering); Joao Vitor Carvalho Almeida† (Engineering)

Abstract:
Software verification, the process of ensuring that a program satisfies its specifications, is central to critical applications in aerospace, cybersecurity, and medicine. However, current approaches to software verification have limitations. Static verification performs verification before execution. While this approach gives immediate feedback, it often requires developers to write extensive specifications for even simple functions, leading to significant upfront cost. Conversely, dynamic verification performs verification at runtime. Although this approach reduces the specification burden, it can cause substantial runtime overhead. Gradual verification addresses the trade-off between upfront and runtime costs by combining the two approaches. It supports incomplete specifications by carrying out static verification when possible and dynamic verification when needed. Gradual C0 is a verifier under development that implements this approach for C0 programs. However, Gradual C0's current scope is limited, preventing it from supporting a broad range of programs. Therefore, we are extending the tool with new language and specification language features, such as quantifiers and fractional permissions, to support a wider variety of programs, particularly those manipulating arrays and vectors. With the extensions, we will have a gradual verifier that can work on a wider range of software.

Mentor(s):
Jenna L Wise DiVincenzo (Engineering)

Other Acknowledgement(s):
Matthew Christian Ruiz (Engineering)

Poster Presentation Abstract Number: 1106

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Evaluating the Effect of Framework Aluminum Distributions on the Hydrothermal Stability of Phosphorus-Modified MFI Zeolites

STEM

SURF

Authors(s):

Emerson Waltz† (Engineering)

Abstract:

Zeolites are a common class of industrial catalysts used for fuel and chemical production. These materials contain active sites within molecular-sized voids (<2 nm), stabilizing reactive intermediates. Their microporous framework of interconnected silica tetrahedra can be substituted with an aluminum atom, generating a negative charge on a neighboring oxygen. These are then charge-compensated by Brønsted acidic protons (H+) that act as active sites. During operation, zeolites are routinely exposed to steam at high temperatures (>700 K), causing a significant loss of acid sites through the hydrolysis of framework aluminum. MFI, one of the most industrially relevant zeolite frameworks, is commonly treated with phosphorus species to achieve greater hydrothermal stability. However, the efficacy of phosphorus stabilization remains unclear as initial framework aluminum and corresponding acid sites become more dilute, increasing site isolation. Herein, we evaluate the limits of this relationship by studying MFI zeolites with varied aluminum densities. Ammonia temperature-programmed desorption (TPD) was used to quantify acid sites before and after hydrothermal treatments. Preliminary results indicate that the effect of phosphorus stabilization is limited at low aluminum density, suggesting a dependence on the proximity of framework aluminum. Ongoing studies use samples synthesized with different organic structure-directing agents to determine how changes in active site location and environment affect phosphorus stabilization. Future work will utilize solid-state NMR spectroscopy to identify the phosphorus species responsible for stabilization. This work provides a deeper understanding of how varying active site distributions, through location and proximity, impact phosphorus stabilization, guiding the design of hydrothermally stable catalysts.

Mentor(s):

Reagan Cole Huckabee (Engineering); Rajamani P Gounder (Engineering)

Other Acknowledgement(s):
Waire Olawolu (Engineering)

Poster Presentation Abstract Number: 1107
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Automated Wafer-Level Electrical Testing Workflow for RRAM Characterization

STEM
SURF

Authors(s):
Minghan Wang† (Engineering)

Abstract:
Resistive Random Access Memory, or RRAM, is a promising nonvolatile memory technology, but characterizing many devices across a chip is time-consuming when probe movement, instrument control, and data collection require manual steps. This project developed a Python-based workflow that coordinates a P200L probe station and a Keysight B1500 semiconductor parameter analyzer to improve the efficiency and repeatability of wafer-level electrical testing. The system automatically follows a row-by-row zigzag path across a 17 by 16 chip map, performs direct current voltage sweeps, applies image-based alignment corrections, and saves measurement and timing data. In preliminary testing, the workflow completed measurements at all 272 sites in approximately 1 hour and 55 minutes, averaging about 25 seconds per die, although alignment drift and communication timeouts remain challenges. This work establishes a reusable platform for high-throughput RRAM characterization and supports future improvements in automated alignment, report generation, and wafer-level visualization of device behavior.

Mentor(s):
Yifan Wang (Engineering)

Other Acknowledgement(s):
Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1108

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Tensioned Metastable Fluid Detection for High-Efficiency Rn-222 Analysis in Drinking Water at Ultra-Trace Concentrations

STEM

SURF

Authors(s):

Ryan James Williams† (Engineering)

Abstract:

Rn-222 (a radioactive gas) in drinking water is regulated by the U.S. EPA. As such, monitoring Rn content in water at the ultra-trace (pCi/L) levels is a requirement for nationwide municipalities. State-of-the-art approaches require lengthy (days to week-long) sample preparation and counting with ion chambers. For this SURF 2026 project, a novel, low-cost, high-efficiency, and rapid (hour-long) technique is being developed. Steps involve Rn-bearing water samples at various concentrations, followed by transferring the Rn into an alpha-radiation counter to evaluate the Rn content. A liquid-scintillation counter is used for monitoring high (4,000 pCi/L) radioactivity levels; for low (1-10 pCi/L) activity levels, Purdue University's tensioned metastable fluid detector (TMFD) technology is used.

Mentor(s):

Rusi P Taleyarkhan (Engineering); Stepan Ozerov (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1109
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

An Integrated Processing and Interference Quality-Check Tool for Drone-Collected Synthetic Aperture Radar Data

STEM
SURF

Authors(s):
Ryan Wu† (Engineering)

Abstract:
Drone-based synthetic aperture radar (SAR) systems provide a flexible platform for environmental monitoring. Operating at microwave frequencies, these systems support the retrieval of biophysical and geophysical variables such as vegetation biomass and soil moisture. However, the scientific utility of drone-based SAR data depends on timely processing and reliable quality evaluation. Current workflows often rely on manual scripts and provide limited automated quality feedback, resulting in long turnaround times and delayed identification of radio-frequency interference (RFI).

This project proposes a desktop application that integrates rapid field inspection, SAR image formation, radiometric calibration, and map alignment within a unified workflow. The tool will support input validation, batch processing of flight lines, and reusable configurations to improve consistency, repeatability, and usability across data collections.

In addition to streamlining processing, the application implements an automated RFI quality-assessment algorithm based on image-domain diagnostic features. Two major interference patterns are considered. First, persistent narrowband interference introduces systematic contamination during data collection, often appearing as a strong imbalance between the near-range and far-range portions of the calibrated image. Second, broadband pulsed interference not fully removed by existing suppression algorithms appears as bright azimuth lines extending across the full range dimension. By detecting these image-domain signatures, the tool assigns intuitive pass, review, and fail quality categories and generates diagnostic reports to support user interpretation. Combining an accessible interface with explainable metrics, the proposed tool improves workflow repeatability and helps users identify low-quality data before downstream scientific analysis.

Mentor(s):
Weihang Li (Engineering); Melba M Crawford (Agriculture|Engineering)

Other Acknowledgement(s):
Lena Azimi (Engineering); Guinan Guo (Engineering); Pramod Sunil Parande (Engineering); Jordan Joseph Alexander (Engineering); Varun Aggarwal (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1110

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Analysis of temperature-sensitive mutations in Salmonella typhimurium

STEM

SURF

Authors(s):

Ruoqin Rachel Yang† (Science); Olivia Nicole Safranek‡ (Science)

Abstract:

The focus of our work is on temperature-sensitive strains of Salmonella typhimurium LT2 within the histidine biosynthesis pathway. These temperature sensitive strains contain mutations that render the activity of specific enzymes in this pathway either on or off at distinct temperatures. It is our hypothesis that temperature-sensitive phenotypes are driven by localized shifts in protein conformation and dynamics, which can be overcome at differing temperatures. Our initial work has focused on the enzymes HisB and HisD, where we have identified multiple mutations that shift the activity of these enzymes. In HisB, higher temperatures (above 42 degree Celsius) lead to an inability to complete steps 6 and 9 in the histidine biosynthesis pathway. This may be due to the mutations being located in one of the two domains of HisB with each domain performing a different enzymatic reaction. All HisB temperature-sensitive strains have at least one mutation in the C-terminal domain. In HisD, the mutation is suspected to disrupt the binding of NAD+, as its location is in the highly conserved Rossmann fold. We have now cloned, expressed, and purified wild type and temperature sensitive mutants of HisB and are currently working to characterize their structural properties to determine what is mediating their temperature sensitive phenotype.

Mentor(s):

Nicholas Noinaj (Science); Laszlo Csonka (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1111

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Smart PPG Earring for Multi-Modal Eating Detection and Dietary Monitoring

STEM

SURF

Authors(s):

Feng Ye† (Science); Nguyen Chan Nhu Pham‡ (Liberal Arts); Antara Durbha‡ (Science)

Abstract:

Continuous, low-burden monitoring of eating behavior can support dietary evaluation, weight management, and interventions for eating-related disorders, but achieving this in everyday settings remains difficult. Existing approaches—based on self-report, cameras, or sensors worn at the wrist, neck, or jaw—each involve tradeoffs among user burden, privacy, robustness, and sensing specificity. We present a set of smart earrings, built on a previously validated ear-based PPG sensor for heart-rate monitoring, that integrates green and infrared photoplethysmography (PPG), a 3-axis accelerometer, and a temperature sensor to enable passive, everyday eating sensing. Our central insight is that motion-induced artifacts in the PPG signal—conventionally treated as noise to be removed in physiological sensing—together with jaw-driven accelerometer signatures, can instead serve as a primary channel for detecting and characterizing eating behavior at the ear. Building on this insight, we investigate three complementary tasks spanning multiple levels of granularity: (1) detecting eating episodes, (2) analyzing chewing behavior through chew counting (3) examining the feasibility of food texture classification (e.g., crunchy, chewy, hard, soft) from ear-worn sensing alone. We describe a modeling pipeline that fuses PPG and accelerometer signals to support these tasks, and discuss the opportunities and open challenges of extending ear-worn multimodal sensing toward unobtrusive, everyday dietary monitoring

Mentor(s):

Qiuyue Xue (Science)

Other Acknowledgement(s):

Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1112
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Experimental Metathesis Low-salt-rejection Reverse Osmosis for Improved Resource Recovery

STEM
SURF

Authors(s):
Kai-Xing Yue† (Engineering)

Abstract:
Recent advancements in high-recovery reverse osmosis (RO) technologies have led to water recovery rates of up to 95%, producing minimal amounts of wastewater. However, higher efficiency results in oversaturation which causes salt crystals to form on the surface of the membrane filter, a phenomenon known as inorganic fouling. This severely shortens membrane life and degrades permeate quality. To solve this problem, we designed an experimental prototype for Metathesis Low-salt-rejection Reverse Osmosis (MLRO), a novel, patent pending, technology which is expected to be able to process much higher feed solution concentrations than conventional RO systems without risking membrane damage.

MLRO improves water recovery rates by preemptively separating ion pairs before they form low solubility salts that accumulate on the membrane. This is achieved by targeting and rejecting problematic divalent ions (e.g., Ca^{2+}, Mg^{2+}). As such, the system requires 3 channels as opposed to the usual 2 needed for a typical RO module. For ease of fabrication, we utilized a plate and frame setup but modified it to include two permeate channels and an additional middle plate facilitating feed flow across two low rejection membranes of opposing charges and different pore sizes. Additionally, ion separation may also allow for the retrieval of certain desirable compounds from the permeate or retentate streams. This early-stage work is designed to support the preliminary theoretical modeling and technical viability of the initial MLRO proposal. We expect that MLRO will allow for the development of higher efficiency technologies with improved lifespan and resource recovery.

Mentor(s):
David Warsinger (Engineering); Mateo Roldan Carvajal (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1113
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Differential Gene Expression Signatures Define Individual Vulnerability to Environmental Toxins in Alzheimer's Disease

STEM
SURF

Authors(s):
Lucia X Zhang† (Engineering)

Abstract:
Alzheimer's disease (AD), a leading cause of dementia, is influenced by both genetic and environmental factors. While environmental toxins such as perfluorooctanoic acid (PFOA) and lead (Pb) have been associated with neurological dysfunction and increased risk of AD, it remains unclear how these exposures alter gene regulation in individuals with and without AD. This study leveraged patient-derived induced pluripotent stem cells (iPSCs) and bioinformatics to investigate gene-environment interactions (GxE) that contribute to individual risk of AD and related dementias. Human iPSCs from 24 ROS-MAP donors (16 AD and 8 non-AD) were exposed to two PFOA concentrations (0.4 and 4 ppb) and two Pb concentrations (15 and 50 ppb) for 4 days. RNA sequencing was then used to measure genome-wide transcriptomic changes, followed by gene set enrichment analysis to identify biological pathways disrupted by each treatment in AD and non-AD donor cells separately. An individual transcriptional responsiveness score was calculated for each donor to quantify variation in chemical sensitivity and correlated significantly with the CERAD neuritic plaque score, a measure of AD neuropathological severity. In the context of AD pathology, these analyses identified biological processes and gene sets associated with individual vulnerability to environmental chemical exposure, providing insight into the biological pathways that mediate GxE. These findings suggest that individuals with AD pathology may exhibit increased vulnerability to environmental toxin exposure, with implications for public health risk assessment and targeted protective strategies for at-risk populations.

Mentor(s):
chongli Yuan (Engineering); Han Zhao (Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1114
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Novel, Low-Cost PLA Biopolymer Based Monitoring of Ionizing Gamma Radiation Dose for Space-Based Microelectronics

STEM
SURF-SCALE

Authors(s):
Seth Everette Cowan† (Engineering)

Abstract:
Polylactic acid (PLA) is a renewable, corn-soy-derived biopolymer whose physical and chemical properties can be tailored by ionizing radiation, making it a promising material for monitoring gamma radiation doses on personnel and microelectronics in high radiation backgrounds as encountered in space-based systems. This work builds upon past research involving monitoring for the mass dissolution ratio (RMD), i.e., chemical dissolution of irradiated PLA resin beads in acetone and water. The project work involved successfully reproducing past results with a ~ 1 g quantity of PLA resin beads (each ~0.02 g mass) dissolved in acetone at elevated temperatures (~50oC) over the range of 0 to 140 kGy. The RMD method was then successfully extended using a single ~16 mm long PLA filament weighing only ~0.04 g at near-room temperature (~22°C). The study also aims to investigate RMD effects in water. These preliminary results suggest that acetone-assisted dissolution of PLA filaments offers potential to provide an even more rapid, ultra-low-cost, and reproducible method for gamma radiation dosimetry applications.

Mentor(s):
Rusi P Taleyarkhan (Engineering); Stepan Ozerov (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Poster Presentation Abstract Number: 1115
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Gantry Camera Machine Vision Study

STEM
SURF-SCALE

Authors(s):
Conner B Stott† (Science)

Abstract:
The Large Hadron Collider (LHC) of CERN is undergoing a detector upgrade among which is the Compact Muon Solenoid (CMS). This upgrade involves assembling sensor modules at multiple U.S. sites, requiring micron-level manufacturing standards. Currently humans are used to identify fiducials on sensors for assembly and based on the measurements a gantry is used to assemble the sensor. This can lead to subjective human error as the apparent center may shift from individual to individual. To improve accuracy this research aims to use computer vision to automate the identification of the fiducials. A dataset of over 250 annotated images was utilized to train a custom py-torch model. This model was evaluated on a test image set to verify its accuracy in a virtual environment before deployment to the local gantry control computer. On the computer the model was integrated into the custom code base in order to be given data for real assembly. Testing of the object detection automation scripts with real modules was done to compare with its human counterparts. Across many tests it was determined to have a five times lower root mean squared error (RMS) when compared to humans. This is believed to be because while an individual with training can get to around half as accurate as the system their perceived center can differ from other humans leading to a higher RMS for humans as a group. Overall this research attempts to increase the precision of the production of sensor modules of the CMS upgrade through the use of computer vision. Future work will focus on expanding the training dataset to improve robustness as well as the deployment will be standardized to allow for easy installation at other assembly sites.

Mentor(s):
Isik Gokcen Karslioglu (Science); Timothy Matthew Jones (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1116

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

MAPPING PHYSICAL VULNERABILITIES IN GLOBAL SEMICONDUCTORS VALUE CHAINS

Business Case Study

UREP-C or UREP-LA

Authors(s):

Angie Ginnella Batista† (DSB); Juan Pablo Rodriguez Lopez† (DSB)

Abstract:

The resilience of the U.S. semiconductor supply chain has become a strategic concern due to increasing geopolitical tensions, global logistics disruptions, and the growing importance of advanced technologies. This study analyzes the physical structure and vulnerabilities of the U.S. semiconductor value chain through maritime imports between 2020 and 2024 using the LIST-THE shipping database. A Python-based ETL pipeline processed over 80 million shipping records to identify 505,249 semiconductor-related shipments across 71 Harmonized System (HS) codes, representing approximately 945,000 TEUs. Supply chain resilience was evaluated through network analysis, geospatial mapping, the Herfindahl–Hirschman Index (HHI), and a Real GDP-normalized approach to mitigate the "Port Effect" in customs data. Results reveal a highly concentrated logistics network dependent on Asia-Pacific suppliers and a limited number of U.S. gateway ports, with China accounting for the largest share of maritime imports. The analysis also confirms the value–volume paradox of the semiconductor industry, where advanced integrated circuits represent only a negligible share of maritime cargo despite their strategic importance, while upstream materials and discrete semiconductor components dominate physical trade flows. Furthermore, increasing HHI values identify emerging concentration risks in critical semiconductor chemical imports, highlighting potential single points of failure within the U.S. logistics network. These findings provide a data-driven framework for evaluating semiconductor supply chain resilience and offer practical insights for industrial policy, infrastructure planning, and strategies aimed at strengthening the security and competitiveness of the U.S. semiconductor ecosystem.

Mentor(s):

Dutt Jagdish Thakkar (DSB); Steven R Dunlop (DSB)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1117
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

COMMERCIALIZING LIPIDOMICS FOR BEEF QUALITY ASSESSMENT Understanding market needs, stakeholder and adoption pathways

Business Case Study
UREP-C or UREP-LA

Authors(s):
Ana Maria Cifuentes Pinilla† (PWL)

Abstract:
Commercializing emerging technologies remains a major challenge in translating scientific innovation into industry adoption. This study aims to evaluate the commercialization potential of a lipidomics-based beef quality technology by identifying market needs, stakeholder incentives, adoption barriers, and opportunities for value creation across the U.S. beef supply chain. The research applies a market research approach integrating industry analysis, competitive landscape assessment, stakeholder mapping, consumer insights, and evaluation of commercialization pathways to examine how scientific innovation can be aligned with market requirements. Preliminary findings suggest that technical performance alone is insufficient to drive adoption; successful commercialization requires a clear value proposition that addresses the priorities of producers, processors, retailers, and consumers. Additionally, consumer research indicates interest in digital tools that improve access to product quality information, highlighting opportunities for technology-enabled transparency and traceability. Rather than viewing commercialization as the final stage of technology development, this study highlights the importance of incorporating market intelligence throughout the innovation process. Overall, this research provides insights into how market-driven strategies can support the transition of lipidomics-based technologies from laboratory innovation to commercially viable solutions that create value across the beef supply chain.

Mentor(s):
Christina R Ferreira (Centers & Institutes); Dipak Narula (PWL)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1118

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Exploratory Analysis of Plasma Lipid Profiles in Largemouth Bass Across a PFAS Exposure Gradient

STEM

UREP-C or UREP-LA

Authors(s):

Maria Jose Suarez Monroy† (PWL)

Abstract:

Per- and polyfluoroalkyl substances (PFAS) are persistent environmental contaminants capable of disrupting lipid metabolism in aquatic organisms. This study explored associations between plasma lipid profiles and tissue concentrations of 21 PFAS in largemouth bass (Micropterus salmoides) collected from ponds across an exposure gradient associated with agricultural biosolid runoff. Relative lipid quantification was performed using multiple reaction monitoring (MRM) profiling, identifying 224 lipid species from seven classes: lysophosphatidylcholines (LPC), phosphatidylcholines (PC), sphingomyelins (SM), diacylglycerols (DG), triacylglycerides (TG), cholesteryl esters (CE), and ceramides (Cer). Principal component analysis (PCA) was used to identify major sources of variation, and Spearman correlation analysis evaluated associations between PFAS concentrations and lipid features. Lipids were organized by class, total carbon chain length, and degree of unsaturation to facilitate interpretation of biological patterns.

PCA indicated that sex was the primary contributor to variation in plasma lipid profiles, whereas PFAS exposure level and treatment site showed limited separation among samples. Sex-specific correlation analyses revealed distinct PFAS–lipid association patterns. In females, long-chain PFAS, including PFDA, PFUnA, PFOS, and PFDS, showed positive correlations with phosphatidylcholines and sphingomyelins, with more associations observed among longer and more unsaturated lipid species. In males, PFAS–lipid relationships were less pronounced, with predominantly negative associations between PFPeA and multiple LPC, PC, and SM species.

Overall, this exploratory study suggests that PFAS exposure may influence plasma lipid composition in largemouth bass. The observed sex-specific lipidomic patterns suggest distinct biological responses to PFAS exposure and contribute to a better understanding of how PFAS may affect lipid metabolism in aquatic organisms

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
Christina R Ferreira (Centers & Institutes); Maria Soledad Sepulveda (Agriculture); Tyler D Hoskins (Agriculture)

Other Acknowledgement(s):
Deise Cruz Santos (Agriculture); Jeremiah Harvey Tennant (Agriculture); Jennifer L McAdams (Agriculture)

Poster Presentation Abstract Number: 1119

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Comparing the Accuracy of Transcondylar Screw Placement Between Drill Bit and K-wire in Canine Humeral Condyle

STEM

Veterinary Scholars Summer Research Program

Authors(s):

Kotoe Jodie Yoshitomi† (Science|JMHC)

Abstract:

Humeral intracondylar fissure (HIF), previously known as incomplete ossification of the humeral condyle (IOHC), is a condition affecting dogs that is characterized by a fissure in the humeral condyle, which can lead to a complete fracture during normal activity if left untreated. A transcondylar screw is commonly placed to prevent a complete fracture. Although 3D-printed partient-specific surgical guides (PSGs) have been shown to improve the accuracy of screw placement, deviations from the planned screw positions still occur. One potential reason is that the sloped surface of the humeral condyle may cause the drill to slip during the procedure. We hypothesized that using a k-wire instead of a drill bit would improve the accuracy of screw placement due to its sharper tip. To test our hypothesis, we designed a pilot study. In this study, four pairs of canine forelimbs from large-breed dogs were imaged using computed tomography (CT), and 3D-printed PSGs were designed to guide the placement of the screw. One forelimb from each pair was randomly designated to the drill-bit or k-wire group. Entry point and angle trajectory deviations were calculated by superimposing preoperative and postoperative CT models and compared using a paired t-test. The results demonstrated that the mean entry point deviation was 3.72 mm for the drill bit and 1.61 mm for the k-wire. The mean trajectory deviation was 4.96° and 5.44°, respectively. Although the k-wire group demonstrated a lower mean entry point deviation, no statistically significant differences were found between the two groups for entry point or angle deviation ($p>0.05$) with a study power of 0.5.

Mentor(s):

Sun Young Kim (Vet Med)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1120

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Search for HH → bbτ⁺τ⁻ Using Run 3 Scouting Data – Analyze Tagging Performances with Unified Particle Transformer

STEM

USCMS-PURSUE

Authors(s):

Qianyue Chen† (PWL); Annella Bellot* (PWL)

Abstract:

B-tagging and tau-tagging performances play an important role in the search for the rare event HH → bbτ⁺τ⁻. A transformer-based neural network, Unified Particle Transformer, is applied for both tagging tasks, and Run 3 proton–proton collision scouting data at center-of-mass energy of 13.6 TeV is used. The scouting data stream accepts events at a much higher rate compared to traditional triggers, but stores only the objects reconstructed in the trigger, no low-level detector information. Therefore, existing taggers trained for the offline event reconstruction cannot be used. Analysis of the SoftMax plots, ROC/AUC curves, confusion matrix, accuracy and losses are used to evaluate model performance. Specifically, the tagging efficiency of the signal and misidentification probability across multiple background processes are compared for varying working points. Different training samples with distinct distributions of jet flavors are utilized and related model performances are analyzed. Interpretability methods, such as Integrated Gradients, is applied to study the input features' influence on the model's decisions, providing insights into potential improvements.

Mentor(s):

Jan-Frederik Schulte (Science); Yao Yao (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1121

Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Effect of UV Intensity and Particle Type on the Cure Depth of Photocurable Molding Powders

STEM

Authors(s):

Kym-Danny Dyah Francis† (Engineering)

Abstract:

Polymer-bonded explosives (PBXs) are relatively safe, yet highly energetic materials that are utilized across a wide range of applications, including mining and defense systems. Traditional PBX manufacturing often relies on toxic solvents and requires several days to process. Novel UV-curable molding powders eliminate the need for these solvents and reduce production time to just a few hours. These UV-curable molding powders undergo a precuring phase where they are briefly exposed (<1 second) to ultraviolet light before being compacted into a pellet using a die. However, the precuring phase often yields inconsistent final properties, such as geometric fidelity and compressive strength. Furthermore, the type of surrogate energetic particles used can affect how well the powder cures. The main purpose of this work is to investigate how spatial inconsistencies in the UV light array and the type of surrogate particles used affect how the UV-curable molding powders cure. First, the spatially varying intensity of the light array was characterized using an LTR390 UV light sensor. Then, UV-curable molding powder mixtures containing either sugar or glass beads, with a solids loading of 81.3 wt.%, were made. To measure the precure depth, the molding powders were placed in a 1 cm tall acrylic container under the UV array, where in-situ temperature measurements using a thermal camera and high-speed optical analysis were performed. The results revealed differences in both the curing kinetics of the specimens and the depth to which the cure progressed. These findings provide a better understanding of the precure process, enabling the development of standardized procedures and improved process repeatability.

Mentor(s):

Ismar Leonel Chew (Engineering); Monique Suzanne McClain (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1122
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Born This Way? Birth Order Differences in Parents' Evaluations of Preschoolers' Math Abilities and the Importance of Math

Social Science

Authors(s):
Anne C. Lim† (HHS); Sanah Kochhar† (HHS)

Abstract:
Early math skills are important predictors of later academic achievement and school readiness (Luo et al., 2022). Furthermore, parents play a key role in supporting children's early math learning through their beliefs and attitudes about math (Eason et al., 2022). Additionally, birth order seems to inform parents' math mindset (Lin & Muenks, 2024). Parents tend to perceive first-born children as more academically competent than later-born children (Jensen & McHale, 2015). But we know very little about the role of birth order in parents' achievement importance. So, we investigated associations between birth order and parents' perceptions of preschoolers' math ability, and their perceived importance given to math achievement. Parents (n = 572) of preschoolers (M age = 4.31 years, SD = 0.78) completed a Prolific survey assessing their importance beliefs and rated preschoolers' math ability. Children were categorized as first-born, later-born or only children. Compared to later-born and only children, parents of first-born children rated their child's math aptitude higher, including stronger perceived abilities relative to peers ($r = .10$, $p = .017$), greater math-language skills ($r = .08$, $p = .050$), and shape-identification skills ($r = .11$, $p = .011$). However, parents of first-borns placed less importance on math achievement than parents of later born or only children ($r = -.11$, $p = .007$). Our findings suggest that parents may perceive their first-born preschoolers as being good at math, while placing less importance on math achievement than parents of later-born or only children. Understanding these patterns may provide insight into family factors influencing early math development and school readiness.

Keywords: Home Math Environment, Family Math Engagement, Parents Motivational Beliefs, Early Math Learning, Early Math Development

Mentor(s):
Siqi Zhang (HHS); Sarah Eason (HHS)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1123
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Conversational FPGA Design Space Exploration: A ReAct-Based LLM Agent Coupled with a Transformer-Based Surrogate Model

STEM

Authors(s):
Carlos Alexis Ortiz Gonzalez† (Engineering)

Abstract:
High-Level Synthesis (HLS) enables deployment of machine learning accelerators on Field-Programmable Gate Arrays (FPGAs), but hardware synthesis remains a bottleneck for iterative Design Space Exploration (DSE), requiring minutes to hours per design. Recent surrogate-modeling approaches show that resource utilization and latency can be estimated without full synthesis, motivating assistants for HLS-driven exploration.

We present a conversational DSE framework built around a Transformer-based surrogate model trained on the wa-hls4ml dataset across Dense, one-dimensional convolutional (Conv1D), and two-dimensional convolutional (Conv2D) architectures targeting Xilinx FPGAs. The framework couples the surrogate with a Reasoning and Acting (ReAct) large language model (LLM) agent that uses tool calling and Retrieval-Augmented Generation (RAG) to interpret natural-language requirements and iteratively generate and evaluate configurations without manual specification. The surrogate predicts six hardware metrics: Block RAM (BRAM), Digital Signal Processors (DSP), flip-flops (FF), Look-Up Tables (LUT), maximum clock cycles, and Initiation Interval (II).

Across the six targets, the surrogate achieves a mean coefficient of determination (R^2) of 0.93 and a mean Symmetric Mean Absolute Percentage Error (SMAPE) of 7.15%. Mean SMAPE by architecture group is 5.95% for Dense, 14.42% for Conv1D, and 14.06% for Conv2D. To address DSP's zero-inflated distribution, an auxiliary classification head distinguishes zero- from nonzero-DSP designs; the downstream regression achieves an R^2 of 0.963. The agent framework was validated through automated functional and constraint-satisfaction tests across the three architecture groups, confirming tool orchestration. These results show that combining the surrogate with the ReAct agent enables accurate, interactive FPGA design exploration while reducing repeated

synthesis. Future work will benchmark alternative LLM backends to assess sensitivity.

Mentor(s):
Kaushik Roy (Engineering)

Other Acknowledgement(s):
Prajna Ganapathy Malettira (Engineering)

Poster Presentation Abstract Number: 1124
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Differential Vulnerability of Excitatory and Inhibitory Synapses to Acrolein-Mediated Oxidative Damage

STEM

Authors(s):
Maheen Syed† (Engineering); John Pao Miles* (Liberal Arts)

Abstract:
[Abstract Redacted]

Mentor(s):
Nikita Krishnan (Engineering); Shatha Jameel Mufti (Engineering); Riyi Shi (Vet Med)

Other Acknowledgement(s):
Timothy Brock Beauclair (Engineering); Jhon Edison Martinez (Engineering)

Poster Presentation Abstract Number: 1125
Presentation Time: Session 1: 10:30-11:30am in PMU Ballrooms

Validating Eye-Tracking Biomarkers for Autism Diagnosis in Low- and Middle-Income Countries

STEM

Authors(s):
Sunny Yoon† (Science)

Abstract:
While the vast majority of autism research has been conducted in high-income countries (HIC), 95% of the world's autistic children live in low- and middle-income countries (LMIC). A lack of autism expertise and culturally adapted and validated diagnostic tools in LMICs represent a significant barrier to autism detection and diagnosis. In previous HIC studies, eye-tracking has proven to be a feasible method for identifying toddlers and young children with autism though this diagnostic method has not yet been explored in LMICs to date. The culturally-adapted eye-tracking battery (10- to 15-minute assessment) measures six independent metrics shown to predict autism outcomes in HICs – non-social preference, attentional disengagement, pupillary light reflex, and oculomotor metrics. To date, eye-tracking biomarker data have been collected from sixty-six, 24- to 72-month-old autistic (n=30) and non-autistic (n=36) children in Kenya. Preliminary results from one of the six biomarkers (non-social preference; non-social looking / total looking time) demonstrate that our adapted measure significantly predicts autism outcomes in Kenyan children. Based on application of a looking time threshold (35% non-social preference), outcomes were concordant with the diagnosis for 84% (n=53) of cases. The adapted non-social preference measure showed promising diagnostic accuracy, suggesting that culturally tailored eye-tracking assessments may be feasible and effective for identifying autism in young children in LMICs. Ultimately, eye-tracking may offer a viable solution to address the persistent challenges of autism diagnosis in LMICs, where access to specialized expertise and validated tools remains limited.

Mentor(s):
Brandon Keehn (HHS)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1200

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Service Life Assessment of Additively Manufactured Carbon Fiber Reinforced Thermoplastic Composite Tooling

STEM

DUIRI

Authors(s):

Changho Lee† (Centers & Institutes)

Abstract:

The rapid advancement of fiber-reinforced thermoplastic composite additive manufacturing has positioned it as a convincing alternative to conventional tooling in aerospace composite manufacturing, offering substantial reductions in lead time and the ability to realize complex geometries. However, the long-term thermomechanical durability of such materials under repeated high-temperature autoclave cycling remains a critical knowledge gap, and establishing a reliable performance baseline across operational life cycles is essential for confident industrial deployment. This study presents a systematic investigation into the property evolution of two high-performance thermoplastic tooling materials subjected to repeated two-hour thermal cycles at 177°C, simulating standard aerospace composite autoclave cure conditions. Specimens were characterized at defined cycle intervals through a coordinated multi-method approach encompassing Dynamic Mechanical Analysis, Differential Scanning Calorimetry, and Thermogravimetric Analysis to monitor changes in viscoelastic behavior, thermal transitions, and decomposition stability. Coefficient of Thermal Expansion analysis was conducted in parallel to characterize dimensional stability evolution throughout the cycling program. The comparative characterization of both materials across successive cycles enables construction of a degradation timeline directly linking accumulated thermal exposure to measurable property changes. These results are expected to identify the cycle thresholds at which thermomechanical performance begins to deviate significantly from baseline, delivering a predictive framework for service life estimation and informing material selection, maintenance protocols, and tool replacement strategies for additively manufactured aerospace composite tooling.

Mentor(s):

Garam Kim (Polytechnic); Eduardo Barocio Vaca (Engineering)

Other Acknowledgement(s):

Anand D Tiwari (Polytechnic)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1201

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Portable Reverse Osmosis with Pulsed and Reversed Flow

STEM

DUIRI

Authors(s):

Gia Phong Phuong† (Centers & Institutes)

Abstract:

The system is a portable water filtration unit designed for in-situ water purification. It combines two advanced reverse osmosis technologies, Pulse Flow Reverse Osmosis (PFRO) and Flow Reversal Reverse Osmosis (FR-RO), to reduce membrane scaling and increase water recovery. PFRO uses periodic high-velocity flushes to disrupt concentration buildup on the membrane surface, while FR-RO periodically reverses flow direction to prevent mineral deposits. Together, these methods improve filtration performance, achieving 20-40% higher water recovery rates and 20-30% lower energy consumption compared to conventional reverse osmosis systems in lower salinities, while also reducing the need for chemical anti-scalants.

To enable field deployment, all components are integrated into a rugged portable enclosure - Air Case (1). The system includes a dual-membrane (2) housing assembly for filtration, a high-pressure pump (3) for feed water pressurization, automated solenoid valves (4) and a relief valve (5) for flow control and pressure protection, and multiple flow meters (6) for real-time monitoring of feed, permeate, and concentrate streams. The fluid manifold is constructed from stainless steel piping and fittings (7, 8 ,9, 10, 11, 12, 13, 14, 15) to withstand hydraulic shocks, resist corrosion from concentrated brine, and maintain water purity. By combining advanced anti-scaling RO technologies within a compact, self-contained package, the system provides a durable and low-maintenance solution for high-yield water purification at the point of use.

Mentor(s):

Jose M Garcia Bravo (Polytechnic)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1202
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Development of a Reflective Solar Concentrator with a Steerable Beam and No Cosine Loss

STEM
DUIRI

Authors(s):
Ava Robinson† (Liberal Arts)

Abstract:
Solar concentrators improve the performance of solar energy systems by increasing the intensity of incident sunlight on a target receiver. This project presents the design and development of a solar concentrator that combines optical modeling with mechanical design to produce a collimated solar beam. The proposed concentrator consists of a primary parabolic reflector that focuses incident sunlight onto an off-axis parabolic mirror positioned at the primary focus. The off-axis mirror recollimates the light into a beam, which is then redirected by a steering mirror to the desired receiver. Reflective optics were selected over refractive lenses to minimize transmission losses while preserving infrared wavelengths that contribute to thermal energy collection. An automated solar-tracking system is incorporated to maintain alignment with the sun throughout the day, thereby avoiding cosine losses and maximizing the amount of solar energy captured. Ray-tracing simulations are being developed to evaluate optical performance and optimize mirror geometry, while a CAD model based on a Newtonian telescope-inspired mechanical configuration supports precise optical alignment. Future work includes prototype fabrication and experimental validation. The resulting system provides a compact solar concentrator for solar thermal and high-intensity photovoltaic applications. This work was directed by Professor W. D. Leon-Salas and funded in part by the Nexus Institute.

Mentor(s):
Walter Daniel Leon-Salas (Polytechnic)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1203

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Developing a toolkit for the in vivo monitoring of circadian rhythmicity in Drosophila Melanogaster

STEM

NSF REU Site: Genetic and Biochemical Analysis of Proteins

Authors(s):

Alan Cortes† (Agriculture)

Abstract:

Circadian rhythms regulate the cyclic nature of many physiological processes, and they are established endogenously by molecular clocks participating in transcription-translation feedback loops that regulate their own temporal changes in abundance and activity. Currently, simple methods for tracking rhythmic gene expression are limited, and the lack of in vivo techniques restricts us to discrete time-point measurements that do not fully capture the continuous nature of these rhythms. Therefore, we are developing a Drosophila melanogaster toolkit for tracking tissue-specific, in vivo expression of clock genes, using a nanoluciferase transgenic construct to produce a bioluminescent signal that reports gene expression with high temporal resolution. Using the existing CRiMIC/MiMIC library of Drosophila lines, we utilize RMCE (Recombinase Mediated Cassette Exchange) to insert the nanoluciferase construct into intronic regions of our genes of interest – generating a collection of lines that express the recombinase-dependent bioluminescent reporter driven by the endogenous promoters of different clock genes. Our system uses existing Gal4-UAS strains to express a second recombinase in a cell/tissue-specific manner, inducing expression of the functional nanoluciferase reporter transgene. Given their robustly rhythmic nature, the vri and Pdp1ε clock genes have served as the reference points for validating this model's efficacy. While in vitro assays have confirmed proper integration and expression of our construct, we have encountered problems delivering the nanoluciferase substrate for in vivo luminescence and are currently optimizing conditions for its uptake. Though in its early stages, the continued development of this toolkit holds meaningful potential as a cost-effective alternative for monitoring and studying oscillatory patterns on a large, tissue- and time-specific scale, which is important given the influence circadian rhythmicity has on metabolism and behavior.

Mentor(s):

Vikki Marie Weake (Agriculture); Seth Daniel Lammert (Agriculture)

Other Acknowledgement(s):
Sarah E. McGovern (Agriculture)

Poster Presentation Abstract Number: 1204

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Evaluation of the Putative ADAR1 Inhibitors, ADAR1i-124 and NAG638

STEM

NSF REU Site: Genetic and Biochemical Analysis of Proteins

Authors(s):

Savannah Doty† (Grand Canyon University); Estelle Nour Gardner‡ (Agriculture)

Abstract:

Despite the revolutionary impact of immunotherapy among modern cancer treatments, many cancers are still resistant to these therapies. A promising solution is targeting adenosine deaminase acting on RNA 1 (ADAR1), an RNA-binding protein that suppresses the innate immune response to endogenous double-stranded RNAs via adenosine-to-inosine editing. Without ADAR1, cytosolic dsRNA sensors such as MDA5 and PKR are activated to trigger tumor cell apoptosis and necroptosis. Consequently, depletion of ADAR1 can overcome immunotherapy resistance, specifically in the case of immune checkpoint blockade. This study evaluated the efficacy of a proposed small-molecule ADAR1 inhibitor, ADAR1i-124, and its derivative NAG638. The compounds were evaluated using cell-free biochemical assays and cell-based in vitro assays. To evaluate inhibition of A-to-I editing, RNA was isolated from treated cells or biochemical reactions and sequenced following reverse transcription PCR. The effect of each compound on cell viability was evaluated using a bioluminescent assay. While ADAR1i-124 demonstrated a dose-dependent reduction in cell viability and decreased A-to-I editing in cell-free assays, sequencing analysis revealed no significant drop in editing frequencies within treated cells. Additionally, the derivative compound NAG638 did not alter cell viability or A-to-I editing at any dosage in either cell-free or cell-based tests. Because neither drug inhibited A-to-I editing in cells, the data suggests that ADAR1i-124 and NAG638 do not function as direct ADAR1 inhibitors. Future work is required to determine the mechanism of ADAR1i-124's biochemical editing inhibition and why these effects do not translate to live cells, as well as whether its observed cytotoxicity stems from off-target effects. Moving forward, continued investigation of alternative small-molecule ADAR1 inhibitors remains vital in the search for this promising cancer treatment.

Mentor(s):
Kyle Aaron Cottrell (Agriculture); Cassandra Smoak (Agriculture)

Other Acknowledgement(s):
Daniel P Flaherty (Pharmacy); Nagabhushana Chinnenahalli Beeralinga (Pharmacy)

Poster Presentation Abstract Number: 1205

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Exploring Rm62 involvement in aging as a regulator of R-loop homeostasis

STEM

NSF REU Site: Genetic and Biochemical Analysis of Proteins

Authors(s):

Kendra Eller† (Agriculture); Louis Michael Delaby* (JMHC)

Abstract:

Aging is a major risk factor for many diseases, including neurodegenerative disorders such as Alzheimer's disease. Understanding the molecular mechanisms that drive aging may therefore provide insight into the underlying causes of these diseases. Dysregulation of gene expression and overall genomic instability are two key hallmarks of aging. R-loops are three-stranded nucleic acid structures composed of DNA:RNA hybrids and a displaced single-stranded DNA strand. Although they form naturally during transcription, excessive accumulation of R-loops can stall RNA polymerase II and contribute to genome instability. Because our previous work has shown that R-loops accumulate in aging fly neurons, we hypothesize that dysregulation of R-loop homeostasis drives aging. To investigate this hypothesis, we use the Drosophila melanogaster (fly) model, which has numerous genes analogous to human genes and a short life cycle, making it ideal for investigating R-loops across aging. We focused on the Drosophila Rm62 gene because RNA-sequencing data revealed that its expression decreases with age, and its human ortholog, DDX17, is implicated in R-loop resolution. To determine whether Rm62 regulates R-loop homeostasis, we knocked down its expression in neurons using RNA interference (RNAi) and then compared R-loop abundance during aging with that of negative-control flies using slot blot assays. Our results consistently show a decrease in R-loop levels with age; however, the differences between control and Rm62 knockdown flies remain inconclusive. In addition, our RNA-sequencing data on Rm62-depleted flies identified numerous potential downstream gene targets. We have selected several significantly upregulated and downregulated candidates for independent validation using quantitative PCR (qPCR) to further characterize the regulatory role of Rm62 in aging and R-loop homeostasis.

Mentor(s):
Hana Hall (Agriculture); Geethma Lirushie Tellambure Vithanage (Agriculture); Kendall Cottingham (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1206

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Production of Bispecific T-Cell Engagers in Rosetta-gami 2 (DE3) Cells

STEM

NSF REU Site: Genetic and Biochemical Analysis of Proteins

Authors(s):

Teresa Hayden† (Agriculture); Yuxin Zhuang‡ (Agriculture); Pragya Jain* (Agriculture)

Abstract:

Immunotherapy is a rapidly growing field of cancer research. Bispecific T-cell Engagers (BiTEs) are a form of immunotherapy consisting of an engineered two-fragment protein designed to bind tumor-associated antigens (e.g. CD19 on B cell lymphoma) on one end and the CD3 receptor on T cells on the other end, thereby redirecting T cells to kill cancer cells. A BiTE consists of two antibody-derived single-chain variable fragments (scFvs), each containing linked VH and VL domains, joined by a flexible peptide linker. Because of this structural complexity, large-scale production within bacterial systems is limited by insoluble protein aggregation. Improved protocols are therefore needed to ensure high BiTE solubility. We hypothesize that a combination of Tween-20 and Triton X-100 detergents within the lysis buffer will enhance solubilization of the BiTE. To test this hypothesis, the protein is expressed within Rosetta-gami 2 (DE3) cells and lysed using lysis buffers containing 0.5% Tween-20, 1% Triton X-100, or 6M Urea. The soluble lysate and insoluble debris are then tested for the presence of the BiTE protein via Silver Staining, Coomassie Blue, and Western Blotting. Ongoing analysis suggests that combining and increasing the concentrations of these non-ionic detergents enhances BiTE solubilization within the cellular lysate. Successfully extracted proteins will then undergo purification to investigate target-dependent cytotoxicity via B-cell depletion. The resulting solubilization may be utilized to further optimize BiTE production for lymphoma and related cancers.

Mentor(s):

Majid Kazemian (Agriculture|Science); An My Nguyen (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1207

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Targeting ASC Filament Formation as a Therapeutic Strategy for Alzheimer's Disease

STEM

NSF REU Site: Genetic and Biochemical Analysis of Proteins

Authors(s):

Erwin Kingston† (Agriculture)

Abstract:

Alzheimer's Disease (AD) affects over 38 million people worldwide, yet a breakthrough cure remains elusive. ASC is an adaptor protein consisting of pyrin (PYD) domain and caspase associated recruiting domain (CARD) that oligomerize into filaments to form supramolecular complexes like the inflammasome. ASC has been shown to cross-seed the formation of amyloid plaques and plays a role in propagating the inflammation associated with AD. In this study we expressed and purified full-length ASC single mutants and compared their filament formation with ASC double mutants. We used fluorescence polarization assay to show the filament formation of these ASC mutants. We also tested previously known compounds against ASC and observed no change in the filament formation. Additionally, we tested a lead compound (Hit-1) and it showed decrease in the initial rate of filament formation of ASC variants. We next optimize the crystal conditions for ASC CARD domain, to solve the structure of ASC CARD and Hit-1 complex. Further,we use Cryo-EM to understand the morphological differences between the filaments formation by ASC mutants in the presence and absence of Hit-1. This work positions the inhibition of ASC as a potential therapeutic vulnerability at the convergence of neuroinflammation and amyloid pathology in AD.

Mentor(s):

Andrew D Mesecar (Centers & Institutes); Nidhi Walia (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1208

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Investigating the Role of Dnmt3bas in Protecting the Dnmt3b Promoter from DNA Methylation

STEM

NSF REU Site: Genetic and Biochemical Analysis of Proteins

Authors(s):
Marlayna Little† (Agriculture)

Abstract:
DNA methylation at gene promoters is an important epigenetic mechanism that can silence gene expression without altering DNA sequence. DNA methylation is essential for maintaining cell identity and genome stability. The Dnmt3b gene encodes a DNA methyltransferase that establishes DNA methylation during development. The regions surrounding the Dnmt3b promoter become methylated over time; however, the promoter itself remains unmethylated. Previous studies have shown that the long noncoding RNA Dnmt3bas recruits a protein complex (PRC2) that catalyzes a repressive chromatin mark (H3K27me3), which may prevent the recruitment of proteins involved in DNA methylation. We hypothesize that Dnmt3bas protects the Dnmt3b promoter from DNA methylation by promoting PRC2-mediated H3K27me3. To test this, genomic DNA was isolated from embryonic stem cells (ESCs) with either normal Dnmt3bas expression or Dnmt3bas knockdown (KD). DNA was purified, quantified, and digested with the restriction enzyme FspEI, which cuts methylated DNA. Digestion was confirmed by agarose gel electrophoresis, and quantitative PCR was performed to measure the amount of uncut DNA remaining at the Dnmt3b promoter and control regions. Preliminary results showed consistent amplification of control regions across samples, indicating comparable DNA input and assay performance. Our current data show no change in DNA methylation at the Dnmt3b promoter in Dnmt3bas KD ESCs across passages, suggesting that DNA methylation is not established at the promoter in the undifferentiated state. Experiments using differentiated cells to test the effect of Dnmt3bas on Dnmt3b promoter methylation are underway. If our hypothesis is correct, we expect to see increased DNA methylation at the Dnmt3b promoter in Dnmt3bas KD ESCs after differentiation. If not, additional chromatin features may protect the promoter from DNA methylation, and future studies will investigate alternative mechanisms of epigenetic regulation.

Mentor(s):
Humaira Gowher (Agriculture); Mudasir Zahoor (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1209

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Optimization of 2-Hydroxyglutarate (2HG)-modified peptide enrichment and identification

STEM

NSF REU Site: Genetic and Biochemical Analysis of Proteins

Authors(s):

Christopher Powell† (Agriculture)

Abstract:

Oncometabolites have recently been established as important factors in cancer development as they accumulate alongside many cancer-associated mutations. One prominent oncometabolite, 2-Hydroxyglutarate (2HG)—which accumulates largely due to conversion of α-Ketoglutarate by mutant IDH1/2 proteins—has been associated with many cancers such as glioma and cholangiocarcinoma. Previous studies have suggested that 2HG progresses tumor development by competitively inhibiting α-Ketoglutarate dependent enzymes. However, a recent work from our group has revealed that 2HG can chemically modify various proteins, including those associated with tumorigenesis. The exact scope, mechanisms, and precise impacts of these modifications are not fully understood, partially due to the relative low abundance of modified peptides coupled with limited selectivity of enrichment methods. Here we aim to improve enrichment methods for 2HG-modified peptides to be used with mass-spectrometry based proteomics. Using a combination of ion-exchange chromatography and PolyMAC affinity beads, we achieved improvements in modified peptide enrichment. Further, we plan to couple enrichment with isotope labeling techniques to improve the assignment of fragmentation ions and thus identification of 2HG-modified peptides in MS/MS spectra. This work aims to provide an improved method allowing further in-depth research of 2HG modifications and their impacts on tumorigenesis and beyond.

Mentor(s):

Weiguo Andy Tao (Agriculture|Science); Shakhzodjon Uzokboev (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1210

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Identification of Regulators of RBX1 Turnover in the Absence of Glomulin

STEM

NSF REU Site: Genetic and Biochemical Analysis of Proteins

Authors(s):

Kyannet Rodriguez-Cruz† (Agriculture)

Abstract:

Ubiquitination is a crucial mechanism for protein and cellular homeostasis, and its dysfunction can lead to effects such as tumorigenesis, impaired DNA repair, exacerbated immune responses, and neurodegeneration. In this process, an E3 ligase tags a target protein with ubiquitin, marking it for degradation. The Cullin-RING Ligases (CRL) family mediates most of ubiquitination events in human cells, making it a critical research subject. CRLs require a RING protein, typically RBX1, which serves as a binding site for E2s, to catalyze ubiquitination. However, RBX1 can alternatively bind a protein called Glomulin (GLMN). Studies using GLMN knockout (KO) models demonstrate that its absence increases RBX1 degradation, significantly decreases RBX1 levels, and results in inefficient CRL substrate degradation. Also, loss-of-function mutations of the GLMN gene cause vascular anomalies known as Glomuvenous Malformations. This project aims to ultimately uncover the cellular machinery responsible for RBX1 degradation, whose activity is increased in GLMN KO. To identify the candidate proteins, we used proximity labeling approach, where RBX1 is fused with TurboID, an engineered biotin ligase that covalently attaches biotin to adjacent proteins. The biotinylated proteins were isolated using streptavidin magnetic beads for later identification via mass spectrometry. We expressed TurboID-RBX1 (full-length) in HEK293 cells with and without GLMN KO, as well as TurboID-RBX1 (RING domain) in GLMN KO cells, in a tetracycline (TET) titratable and inducible fashion. Thus far, we have confirmed TET titration via Western Blot, successfully generated protease resistant streptavidin conjugated beads, and used the beads to capture biotinylated proteins through affinity precipitation. Altogether, these advances bring us closer to better comprehend RBX1 turnover and elucidate the regulators of CRL activity.

Mentor(s):

Xing Liu (Agriculture); Rajasi Somesh Dravid (Agriculture)

Other Acknowledgement(s):
Leah N Durst (Agriculture)

Poster Presentation Abstract Number: 1211
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Geometric Characterization of Helix Orientation Across Protein Kinase Conformational States

STEM
REU-in-SCBB

Authors(s):
Nycholas Contreras† (PWL)

Abstract:
Protein kinases regulate cellular signaling through a process called phosphorylation whereby they phosphorylate substrate proteins to generate a cellular response. Kinases are also regulated via phosphorylation which promotes either a catalytically active or inactive state. This transition is managed by many structural changes, including αC-helix reorientation, repositioned side-chains of key residues, rearrangements of the activation loop, and the breaking and formation of critical salt bridges. Kinase structural databases now contain thousands of conformational states with considerable variation in these structural features. Most descriptions about conformational state reduce the αC-helix orientation to one distance, which ignores other degrees of freedom and how other helices' orientations can influence salt bridge formation. Several published methods quantify helical geometry using orientation, bending, tilt, and related geometric properties, and some have been proposed as feature-generation tools for machine learning. However, these ideas have not been explored across the kinase structural databases. This project aims to draw a connection between salt-bridge networks and geometric measurements of kinases to gain a better understanding of kinase conformations. Salt-bridges are measured directly from atomic coordinates, while helix bending and orientation are characterized geometrically across a set of kinase structures. Because misregulated kinase activity can be linked to many harmful diseases, and kinases are the second most common drug targets, a clearer description of active or inactive states could help design more effective inhibitors. This work also provides a foundation for a future kinome-wide, geometry-based approach to classifying kinase activation states.

Mentor(s):
Carol B Post (Pharmacy); Rajarshi Roy (Pharmacy)

Other Acknowledgement(s):
James Richard Ellegate (Pharmacy); Ismaila Adams (Pharmacy); Nicholas Noinaj (Science); Vivek Govind Kumar (Pharmacy)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1212
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Development of G-Quadruplex Database for Structural and Comparative Analysis

STEM
REU-in-SCBB

Authors(s):
Sebastian Cruz† (PWL)

Abstract:
G-Quadruplexes (G4s) are non-canonical secondary structures formed in guanosine-rich regions of DNA. Most biologically relevant G-quadruplexes are commonly formed by four G-tracks containing three continuous guanines. They are commonly found in telomeres and oncogene promoter regions, such as MYC, suggesting a regulatory function. Additionally, they have been proposed as important drug targets.

The current work aims to provide a comprehensive summary of all reported G4 structures, combined with biophysical characterization data, in the form of an accessible platform that enables future studies to build upon the cumulative knowledge in the field. For example, it could provide insights into future G4 recognition and targeting efforts. Other databases, such as the DSSR G4DB, while useful and comprehensive, do not include ligand information, complete nucleic acid sequence, or supporting biophysical data.

Within the database, genomic origin, sequence, folding structural features, and bound ligand information were recorded; alongside biophysical data including 1H NMR and circular dichroism spectra. These characteristics provide information on structure viability in biologically relevant conditions and key structural motifs that influence targeting efforts. Additionally, biophysical data provides a base to assess structure reliability. Throughout the construction of the database, capping structures and ligand-G4 interactions were visualized utilizing PyMol for comprehensive and comparative structural analysis.

Currently, 264 PDB structures (all reported NMR structures, to the best of our knowledge) have been added to the database, which allowed for easy analysis of reported structure subsets. Around 36% of reported structures displayed parallel topology. The remaining percent is composed of non-canonical folding topologies. Additionally, 19.7% are

G4-Ligand complexes. Our future endeavors will work towards the inclusion of X-ray and Cryo-EM structures.

Mentor(s):
Jinho Jang (Pharmacy); Danzhou Yang (Pharmacy)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1213
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Information Theoretic Analysis of Protein Structures

STEM
REU-in-SCBB

Authors(s):
Laura Dong† (PWL)

Abstract:
Classical information theory provides a means to quantify information and differentiate meaning from randomness in a communicated message. Since its invention in the 1950s, it has been extended to apply to a variety of fields, such as biology. Previous applications of information theory to biology include calculations of the information content of gene and protein sequences, determining protein-protein interactions, and analysis of metabolic, gene-regulatory, or protein interaction networks. However, little work has been done to investigate protein structure from an information-theoretic perspective. Recent advances in computational structural biology have popularized the graph representation of a protein as a way to reduce dimensionality for computational study and structure prediction. Utilizing these graph representations, we were able to calculate the entropies and information content of different proteins across their domains and disordered regions. We were also able to show how entropy of a multiple sequence alignment is connected to its protein structure.

Mentor(s):
Daisuke Kihara (Science); Anika Jain (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1214

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Discovery of Novel Covalent Inhibitors of the Cryptic Site of the Protein Tyrosine Phosphatase SHP-1.

STEM

REU-in-SCBB

Authors(s):

Roman Matamoros† (PWL); Olivia Nicole Safranek* (Science)

Abstract:

Protein Tyrosine Phosphatases (PTPs) are a family of enzymes that catalyze the dephosphorylation of phosphotyrosines, regenerating the tyrosine while also producing an inorganic phosphate. PTPs are the counterpart to Protein Tyrosine Kinases (PTKs) and play a role alongside them in cell signaling transduction pathways, such as the Receptor Tyrosine Kinase (RTK) and the Mitogen-Activated Protein Kinase (MAPK) pathways. The specific protein of interest is SHP-1 (Src Homology 2 Domain-Containing Phosphatase-1). Across the family of PTPs, the active site, which often contains a reactive cysteine residue that exists as a thiolate centered in a positively charged pocket, is highly conserved. This presents a challenge of obtaining selectivity so as not to encourage potentially toxic off-target effects. However, it has been found that there is a potential second site on the SHP-1 protein, a cryptic allosteric site. This site is revealed during natural fluctuations between the auto-inhibited “closed” state and the active “open” state. For context, SHP-1 naturally sits in an inactive state, and only opens up to reveal the active site when its N-SH2 domain binds to a phosphorylated tyrosine. Then, the N-SH2 domain swings up and out of the way for other phosphotyrosines to come in, bind, and be dephosphorylated by the cysteine and coordinating residues. During these natural interactions, when SHP-1 is activated, a cryptic site is revealed that also contains a cysteine residue. This solves the problem by allowing an opportunity for a covalent inhibitor to bind to this cryptic allosteric site therefore deactivating SHP-1. The reason for this comes from research that shows SHP-1 inhibition can enhance antitumor efficacy. SHP-1 acts as an inhibitory checkpoint for the immune system, so when it is deactivated, it allows T cells and Natural Killer cells to become more active. From an initial screening, M029 showed selectivity for SHP-1 over other PTPs with an IC50 of 2.6 ± μM.

Mentor(s):
Momen Mohamed Am Al-Hindy (Pharmacy); Zhong-Yin Zhang (Pharmacy|Science)

Other Acknowledgement(s):
Nicholas Noinaj (Science)

Poster Presentation Abstract Number: 1215

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Structural and Functional Insights into the Potent and Selective Inhibition of G Protein-Coupled Receptor Kinase 6

STEM

REU-in-SCBB

Authors(s):

Tyler Paine† (PWL)

Abstract:

G protein-coupled receptor kinases (GRKs) are kinases that primarily bind to and phosphorylate activated G protein-coupled receptors (GPCRs), thereby recruiting arrestins to facilitate their desensitization and internalization. There are seven human GRK isoforms that are grouped by sequence homology into GRK1/7, GRK2/3, and GRK4/5/6. Among them, GRK6 is found to be overexpressed in patients with multiple myeloma (MM), a blood cancer that produces cancerous M proteins in the plasma of bone marrow. Thus, GRK6 emerges as a key regulator of MM cell survival, with increased expression enhancing tumor-promoting signaling pathways. The central hypothesis of this study is that selective and potent inhibition of GRK6 will impair GRK6-driven survival signaling in MM, while minimizing off-target effects associated with broader GRK inhibition. A series of highly potent and selective inhibitors was synthesized based on Sunitinib, an FDA-approved inhibitor against receptor tyrosine kinases (RTKs), and aminoquinazoline scaffolds. Their kinase activity was quantitatively assessed using radiometric kinase inhibition assays. In addition, lead GRK6 inhibitors were evaluated in MM cell lines to determine whether inhibition of GRK6 compromises tumor cell viability. Among the compounds evaluated, several showed high potency (IC50 < 100 nM). Based on their favorable biochemical profiles, these lead compounds were further evaluated in MM cell viability assays. Consistent with their potent inhibition of GRK6, these compounds effectively reduced MM cell viability, with EC50 values less than 1 μM. Taken together, these findings establish multiple compounds as lead GRK6 inhibitors, with additional promising candidates. These inhibitors provide a foundation for future studies to evaluate GRK6 selectivity and determine inhibitor-bound structures using X-ray crystallography and cryo-EM, enabling mechanistic insight and guiding next-generation inhibitor design.

Mentor(s):

John Tesmer (Science); Sandali Lakmini Piladuwa Gamage (Science)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1216
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

DAQnuc: Per-Atom and Per-Residue Quality Assessment for Nucleic Acid Models from Cryo-EM Density Maps

STEM
REU-in-SCBB

Authors(s):
Isaiah Philip† (PWL); Devanshi Gupta‡ (PWL)

Abstract:
Accurate validation of atomic models built from cryo-EM density maps is essential for structural biology. However, existing local quality assessment tools like DAQ were developed specifically for proteins and do not extend naturally to nucleic acids. As RNA and DNA structures become increasingly prominent in the cryo-EM-solved structure landscape, a comparable quality metric is needed for nucleotide models.

We present DAQnuc, a per-atom and per-residue quality scoring method for nucleic acid models, adapting the real-time local quality estimation framework introduced by DAQ to the nucleic acid domain. DAQnuc generates a local atom- and residue-wise probability grid via deep learning, then queries this grid at each feature to assign a score reflecting the likelihood that the atom/residue assignment is correct. DAQnuc is implemented as a ChimeraX plugin that colors models on a red-blue gradient, from low (red) to high (blue) probability, with real-time scoring that gives users immediate feedback as they edit.

DAQnuc reports five scoring metrics: three residue-level (evaluating base type: A, G, C, or U/T) and two atom-level (evaluating atom group: base, sugar, or phosphate). Users can toggle between atom- and residue-level scoring to move from broad to fine-grained validation; e.g., flagging a low-probability residue, then using atom scores to pinpoint the responsible group.

Following the versioned-database strategy used in DAQ, we are benchmarking DAQnuc across multi-version DNA/RNA models in the PDB, testing whether significantly revised atoms/residues show consistent score improvement between earliest and latest versions. Preliminary results are promising (AUC 0.799, average precision 0.448); we continue refining the algorithm and tuning hyperparameters.

Mentor(s):
Genki Terashi (Science); Daisuke Kihara (Science)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1217
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Computational and Experimental Analysis of SAH Hydrolase inhibition by Adenosine Analogs

STEM
REU-in-SCBB

Authors(s):
Emily Truong† (PWL)

Abstract:
S-adenosylmethionine (SAM) is an important component of methylation reactions. It is a compound that is converted into S-Adenosylhomocysteine (SAH) after donating a methyl group to the desired protein. SAH Hydrolase (SAHH) is the only enzyme that breaks down SAH, keeping SAH levels low so that cellular methylation can continue. Because many candidate methyltransferase inhibitors are adenosine analogs structurally similar to SAH itself, such compounds risk inhibiting SAHH directly, causing SAH to accumulate and suppress methylation broadly rather than acting on their intended target.

To evaluate this potential off-target liability, a library of approximately 100 adenosine analogs was docked against the SAHH cofactor-binding pocket using AutoDock Vina. The docking poses were validated against the enzyme's known binding geometry to confirm that the compounds would engage in the correct spot biologically rather than reflecting scoring artifacts, flagging compounds likely to bind SAHH. Only a small subset of compounds showed validated binding to the true active site. Structural analysis confirmed that the full library shares the core chemical features required for SAHH's catalytic mechanism, indicating that computational screening alone cannot exclude any candidates from risk. Therefore, it is critical to experimentally validate the off-target effects during methyltransferase inhibitor development.

To validate these computational predictions, SAHH was purified using nickel-affinity chromatography, followed by His-tag removal. Protein purity was confirmed by SDS-PAGE, and concentration was determined by absorbance at 280 nm. A ThioGlo-4 based fluorescence assay was established to monitor SAHH activity by detecting the free thiol released by the hydrolysis of SAH. In this research, we determined the Km of purified SAHH for SAH, which then informs substrate conditions for subsequently screening the adenosine analog library directly against SAHH.

Mentor(s):
Mingqing Liu (Pharmacy); Rong Huang (Pharmacy); Nicholas Noinaj (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1218

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Characterizing the Role of Mouse Granzyme A in LPS-Mediated Inflammation

STEM

REU-in-SCBB

Authors(s):

Anika Vaz† (Purdue University); Samantha Sarah Lin‡ (Pharmacy|JMHC)

Abstract:

Granzyme A (GrA) is a 28 kDa serine protease that can form dimers and remains active in both monomeric and dimeric states, and is stored in the granules of cytotoxic lymphocytes. It is known for inducing death in infected or cancerous cells. Studies have reported elevated extracellular GrA levels in various inflammatory diseases, suggesting that GrA regulates inflammation and immune signaling. Notably, human GrA binds lipopolysaccharide (LPS), a component of the bacterial outer membrane, and interacts with the CD14/TLR4 receptor complex on monocytes, enhancing inflammatory signaling and pathogen clearance. Because mouse models are widely used to study immune mechanisms and develop therapies, determining whether mouse GrA shares this LPS-CD14/TLR4-mediated signaling function is essential for accurate translation to human disease. While human and mouse GrA are known to differ in their enzymatic substrate specificity, it remains unclear whether they function similarly in promoting LPS-mediated inflammatory signaling through CD14/TLR4, or whether additional species-specific differences exist in this pathway. We hypothesize that GrA facilitates LPS recognition by Toll-like receptors (TLR) through binding and delivering LPS to the CD14/TLR4 complex, a function we predict is conserved in mouse GrA. To test this, we are expressing and purifying recombinant mouse GrA. In collaboration with the Olson Lab, we will compare its biological activity to that of human GrA by examining each protein's ability to facilitate LPS-mediated CD14/TLR4 signaling and assessing whether their structures are conserved across species. These results will show whether mouse GrA mirrors the inflammatory function of human GrA, informing how reliably the mouse model captures GrA-mediated immune signaling in disease. Observing conserved function would validate the mouse model for studying GrA-mediated inflammation and support its use in future therapeutic research targeting GrA in inflammatory disease.

Mentor(s):
Marlyn Michelle Bush (Science); Nicholas Noinaj (Science)

Other Acknowledgement(s):
Jenny Alejandra Rodriguez Osorio (Science); Rheanna Elizabeth Walther (Science); Matthew Olson (Science); Yi Lien (Science)

Poster Presentation Abstract Number: 1219

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

EMT-Mediated Regulation of Exogenous Fatty Acid Uptake in Breast Cancer Cells

STEM

SROP

Authors(s):

Arianis Loraine Hernández Peña† (PWL)

Abstract:

Breast cancer is a leading cause of cancer-related death among women, largely due to metastasis. Metastasis is supported by cellular programs such as epithelial-to-mesenchymal transition (EMT), in which epithelial-like cells acquire mesenchymal traits that increase motility and invasion. EMT can be triggered by diverse cues, including growth factors such as TGF-β, which drives transcriptional reprogramming toward a mesenchymal state. Altered lipid metabolism enables aggressive breast cancer cells to accumulate lipid droplets, reservoirs of energy and lipid precursors that support survival and facilitate metastatic progression. However, whether EMT regulates exogenous fatty acid uptake and storage in cancer cells remains poorly understood. We investigated whether TGF-β-mediated EMT alters oleic acid (OA) uptake and lipid droplet accumulation in the 4T1 model of breast cancer. 4T1 cells were treated with PBS control, OA, TGF-β, and sequential OA/TGF-β conditions to evaluate whether EMT affects newly formed lipid droplets or modifies pre-existing lipid droplets. BODIPY493/503 staining detected neutral lipid droplets, and DAPI staining visualized nuclei. Preliminary results show that OA-treated 4T1 cells accumulated cytoplasmic lipid droplets, establishing BODIPY/DAPI staining as a useful assay for evaluating lipid droplets. Cells undergoing TGF-β-driven EMT showed decreased OA-uptake and reduced cytoplasmic lipid droplet storage compared with non-EMT OA-treated cells. These findings suggest that EMT alters exogenous fatty acid handling in 4T1 breast cancer cells. Understanding how EMT regulates lipid storage may reveal metabolic vulnerabilities in metastatic breast cancer and suggest strategies to inhibit metastasis, especially in obesity, where lipid availability is elevated. These findings support lipid metabolism as a potential therapeutic target. Next steps include quantifying BODIPY signal, confirming EMT markers, and testing migration or invasion.

Mentor(s):

michael Wendt (Vet Med); Yun Li (Vet Med)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1220

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Caffeic Acid-Tin Nanoparticles for Acute Kidney Injury Treatment

STEM

SROP

Authors(s):

Alexander Nikos Koron† (PWL)

Abstract:

Acute kidney injury (AKI) is characterized by the sudden and rapid loss of renal function, and is associated with mortality rates of 25-50%. AKI affects roughly 2 million hospitalized patients in the US annually, increasing healthcare costs by $5.4 billion to $24 billion. Currently, there are no approved therapies available for AKI, motivating the need for effective therapeutic strategies. One of the major drivers of AKI is the overproduction of reactive oxygen species (ROS), leading to oxidative stress and cell death. Therefore, we developed a novel caffeic acid-tin nanoparticle with antioxidant properties to scavenge excess ROS and restore oxidative balance for the successful treatment of AKI. We synthesized the nanoparticles using a 1:1 molar ratio of sodium stannate trihydrate to caffeic acid in a heated aqueous solution. Using UV-vis spectroscopy, the nanoparticles had a broadband absorbance spectrum, consistent with other tin-based nanoparticles. We measured the core size using transmission electron microscopy (TEM), the hydrodynamic size using dynamic light scattering (DLS), and the concentration using X-ray fluorescence (XRF). Our initial results yielded a Z-average hydrodynamic diameter of 37.7 ± 5.7 nm. Furthermore, we assessed nanoparticle stability under physiological conditions over 7 days. We quantified ROS scavenging capacity in solution using ABTS and H_2O_2 assay kits. Finally, we tested our nanoparticles in vitro using human embryonic kidney (HEK293) cells, both with and without H_2O_2 exposure. We expect that our nanoparticles will effectively scavenge ROS in a nanoparticle concentration-dependent manner. We also expect that caffeic acid-tin nanoparticles will not be toxic to HEK293 cells at therapeutic concentrations and will protect the cells from oxidative damage following H_2O_2 exposure. Successful validation would establish caffeic acid-tin nanoparticles as a novel therapeutic strategy warranting further investigation in animal models of AKI.

Mentor(s):

Jessica Hsu (HHS)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1221
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Salience of Racial Demographic Shift and Childlessness Information on Attitudes Towards Reproductive Choices

Social Science
SROP

Authors(s):
Jasmine Yichen Lu† (PWL)

Abstract:
As the United States becomes more ethnically diverse, White Americans have felt threatened and have expressed more prejudice against immigrants and racial minorities. The current study examines how these shifts in U.S. racial demographics impact attitudes toward women's reproductive choices and reproductive policy. We recruited 244 white, conservative male participants from CloudResearch, who were randomly assigned to watch a video either with information on the racial demographic shift or on the decline in long-form reading (control condition). After reading media posts either reporting high childlessness among White or Latina women, participants reported their attitudes on reproductive policy, women's childlessness, and perceived existential threat. In 2 (Demographic Shift: Race vs. Control) × 2 (High Childlessness: White vs. Latina) ANOVA, we found a significant main effect of childlessness information such that participants had more negative attitudes towards a White woman who was childless than a Latina woman. They were also less supportive of policies such as abortion when reading that White women (vs. Latina women) have high abortion rates and reported more existential threat (i.e., the fear that their racial ingroup will cease to exist). Counter to hypotheses, there was no significant main effect of the demographic shift condition or an interaction with the childlessness condition – our results did not support the notion that concerns about the racial demographic shift directly affect reproductive policy. However, they demonstrate that concerns about lower White birthrates may lower White men's support for women's choice in their reproductive decisions. These findings have implications for political rhetoric focused on birthrates and how it might shape political behavior.

Mentor(s):
Teri Kirby (HHS); Linh Nghiem Hai Pham (HHS)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1222
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Evaluating LLM Biases Across Computer Science Conferences and Institutions

STEM
SROP

Authors(s):
Erin Rodriguez† (PWL)

Abstract:
Large Language Models (LLMs) are revolutionizing the way in which students and researchers search for scientific literature. Although LLMs are efficient tools, such models can introduce biases that are not present in traditional research-focused search engines, diminishing their trustworthiness and reliability. The exact nature of these pressing biases, as well as their prevalence, has remained unstudied in the existing literature. In this work, we examine biases across conferences and institutions by conducting a comprehensive empirical study across six LLMs, including three proprietary foundation models and three smaller open-source models. Each model is provided with a series of prompts requesting for a ranking of conferences and institutions for different computer science niches. Preliminary findings on conference ranking tests show that models tend to rank traditional software engineering conferences higher than top-tier artificial intelligence conferences. Across most prompts, the bias towards software engineering led to lower-tier conferences being significantly overranked compared to other first-tier conferences. The issues persist across some models even when prompts do not directly mention software engineering, suggesting that these models fail to fully account for conference quality and instead prioritize the conference's relevance to the prompt, which does not align with established metrics. Our findings demonstrate a need to further investigate the circumstances in which these model inconsistencies arise. We identify some open problems and challenges for future work that would allow for a greater understanding of LLM biases in academia.

Mentor(s):
Lin Tan (Science); Kevin Zhang (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1223
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Evaluation of Visual Language Models Through Narrative Sensory Framing

STEM
SROP

Authors(s):
Lena Yvonne Grace Rotteveel† (PWL)

Abstract:
Previous psycholinguistic research notes that inserting non-sensory baseline verb phrases into a narrative shifts the human readers' perspective towards the narrator's opinion, whereas visual, olfactory, and gustatory verb phrases elicit more character-centered interpretations (Kaiser, 2021). If Visual Language Models (VLMs) process narrative perspectives similarly to humans, they should exhibit similar perspective bias. However, it is unclear how this linguistic framing is expressed through multimodal artificial intelligence, despite its impressive performance in downstream tasks. This study examines the similarities and differences in perspective bias when that concept is applied to VLMs, ultimately improving VLMs' transparency and interpretability. Using VLM (llava-hf/llava-1.5-7b-hf), we evaluated 100 narrative phrases presented as multi-sentence contexts with binary-choice questions (without images). These items were analyzed across three distinct prompting conditions designed as an ablation study: a standard text baseline, a prompt directing the model to reason as a linguist, and a structurally relaxed prompt removing detailed explanation constraints. Across all three prompts, it was noted that the VLMs' responses for baseline verb phrases closely aligned with human judgements. However, different from human behavior, the model also trended towards higher character preference when evaluating visual verb phrases. These results highlight a potential disconnect in multimodal narrative processing, suggesting that vision-language models weigh vision linguistic cues differently than human readers. The work adds to prior findings that VLMs mostly rely on their language backbone rather than the vision encoder when making linguistic decisions.

Mentor(s):
Yan Cong (Liberal Arts)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1224
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

High-Resolution Monitoring of the Lake Michigan Shoreline Position Using Orthorectified Camera Imagery

STEM
SROP

Authors(s):
Abner Obed Ruiz Pérez† (PWL)

Abstract:
The Shoreline of Lake Michigan has undergone substantial shifts in position in recent years, drawing the attention of coastal communities and researchers. Between 2013 and 2020, the Great Lakes experienced a rapid water level increase that led to substantial shifts in shoreline positions. Shoreline change has environmental, social, and economic impacts on coastal communities; the quantification of shoreline drift is necessary for addressing vulnerabilities, and assessment for natural and developed coastal areas. This research aims to quantify the movement of the Lake Michigan shoreline for Indiana Dunes State Park (IN, USA) using a newly-installed coastal camera that is part of the WebCOOS network. This system provides high resolution, open-source coastal observing cameras. An algorithm, based on a WebCOOS API, was developed to detect and delineate the shoreline location in camera imagery. This process utilizes a Blue-Red pixel index followed by an OTSU method of image thresholding technique. After this positioning is acquired, an orthorectification process that removes distortion on raw images was necessary to convert shoreline image coordinates to geographic coordinates. Field work was conducted to obtain ground control points from the berm and the shoreline to accurately orthorectify the images. Following rectification, a statistical comparison was performed to compare the team's camera-derived shoreline position with surveyed and pre-existing satellite-detected positions. Preliminary results from the model show the accurate identification of the shoreline positioning. Finally, challenges faced included camera resolution and objects that appeared in the images and occluded the shoreline (e.g. people, dogs, seagulls, etc). For future research improvements, the team should implement higher resolution cameras or infrared images to simplify the algorithmic detecting process, along with the continued collection of shoreline positions for calibration and validation.

Mentor(s):
Cary D Troy (Engineering)

Other Acknowledgement(s):
Kendahl R Klatt (Engineering); Owen R Hodges (Engineering); Max Ahrbecker (Engineering)

Poster Presentation Abstract Number: 1225

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Quasi-Steady State Performance Analysis of a Dual-Module Humidity Pump and Heat Pump Integrated Industrial Dryer

STEM

SURF

Authors(s):

Md Sadat Aarik† (Engineering); Ishan Gopu Nair‡ (Engineering); Mudit Pandey‡ (Engineering)

Abstract:

Conventional convective heat pump-based drying systems are highly energy-intensive due to the requirement of cooling air below its dew point to condense moisture before reheating. Membrane-based dehumidification offers an efficient alternative by driving moisture removal through a water vapor partial pressure gradient without requiring phase change. However, modeling the true performance of these systems is complex because agricultural and food specimens experience significant volume shrinkage, which continuously alters their moisture and thermal diffusivity properties during operation. Past literature frequently overlooks these dynamic drying kinetics, assuming static dryer outlet conditions. To address this gap, a dynamic simulation model was developed using the finite difference method to predict transient heat and mass transfer profiles along a dryer's length. The model's predicted average moisture content over time was successfully validated against experimental literature for banana slices. An investigation was conducted by varying the dryer inlet air velocity from 0.5 m/s to 2 m/s. Utilizing these transient dryer outlet profiles, the dynamic performance of an integrated dual-module humidity pump (DMHP) and vapor compression heat pump system was evaluated. The results demonstrate that the proposed parallel-channel membrane-assisted dryer successfully dried a batch of banana slices to their equilibrium moisture content while consuming a total of only 2 kWh of energy.

Mentor(s):

David Warsinger (Engineering); Davide Ziviani (Engineering); Md Ashiqur Rahman (Engineering)

Other Acknowledgement(s):

Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1226
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Radiation Cascade Studies in GST-C Using Molecular Dynamics

STEM
SURF

Authors(s):
Agustin Abt† (Engineering); Aryan Rauniyar‡ (Engineering)

Abstract:
Phase-change materials such as carbon-doped germanium antimony telluride (GST-C) are promising candidates for next-generation non-volatile memory and radiation-tolerant electronics because of their rapid, reversible switching between crystalline and amorphous phases. However, the atomistic mechanisms governing radiation-induced damage and structural recovery remain poorly understood. While ab initio molecular dynamics based on density functional theory (DFT) provides accurate descriptions of atomic interactions, its computational cost limits simulations to small systems and short timescales, preventing the study of fully developed displacement cascades. In this work, we employ an Allegro machine-learning interatomic potential, trained on DFT data, to drive large-scale molecular dynamics simulations in LAMMPS, enabling the study of radiation damage in crystalline GST-C with near-DFT-level accuracy at substantially lower computational cost. This approach enables simulations of primary knock-on atom (PKA) cascades for PKA energies between 200 eV and 10 keV, spanning different atomic species, crystallographic directions, temperatures, and carbon concentrations. To resolve how these conditions shape the damage, the resulting evolution is characterized with atomic resolution by quantifying defect production, structural recovery, residual damage, and the healing rate following the cascade. The proposed simulations are expected to elucidate how these parameters influence damage morphology and recovery dynamics, thereby clarifying the atomistic mechanisms and their associated timescales that govern phase stability under irradiation. This work is expected to establish a computational framework for predicting radiation-induced structural degradation in phase-change materials and to support the future design of radiation-hardened phase-change devices.

Mentor(s):
Ethan Wayne Holbrook (Engineering); Alejandro H Strachan (Engineering)

Other Acknowledgement(s):
Sourabh Vitthal Desai (PWL); Baptiste Tongasoa Martin (Engineering); Robert Joseph Appleton (PWL); Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1227

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Quantitative Analysis of Shape and Topological Changes in EVL Cells during zebrafish epiboly

STEM

SURF

Authors(s):

Garv Atri† (Engineering|Science)

Abstract:

Epiboly in zebrafish is a critical morphogenetic process that depends on the coordinated thinning and spreading of the enveloping layer (EVL), deep cells, and the yolk syncytial layer. Underlying these tissue-wide rearrangements are tightly regulated mechanical and molecular cues. In this study, we employ an imaging-driven computational approach to investigate EVL cell morphology and topology during epiboly in wild-type zebrafish. By using high-resolution confocal microscopy of Tg(actb2:lifeact-gfp) embryos, we capture detailed spatiotemporal data of EVL cells. We then apply advanced image-processing pipelines to map three-dimensional volumetric data onto two-dimensional projections while preserving depth information for robust cell segmentation and tracing in 3D. Through these computational methods, we extract morphometric descriptors—cell area, aspect ratio, and circularity—to quantify changes in cell shape during epiboly. We also evaluate topological parameters such as junctional angles, cell–cell border lengths, and neighbor exchange rates to gain insight into tissue-level packing geometry. This integrated methodology provides a quantitative framework for understanding the dynamic cellular reorganization that underlies epiboly. Furthermore, our imaging-based computational approach highlights the power of combining live imaging with quantitative analytics to elucidate how cellular behaviors drive tissue morphogenesis.

Mentor(s):

Linlin Li (Engineering)

Other Acknowledgement(s):

Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1228
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Selective Molecular Editing via Earth-Abundant Transition Metal Catalysis

STEM
SURF

Authors(s):
Aritra Barman† (Science)

Abstract:
Many biologically active molecules contain a beta-oxo-alpha-thio substituted structural motif, including pharmaceuticals such as diltiazem. Although its structurally related analogues have been prepared using well-established methods, the direct and efficient synthesis of this particular motif remains challenging and underexplored. In this project, we developed a new synthetic strategy based on a bromo-acyloxy transposition process previously discovered and studied in our laboratory. This protocol generates a more reactive intermediate during the reaction, allowing selective formation of carbon-sulphur and carbon-selenium bonds via Iron catalysis. To evaluate the versatility of this method, we tested a range of bromo-acyloxy-based starting materials derived from different synthetically prepared styrenes and migrating groups, as well as some sulfur- and selenium-based nucleophiles. The protocol consistently produced the desired thio-oxo and seleno-oxo products with great selectivity, thus overcoming the alpha-oxo-beta-thio selectivity issue observed in the conventional reactions. This strategy provides an efficient route to valuable sulphur- and selenium-derived molecular building blocks from simple, readily accessible starting materials, thereby facilitating the synthesis of pharmaceutically relevant compounds.

Mentor(s):
Saghnik Saha (Science); Ming Yu Ngai (Science)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1229

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

2D and 4D Ultrasound Assessment of Ejection Fraction in an Empagliflozin-Treated Murine Model of Duchenne Muscular Dystrophy

STEM

SURF

Authors(s):

Olivia Bell† (Engineering); Alekh Pratish Shah‡ (Engineering); Xavier Thomas Cedric Tribout‡ (PWL)

Abstract:

Duchenne muscular dystrophy (DMD) is an X-linked recessive disorder characterized by the progressive weakening of the skeletal and cardiac muscle. With recent advancements in addressing skeletal and respiratory muscle weakness, cardiomyopathy is the leading cause of death among individuals with DMD. We evaluated empagliflozin, a sodium-glucose cotransporter-2 inhibitor (SGLT2i), in this study as a potential therapeutic treatment through longitudinal 4D ultrasound assessment of cardiac function in the D2.B10-Dmdmdx/J murine model of DMD. Treatment efficacy is evaluated using the primary metric of left ventricular ejection fraction (EF). Conventional EF analysis relies on two-dimensional (2D) imaging, including both M-Mode short-axis and EKV long-axis views. However, because EF is dependent on accurate measurements of ventricular volume, recent studies have utilized 4D ultrasound imaging to quantify EF, demonstrating its ability to monitor disease progression in DMD. This study aims to further validate the use of 4D ultrasound imaging by comparing EF values obtained from 4D images with those derived from 2D M-Mode and EKV images. Although 2D M-Mode, EKV, and 4D ultrasound demonstrated comparable EF measurements, 4D-derived EF values exhibited lower variability, supporting greater sensitivity for detecting functional changes. In addition, respiratory function was examined in C57BL6/J mice using 2D ultrasound measurements of diaphragm excursion (movement upon inspiration) and diaphragm thickening fraction across varying respiratory rates to assess this methodology’s potential for future analysis of longitudinal respiratory dysfunction in DMD murine models. Results show that diaphragm excursion is an appropriate metric for respiratory function in the range of 80-110 breaths per minute, providing established respiratory measures and imaging protocols that can be extended to future DMD cohorts.

Mentor(s):
Craig Goergen (Engineering); Benjamin Zeidler (Engineering)

Other Acknowledgement(s):
Niharika Narra (Engineering); John Patrick Salvas (Engineering); Alyssa Marine Richards (Engineering); Conner Clair Earl (Engineering); Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1230

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Developing a Cave Virtual Reality Application for Geoscience Education using Collaborative Design to Establish Learning Goals

STEM

SURF

Authors(s):

Anushka Bhave† (Polytechnic); Hiya Samanta‡ (Science)

Abstract:

Geoscience courses prioritize hands-on learning to achieve pedagogical goals, a requirement that is traditionally fulfilled via field trips. However, trips to geological formations, such as caves, have accessibility concerns and can be expensive, indicating a need to explore alternative techniques, like virtual reality (VR), that can achieve similar pedagogical goals with realistic learning in the classroom. Previous work has suggested that VR can be used as an effective learning tool in the classroom; however, implementing a realistic and interactive experience following learning and teaching requirements delineated by both students and faculty in geoscience courses has not been explored. Three collaborative design (co-design) workshops with students and faculty in the Earth, Atmospheric, and Planetary Sciences department at Purdue University were conducted to determine educational requirements for a VR cave application. Concurrently, an initial VR cave application was constructed in Unity Game Engine using LiDAR data from the inside of Carlsbad Cave to construct the virtual cave environment and designing interactive components with Meta XR technologies. The co-design workshops identified interactive tools, namely a headlamp, a tape measure, a camera, a notebook, and a virtual tour guide, as essential tools for hands-on geoscience learning in the VR cave application. Based on these findings, the headlamp, tape measure, and camera features were implemented into the VR application. Current work focuses on developing the notebook and virtual tour guide. We will assess the effectiveness of this application by integrating this application into an undergraduate geoscience course at Purdue University in Fall 2026.

Mentor(s):

Caue Sciascia Borlina (Science); Anastasia Kouvaras Ostrowski (Polytechnic); Ali Bramson (Science)

Other Acknowledgement(s):

Nuela Enebechi (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1231

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Development of a Comfortable, Wearable, Cut-Resistant Hockey Neck Guard

STEM

SURF

Authors(s):

Cole J Burnett† (Engineering); Nicolas Gomez Velasquez‡ (Engineering)

Abstract:

Skate blade neck lacerations in ice hockey are rare but potentially life-threatening injuries that can sever the carotid artery and/or jugular vein. High-profile cases, including the death of NHL player Adam Johnson, have brought this issue into the national spotlight. As a result, governing bodies such as USA Hockey and the National Hockey League (NHL) have implemented neck guard requirements for multiple player categories. However, currently marketed neck guards often have limited coverage or restrict range of motion, prompting player resistance. This research seeks to develop a next-generation, comfortable, wearable, cut-resistant neck guard through a human-centered design approach. Cut-resistant composites containing thermoplastic elastomer (TPE) and Kevlar® were fabricated using compression molding. Samples were tested for cut resistance and stretchability to identify material stacks capable of achieving ANSI A5 cut resistance while maintaining the elasticity required for seamless don and doff. Stretchability was evaluated using ASTM standard D3107, with preliminary results suggesting that 10 Shore A TPE and interlock knit Kevlar® provide promising material stretch while minimizing long-term growth. Cut-resistance testing is ongoing using ASTM standard F2992, and results will influence final material selection. Outer shell fabrics and breathable 3D spacer mesh materials were also evaluated. Preliminary results indicate that a poly-spandex outer layer provides greater stretchability than nylon, while a 3 mm spacer mesh exhibits greater stretchability than a 1 mm spacer mesh. Selected materials will be integrated into a functional, neck-formed prototype using heat-forming and stitching. This research provides preliminary design guidance for developing a comfortable, wearable, cut-resistant hockey neck guard. Further research should explore integrating this neck guard into a breathable base-layer shirt to improve stability and promote player adoption.

Mentor(s):
Jan-Anders E Mansson (Engineering); Adeline Nora Ripberger (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1232
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Evaluation and Analysis of Low-GWP Refrigerant-Lubricant Miscibility for Ultra-Low Temperature Applications

STEM
SURF

Authors(s):
Emma Caron† (Engineering|JMHC)

Abstract:
With growing demand for ultra-low temperature (ULT) refrigeration systems, there is an increased need for understanding of refrigerant-lubricant properties. Current U.S. Environmental Protection Agency and European Union standards do not regulate global warming potential (GWP) limits on refrigeration equipment operating below −50°C. However, as ULT refrigeration continues to expand, the development of efficient, and environmentally sustainable refrigeration systems is becoming increasingly critical. The following study provides an experimental analysis on the properties of R170 (ethane) and POE 32 (polyolester oil). Ethane, a naturally occurring hydrocarbon, has been found to be a suitable replacement for high GWP refrigerants largely used today such as R23 and R508B. In this study, thermophysical properties were measured using a recirculation method. Based on previous literature studies, R170 and POE32 had been assumed to be completely miscible, but the experimental results show that this assumption cannot be generalized through the ultra-low temperature range and different refrigerant mass fractions. Following these observations, experiments were expanded to investigate refrigerant–lubricant miscibility. A large transparent test cell was used to visualize phase separation at various temperatures, allowing for the analysis of miscibility trends through refrigerant mass fractions from 0.54 to 0.8 and a minimum temperature of -70°C. The results of this work contribute to a better understanding of refrigerant relationships and support the advancement of refrigeration technology with less environmental impact.

Mentor(s):
Riley Bradley Barta (Engineering); Ganesh Brammanayagam venkatesan (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1233
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Additive Manufacturing of Transverse Flutes

STEM
SURF

Authors(s):
Anirud Chakkarapani† (Engineering); Mirza Orunav Shahper* (Engineering)

Abstract:
Additive manufacturing (AM), commonly known as 3D-printing, enables fabricating complex design structures that would otherwise be difficult to manufacture traditionally. The acoustic properties of woodwind instruments are highly related to their geometry and materials, making them an under-explored candidate for AM applications. This research aims to successfully design, manufacture and characterize AM woodwinds, specifically transverse flutes, with the use of Laser Bed Powder Fusion, Stereolithography, and Fused Deposition Modelling fabrication techniques. Mathematical modelling is used to guide decisions about instrument geometry, with Venu, Bansuri and Irish flutes used as references. The selected designs are manufactured in stainless steel, dental resin, and PLA plastic, before being compared to conventionally manufactured flutes made of bamboo and stainless steel. Frequency testing is used to assess the impact of fabrication method and material upon acoustic properties such as timber and tone of the instrument. Acoustic property variations can then be used for future instrument development where AM methods can be used to develop novel geometries or sounds.

Mentor(s):
Luz Sotelo (Engineering); Harshith Kumar Adepu (Engineering); Davis Roy Avera (Engineering)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1234

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Adhesive Interaction between Chitosan Microgel and Polystyrene Plastic Particle by Optical Tweezers

STEM

SURF

Authors(s):

Pin-Yu Chen† (Engineering|Science)

Abstract:

Biopolymer-based filters have been widely used for microplastic removal in aquatic environments. However, existing methods for characterizing adhesive interactions, such as colloidal probe atomic force microscopy and micropipette aspiration, are limited to unidirectional or colloidal-scale measurements. Here, we develop a flexible and high-fidelity method to characterize the distance-dependent interactions between chitosan microgels and polystyrene (PS) nanoparticles. Optical tweezers are used to trap and manipulate a single PS nanoparticle at varying positions relative to a fixed chitosan microgel. The adhesive interaction is quantified from the particle's Brownian fluctuations. Using the image segmentation capabilities of Meta Segment Anything Model 2, particle trajectories and fluctuations are tracked to establish the adhesion force-distance relationship. This study further investigates the effects of chitosan surface modifications and NaCl concentration on nanoparticle adsorption behavior. By introducing an optical tweezers-based framework for spatially resolved adhesion measurements, this work provides a versatile and high-precision strategy for characterizing interparticle interactions in diverse systems.

Mentor(s):

Junyuan Lu (Engineering); Jingang Li (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1235
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Towards translating Low Frequency Alternating Current (LFAC) stimulation for modulating bladder function

STEM
SURF

Authors(s):
Martinos Christodoulides† (Engineering)

Abstract:
Conventional electrical stimulation uses rectangular pulse waveforms to activate nerve fibers; however, it activates nerve fibers in the opposite order as natural nerve activation, with large fibers activated first, and smaller fibers activated by increasing stimulus strength. Low Frequency Alternating Current (LFAC) stimulation offers new modes to modulate nerve activity. At low amplitudes, it locally slows nerve conduction. With increasing amplitude, nerve conduction is blocked. With even larger amplitudes, the nerve activates, but with smaller fibers activating first and larger fibers activated with increasing stimulus strength.

However, safe delivery of the low frequency (<10Hz) LFAC waveform requires an electrode with both low low-frequency impedance and high low-frequency charge capacity. Several implantable bipolar cuff electrode devices were acquired or built. 1) USC CARRS parylene cuffs, 2) Cortec Biotex cuff, 3) Bioellab TPS+C cuffs, and 4) Bioellab Percolated Carbon cuffs. To assess the capabilities of the electrodes, each device was tested using Cyclic Voltammetry (CV) and Electrochemical Impedance Spectroscopy (EIS). The EIS phase, magnitude, and CV based charge capacity were characterized.

The thin film USC electrodes showed good impedance but volatile phase at low frequencies. The Bioellab electrodes showed low impedance and less phase at low frequency. The Stainless Steel electrodes had relatively low impedance for uncoated electrodes, but poor low frequency impedance and charge capacity. These improved minimally after electroplating with PEDOT:PSS. Both Bioellab's electrode design and CorTec's cuff displayed similar resistance and phase at low frequencies, making them viable candidates for use with LFAC in upcoming in-vivo trials for nerve conduction block.

Mentor(s):
Nathaniel Liam Lazorchak (Engineering); Ken Yoshida (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1236

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Resource Allocation to Mitochondria at Slow Growth Rates

STEM

SURF

Authors(s):

Allison Clark† (Science)

Abstract:

The mitochondrion is a crucial organelle primarily responsible for energy production in the form of adenosine triphosphate (ATP) via cellular respiration. Rapidly growing cells require more ATP for growing biosynthetic demands; thus, it is expected that as cells grow more rapidly, more resources will be invested into mitochondria. However, a seemingly contradictory pattern was previously observed, indicating that cells with low growth rates have large mitochondria and cells with high growth rates have small mitochondria. To investigate this paradox, two physiologically contrasting yeast species, Kluyveromyces marxianus and Vanderwaltozyma polyspora, were used to probe the proteome, quantifying how resources are being allocated at various growth rates. To achieve this, chemostats were run with a constant carbon source but differing dilution rates, allowing for continuous culturing of cells ranging from very low to high growth rates for multiple generations. These cells were then used for mass spectrometry-based proteomics to determine distinct differences and similarities in resource distribution between yeast species across growth rates. Exploring the pattern between growth rate and proteome resources devoted to mitochondria not only provides insight into a crucial cellular component but also allows for a better understanding of the unknown circumstances surrounding the ancestral single endosymbiotic event that gave rise to mitochondria.

Mentor(s):

Sergio Munoz-Gomez (Science)

Other Acknowledgement(s):

Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1237

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Iron Status, Cognitive Function, and Quality of Life in Perimenopausal Women: Baseline Findings from an Intervention Study

STEM

SURF

Authors(s):

William Thomas Covington†

Abstract:

Perimenopausal menorrhagia (PM), abnormally heavy bleeding during the menopause transition, affects about 25% of perimenopausal women and is a leading cause of iron deficiency and iron deficiency anemia. Iron deficiency has been linked to fatigue and decreased work performance, but its effects on cognitive function and quality of life in perimenopausal women are poorly understood. This study investigates the relationship between iron levels, cognitive function, and quality of life in this population, using baseline data collected prior to iron supplementation as part of a larger intervention trial. We hypothesized that women with lower iron levels would perform more poorly on cognitive tests and report reduced quality of life compared to iron-sufficient women. Participants recruited across several Indiana communities self-reported as perimenopausal, spoke English, and took no psychoactive medication. Iron status was assessed using ferritin, hemoglobin, soluble transferrin receptor, and alpha-1-acid glycoprotein, and participants were classified as iron sufficient, iron deficient, or iron deficient with anemia based on ferritin (adjusted when inflammation was present). Cognitive function was measured across five domains: inhibitory control, planning, attention, working memory, and cognitive flexibility. This was done via the Go/No-Go task, Tower of London, Attentional Network Task, Sternberg Working Memory Task, and Berg Card Sorting Test. Quality of life was evaluated using the Menopause-Specific Quality of Life Questionnaire, SF-36, Beck Depression Inventory, and FACES. Associations will be assessed with ANOVA across groups and Pearson correlations between ferritin and outcome scores. Recruitment and baseline assessments are ongoing. Findings will inform whether iron repletion should be considered as part of perimenopausal symptom management.

Mentor(s):

Laura Elaine Murray-Kolb (HHS); Emily Rebekah Seiger (HHS)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1238
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Investigating the Role of Lithium During FAU-to-CHA Inter-Zeolite Conversion

STEM
SURF

Authors(s):
Sylvia Isabella Diaz† (Engineering); Sarah E Mollan‡ (Engineering)

Abstract:
Zeolite catalysts are among the most versatile materials used in industry because of their well-defined pore structures, high stability, and ability to catalyze a wide range of chemical reactions. As the demand for more efficient and selective catalysts grows, developing methods to better control zeolite synthesis has become increasingly important. One such method is inter-zeolite conversion (IZC), in which a parent zeolite is transformed into a different zeolite framework. Compared to conventional synthesis, IZC can accelerate the conversion of faujasite (FAU) to chabazite (CHA) while providing greater control

over framework composition and catalyst properties.

Previous work has shown that the addition of lithium ions (Li^+) during FAU-to-CHA IZC accelerates crystallization and promotes the formation of paired aluminum sites. This is significant because the framework aluminum atoms determine the location of acid sites, influencing the catalytic properties and performance. However, the mechanism by which Li^+ directs aluminum during this transformation remains poorly understood. This project investigates the role of Li^+ during FAU-to-CHA

inter-zeolite conversion by breaking the synthesis process into individual stages and characterizing the material at each step. To investigate these effects, samples were synthesized with varied Li^+ concentrations and synthesis times and then characterized using XRD, elemental analysis, NH_3-TPD, micropore volume, and Co^{2+} ion exchange. By comparing these measurements across the synthesis, this work identifies how the structural, compositional, and acidic properties of the zeolite evolve during FAU-to-CHA inter-zeolite conversion, providing insight into the dynamic role of Li^+ throughout the transformation. A better understanding of these synthesis mechanisms will support the rational design of more effective zeolite catalysts for industrial applications, including emissions control and hydrocarbon conversion.

Mentor(s):
Sarah Gustafson Wagers (Engineering); Rajamani P Gounder (Engineering)

Other Acknowledgement(s):
Bereket Tassew Bekele (Engineering)

Poster Presentation Abstract Number: 1239
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Statistical Methods for Predicting Instability in Quantum Emitters

STEM
SURF

Authors(s):
Abhigyan Doshi† (Engineering)

Abstract:
Abstract: Quantum emitters can produce extremely narrow optical signals that are useful for quantum sensing, communication, and information processing, but their spectra often fluctuate over time. These fluctuations make it difficult to decide which emitters are stable enough for downstream experiments and which are likely to drift or become unpredictable. This project develops a data-driven framework for preselecting quantum emitters by measuring both spectral stability and forecastability. We analyze time-resolved zero-phonon-line spectra collected from multiple emitters and extract peak-position trajectories across sequential frames. To quantify whether an emitter remains in the same physical state over time, we compute replica-theory q-overlap statistics on local spectral windows. We then compare each local q-overlap distribution to identify unstable regions and behaviour of the emitters. These stability features are evaluated alongside forecasting baselines, including persistence, moving-average, autoregressive, hidden Markov, and recurrent neural-network models, to test whether replica-theory features explain when peak predictions fail. This framework provides a quantitative rule book for ranking emitters before expensive experiments, separating stable emitters from those that are unstable but still predictable. The results support a more reliable machine-learning workflow for selecting quantum systems suitable for future nanoscale quantum technologies and research.

Mentor(s):
Pranshu Maan (Engineering); Alexander V Kildishev (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1240
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Project Rosa: An Off-Grid Edge Computing Gateway for Agricultural Data

STEM
SURF

Authors(s):
Pavle Duric† (Engineering|Polytechnic); Spencer Michael Beane* (Engineering); Keri Lyn Christman* (PWL)

Abstract:
Modern agricultural monitoring relies on field sensors, but transmitting high-volume data is obstructed by signal attenuation from crops. Sending raw data to the cloud is expensive, and existing network infrastructure in rural US areas is often unreliable. While 5G and LTE are viable, they require optimal conditions rarely found on remote farms. To overcome these limitations, an affordable, highly portable, and entirely wireless edge computing gateway is needed. By processing data locally in the field, this off-grid system drastically reduces the amount of data that must be transmitted over weak networks.

Project Rosa is a reproducible edge computing node powered by a 12-volt system, capable of handling demanding tasks like image analysis. It overcomes crop signal attenuation using radio protocols such as Wi-Fi HaLow and LoRa, which operate in the 915 MHz Industrial, Scientific, and Medical (ISM) band. A LattePanda Mu handles local processing, while Ansible and Fedora Linux automate software deployment. To guarantee continuous off-grid operation during the cropping season, a Python simulation used NASA weather data to optimize solar panel and battery requirements.

Physical load tests revealed a 19-watt idle draw and a 33.7-watt spike under heavy stress, establishing a continuous average usage of 24 watts. Guided by the multi-year simulation, the minimum solar panel rating and battery capacity were identified to maintain 100% uptime while minimizing cost and physical footprint. Ultimately, Project Rosa provides a practical, automated, and power-efficient edge computing solution, paving the way for advanced local processing, such as machine-vision crop analysis.

Mentor(s):
Fabio Andres Castiblanco Rubio (Engineering); Yaguang Zhang

(Agriculture); Andrew Balmos (Engineering); James V Krogmeier (Engineering)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1241
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Functionalized DNA Tetrahedra for siRNA Delivery Across the Blood–Brain Barrier

STEM
SURF

Authors(s):
Emma Foster† (Engineering|Science)

Abstract:
A major challenge in drug delivery to the brain is the highly selective nature of the blood-brain

barrier (BBB), which severely limits the transport of therapeutics into the central nervous

system. Nanotechnology has emerged as a promising approach to improve therapeutic stability,

targeting, and transport across the BBB. DNA tetrahedra (TDN) are attractive nanocarriers due to

their high biocompatibility, small size, structural stability, and ability to carry therapeutic cargo.

Among these cargo, small interfering RNA (siRNA) has significant therapeutic potential, but is

severely limited in clinical applications due to its rapid degradation and poor cellular uptake.

Therefore, using DNA TDN to transport siRNA across the BBB holds great promise for

treatment of neurodegenerative diseases; however, efficient cellular uptake remains a key

challenge for maximizing therapeutic delivery. Functionalization of TDN with cholesterol, the

cationic lipids DOTMA and DOTAP, and the cationic polymer DEAE-Dextran was shown to

enhance cell membrane binding and promote cellular uptake. In this study, TDN with 2 full turns

between vertices (7.1 nm in length) were functionalized and evaluated for cellular association.

HBEC-5i human cerebral microvascular endothelial cells were used as an in-vitro BBB model.

Cells in 24-well plates were stained with Hoechst (nuclei) and DiO (cellular membrane), while

Cy3-labels were used to monitor TDN localization. Cells were incubated with media containing

functionalized TDN for one hour and observed using confocal microscopy. The results

demonstrate that functionalization significantly enhances cellular TDN associated with HBEC-5i

cells and siRNA uptake compared with unmodified TDN. Future work will focus on evaluating

additional functionalization strategies, optimizing further the ratios of functionalization

molecules, and assessing the intracellular delivery and biological activity of siRNA following

uptake.

Mentor(s):
Grigorii Aleksandrovich Rudakov (Engineering); Tamara L Kinzer-Ursem (Engineering); Leopold Noel Green (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1242
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Geographic Robustness for Agricultural Earth Observation Foundation Models through Post-Hoc Adaptation

STEM
SURF

Authors(s):
Akshith Garapati† (Engineering)

Abstract:
Earth Observation Foundation Models (EOFMs) are large scale machine learning models that have been gaining increasing utility for agricultural remote sensing tasks such as surveying croplands and yield estimation. However, their practical value is often limited due to geographic instability as they can underperform when transferred and used across different geographic regions with different climates and crop calendars. This study evaluates whether the frozen outputs of these EOFMs can be used to support geographically robust crop mapping tasks ensuring that they adapt well across new and unseen geographic regions through lightweight post-hoc adaptation wherein we do not edit the internal mechanisms of the model at all but only the final output, therefore preventing the cost of expensive model fine-tuning. We compare five representative EOFMs across four canonical benchmarks for agricultural tasks using a new experimental protocol that includes novel methodologies for splitting the datasets in order to simulate a more realistic deployment setting. In doing so, this protocol is able to evaluate the model capability, computation-efficiency and geographic robustness in a consistent framework. We identify that these frozen outputs retain useful agricultural information across geographic shifts and show results that indicate that this robustness varies across different models, benchmarks and deployment regimes. Our findings from applying lightweight post-hoc adaptation methods can guide more reliable and consistent use of these EOFMs in crop mapping, cropland classification and scalable decision support for agricultural tasks. This research tackles the pressing issue of deployability concerns amongst EOFMs with further work consisting of developing new experimental benchmarks that aim to gather new primary data to evaluate models on truly unseen data.

Mentor(s):
Dharmendra Saraswat (Agriculture|Engineering); David Iseri Inouye (Engineering); Rajiv Ranjan (Agriculture|Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1243
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Self-Improving Agent Skills for Reproducible Scientific Simulation Workflows

STEM
SURF

Authors(s):
Juan Garcia† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Hector Gomez Diaz (Engineering); Mahmoud Golestanian (Engineering); Lin Tan (Science)

Other Acknowledgement(s):
Jorge Enrique Neira Garcia (Engineering)

Poster Presentation Abstract Number: 1244
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Coated in slime: the physical properties of skin mucus across fish species

STEM
SURF

Authors(s):
Gabriela Garcia Cardenas† (Science)

Abstract:
Every fish is coated with a thin layer of mucus, a gel secreted by the epidermis that plays essential roles in respiration, osmoregulation, reproduction, immunity, and locomotion. Evidence suggests that fish mucus is viscoelastic, changing its physical properties with shear stress, such as when a fish increases swimming speed or brushes against the substrate. Despite fishes representing the most species-rich group of vertebrates (~35,000 species), the physical properties of skin mucus have been investigated in only a few species. This leaves a gap in our understanding of how these properties vary among fish species. To address this gap, we pursued three objectives: (1) to characterize interspecific variation in the physical properties of mucus, (2) to test how storage conditions affect these properties, and (3) to quantify interspecific variation in mucus production and its relationship to body mass, surface area, and body shape. Mucus was collected from 13 species by gently scraping the skin with our bare hands. The physical properties of mucus were characterized in five of these species using tests that evaluated how mucus responds to increasing shear forces, to slow and fast movements, and when it first begins to flow. So far, in every species tested, mucus behaved as a shear-thinning, predominantly elastic gel, consistent with a lubricating layer that may reduce frictional drag during swimming. Physical properties also showed interspecific variation, with eel mucus exhibiting lower viscoelasticity than the other species. Likewise, storage conditions altered these properties, underscoring the need for standardized handling. Finally, mucus production differed among species, and surface area and body mass were the best predictors ($r^2 \approx 0.8$). These preliminary results provide a first comparative view of how the physical properties of fish skin mucus vary across species and may reflect species-specific functional adaptations.

Mentor(s):
Dylan Kenji Wainwright (Agriculture|Science); Matthew Kaboolian (Engineering); Hana Noell Larkins (Science); Kendra A Erk (Engineering)

Other Acknowledgement(s):
Jorge Enrique Neira Garcia (Engineering)

Poster Presentation Abstract Number: 1245
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Scaling Real-Time Inference and Automated Anomaly Detection for 250+ Type II Supernovae

STEM
SURF

Authors(s):
Medhansh Garg† (Science)

Abstract:
The Vera C. Rubin Observatory is now operational and conducting the Legacy Survey of Space and Time, recording millions of changes in the sky each night and generating on the order of 20 TB of data nightly. This data volume is too large for manual inspection. The Recommender Engine for Intelligent Transient Tracking (REFITT) is an autonomous machine learning system that ingests alerts from time-domain surveys, forecasts the future evolution of transient light curves, and recommends optimal follow-up observations to participating facilities (Sravan et al. 2020). We extend REFITT by applying its inference models to a sample of more than 250 Type II supernovae observed with the Zwicky Transient Facility. The REFITT-CCSN Infer pipeline performs real-time characterization of each light curve, comparing the observed behavior against REFITT's inferred explosion parameters, including progenitor mass, mass loss rate, explosion energy, and total radioactive nickel mass. By doing so, the pipeline flags outliers with characteristics that depart significantly from model expectations. We present these candidates through an interactive, public-facing portal that enables astronomers to rapidly identify them and prioritize them for follow-up study.

Mentor(s):
Danny Milisavljevic (Science); Danielle Dickinson (Science)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1246

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

An Empirical Study of LLM-Driven Microwave Circuit Design

STEM

SURF

Authors(s):

Elijah Goodman† (Rochester Institute of Technology)

Abstract:

Microwave circuit design is a critical discipline in modern electronics; however, it remains complex and labor-intensive due to the need to customize circuits for specific characteristics of a target application. To remedy the labor need, this research investigates the feasibility of using large language models (LLMs) to design passive microwave circuits such as impedance matching networks, filters, and power dividers. The pipeline for this process takes a natural-language objective statement and prompts the LLM to generate circuit-design code with scikit-rf, simulate the resulting network, and check its performance against the originally provided specification. Early testing with a proprietary model, Claude Sonnet 4.6, was promising due to the ease with which the model repeatedly output correct executable simulation code that met the target performance characteristics. Similar testing was then run on freely available open-source models that were augmented with microwave circuit design documentation through retrieval-augmented generation (RAG). These LLMs were then embedded in an automated loop that returned simulation feedback to the models automatically, allowing for a chain-of-thought self-correction process without human intervention. Across this experimentation, the open-source models frequently failed to produce executable simulation code unlike the proprietary baseline –an unexpected outcome given the strong coding performance that LLMs typically exhibit. The source of the observed performance gap could stem from model capability, retrieval quality, prompt formatting, or orchestration; however, the exact reason remains under investigation. Additional avenues such as multi-model or swarm deployment also remain available and have yet to be explored; however, the results so far indicate that LLM-driven microwave circuit design is feasible with sufficiently capable models, and they motivate a closer study of why the open-source models tested here fell short.

Mentor(s):

Dan Jiao (Engineering); Hongyang Liu (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1247
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Q-JSR: A Hybrid Classical-Quantum Framework for Multi-Class Instance Segmentation in Aerial Imagery

STEM
SURF

Authors(s):
Arsh Gupta† (Science); Connor Siurek† (Science)

Abstract:
Dense urban aerial imagery from satellites and drones is increasingly used in urban planning, disaster response, and autonomous navigation. A core task here is instance segmentation: identifying and delineating every object, such as a building, tree, or vehicle, in a scene. This requires correct labeling and precise boundaries, even when objects overlap, cast shadows, or resemble one another. The Join-Split-Resize (JSR) framework represents an image as a graph of superpixels, small pixel regions, and iteratively merges or splits adjacent regions until each group corresponds to one object. JSR performs well on single-class scenes but loses accuracy in multi-class settings, since the number of possible decisions grows exponentially and JSR's sequential, greedy decisions cannot be revised once made.

This proposal introduces Q-JSR, a hybrid classical-quantum framework that replaces JSR's combinatorial decision stage with the Quantum Approximate Optimization Algorithm (QAOA), a gate-based quantum method for combinatorial optimization. Each merge or split decision is encoded as a qubit, and a cost function combining boundary strength, shape regularity, and cross-class consistency is optimized jointly rather than sequentially. A topology-aware mixing operator preserves the image's spatial structure, and the circuit is initialized using classical image features to bias the search toward promising configurations. To address current qubit limits, we explore vector quantization of local merge patterns to compress the decision space.

We evaluate Q-JSR against classical JSR using quantum circuit simulation on aerial segmentation benchmarks across single-, two-, and three-class settings, comparing joint quantum optimization to greedy sequential processing and identifying when quantum search offers measurable gains for overlapping classes and ambiguous boundaries.

Algorithmic modifications may occur in both versions of this abstract as the research progresses.

Mentor(s):
Daniel G Aliaga (Science); Eric Samperton (Science)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1248
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Using SAM2 for Floe Size Distribution Analysis

STEM
SURF

Authors(s):
Caleb Carr Hamilton† (Engineering)

Abstract:
Abstract:

The evolution of arctic sea ice floe size distribution (FSD) over the seasons is a complicated and not well understood process, due to the interaction of ice dynamics and thermodynamics. To study this phenomenon, we take a macroscopic approach, using AI image segmentation to determine the physical characteristics of floe(s) during specified time periods to extract useful data. Imaging of the arctic ice is achieved by using high resolution NASA satellite (WorldView-1, etc.) imaging in collaboration with the Polar Geospatial Center (PGC), which is then exported to a python script, utilizing Meta's image segmentation AI, Segment Anything Model 2 (SAM2), which can perform image masking for floe identification, and can actively provide surface area measures of each mask (after proper scaling is applied). This study compares the FSD to other experimental results which have been obtained using standard edge detection methods, which is used as calibration for the AI, using SAM2's masking which makes results easier to visualize, additionally SAM2 allows for tuning of the model to refine object detection. This research proposes a method to collect FSD values using high resolution satellite imagery and Meta's SAM2 AI, in the future the FSD results will be used to simulate floe melting and floe dynamics as time progresses using empirical results to confirm simulation results.

Mentor(s):
Yue Meng (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1249

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

When the Brakes Come Off: Investigating Role of CSK in Stem-Cell Growth and Blood Development

STEM

SURF

Authors(s):

Ananya Hegde† (Engineering)

Abstract:

Human pluripotent stem cells (hPSCs) are self-renewal and capable of differentiating into many cells, including hematopoietic cells. In this study, we investigated the role of C-terminal SRC kinase (CSK), a key negative regulator of growth-related signalling, by comparing wild-type hPSCs with CSK knockout (KO) hPSCs. Both lines were directed through endothelial and hematopoietic differentiation, followed by neutrophil specification, and evaluated using imaging and flow cytometry. We used stage-specific lineage markers to identify cell populations during differentiation in wild-type and CSK-KO lines. Without CSK, cells showed enhanced early proliferation, suggesting increased progenitor expansion. However, they also displayed reduced endothelial tube formation and less efficient neutrophil differentiation than wild-type controls. Together, these results suggest CSK loss accelerates early growth at the cost of proper blood-vessel organization and later immune-cell maturation. Overall, our results support a role for CSK in coordinating proliferation with faithful lineage commitment. As this same balance between proliferation and proper differentiation is central to both cancer and regenerative medicine, understanding CSK's role may inform how to control stem-cell behaviour for cancer therapy.

Mentor(s):

Xiaoping Bao (Engineering); Jingqiao Shen (Engineering)

Other Acknowledgement(s):

Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1250

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

RNA expression reveals heat shock resistance genes in distinct potato cultivars

STEM

SURF

Authors(s):

Valeria Raquel Hernandez Barboza† (Science)

Abstract:

Potato plants are a globally important crop, but they are sensitive to global warming. Tuber size and crop yields decrease significantly when plants are exposed to temperatures above 24 degrees, although not all cultivars are affected equally. Understanding temperature resistance in potato cultivars is necessary to uncover the mechanisms that protect these plants. Although we know thermotolerant potatoes produce tubers despite extreme temperatures by maintaining their metabolic systems, the genetic and molecular mechanisms that underly this are unknown. This research will identify genes and processes that contribute to resistance to high temperatures by measuring and comparing differential RNA expression in thermotolerant and susceptible cultivars of potatoes in the Phureja group, and examine changes in RNA level during 48h exposure to high temperature, followed by 24h at normal temperature. We use the stringtie bioinformatic tool to extend the reference genome annotation and quantify RNA. The functions of differentially expressed genes are identified by comparison to known proteins using gene ontology overrepresentation analysis. There are thousands of significant differentially expressed genes among the four cultivars. Many genes are clearly related to heat shock response and to conservation of energy and nutrients during exposure to high temperature. The cause of thermotolerance may be due to early activation of heat shock responses, or to suppression of genes that interrupt normal plant metabolic processes during heat exposure. As the planet warms, agriculture demands plants that can adapt to changing conditions. Identifying genes underlying thermotolerance is one step, but expanding research into genetic modification and transgenic production could be a key factor distinguishing food scarcity and food security in the upcoming decades.

Mentor(s):

Michael R Gribskov (Science)

Other Acknowledgement(s):

Jorge Enrique Neira Garcia (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1251
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Beyond Rest and Task: Information-Theoretic Measures of Brain Reconfiguration as Biomarkers of Familial Risk for Alcohol Use

STEM
SURF

Authors(s):
Ana Maria Hernandez Conde† (Engineering)

Abstract:
Brain connectivity research typically examines the brain either at rest or during tasks, often overlooking the critical transitions between these states. Yet these transitional periods, when the brain engages with or disengages from cognitive demands, offer a unique opportunity to understand how large-scale networks flexibly reorganize. Previous studies have characterized this reorganization using functional connectivity, but conventional approaches cannot determine whether brain regions share overlapping information (redundancy) or generate new information through their joint interactions (synergy). This limitation may obscure the mechanisms underlying functional brain reconfiguration.

Here, we quantify brain reconfiguration during transitions between rest and task-engaged states using two information-theoretic measures: Total Correlation (TC) and Dual Total Correlation (DTC). We further examine whether these reconfiguration patterns are associated with familial risk for alcohol use disorder (AUD). TC and DTC are estimated from discrete entropy across sliding windows of functional magnetic resonance imaging (fMRI) data from 54 participants and 17 large-scale functional brain networks. We compare individuals with (FHA+) and without (FHA−) a family history of AUD during both task engagement and disengagement, and assess associations with alcohol consumption, impulsivity, and other behavioral risk measures.

This work tests whether redundancy- and synergy-related patterns of functional reconfiguration differ as a function of familial AUD risk. More broadly, it evaluates whether information-theoretic measures provide greater sensitivity than conventional functional connectivity for detecting AUD-related alterations in large-scale brain dynamics and identifying candidate biomarkers of addiction vulnerability.

Mentor(s):
Joaquin Goñi (Engineering)

Other Acknowledgement(s):
Jorge Enrique Neira Garcia (Engineering); Daniel Guerrero (Engineering); Mahdi Moghaddam (Engineering)

Poster Presentation Abstract Number: 1252

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Evaluating Grid Collimator Spatial Configurations to Maximize Bystander Effects in Spatially Fractionated Radiation Therapy

STEM

SURF

Authors(s):

Kenli Hetrick† (HHS); Pia Kapur‡ (Centers & Institutes)

Abstract:

A century after its first use in 1909, spatially fractionated radiation therapy (SFRT) has re-emerged as a valuable approach for treating bulky, deep-seated, or recurrent tumors, mostly in palliative settings. SFRT delivers radiation in high-dose “peaks” and low-dose “valleys.” This dose heterogeneity has been found to elicit the bystander effect in tumors, a phenomenon where cells in the low dose valley regions have similar levels of cell death as cells in the high dose peak regions due to cell signaling. Despite its long clinical history, the optimal spatial arrangement of “peaks” and “valleys” is still unknown. With modern technological advances, new investigations are warranted to determine the most effective grid collimator configurations for eliciting the bystander effect in tumors. Even in current clinical practice, there is no standardization; institutions create SFRT plans that differ greatly compared to one another. To address this gap, we conducted experiments on 4T1 cells, an aggressive murine mammary cancer cell line used to model human triple-negative breast cancer. We utilized multiple uniquely designed 3D-printed grid collimators at 2 Gy and 8 Gy with corresponding non-grid controls in an in vitro experiment, counting the cells 48 hours after treatment to assess which treatment is most effective. The working hypothesis is that grid collimation configurations with the highest perimeter to area ratio will produce greater anti-tumor effects and stronger bystander effects than conventional irradiation and other grid collimator configurations. The results will be used to identify the most effective grid collimator designs for future in vivo experiments.

Mentor(s):

Matthew Louis Scarpelli (HHS); MacKenzie Coon-Haworth (HHS)

Other Acknowledgement(s):

Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1253
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Injectable Alginate–Chitosan Hydrogel: Fabrication and Characterization

STEM
SURF

Authors(s):
Habin Jang† (Agriculture|Engineering); Maxwell J Gootee‡ (HHS|Liberal Arts|JMHC)

Abstract:
Chronic wounds and diabetic ulcers remain a significant clinical challenge because conventional wound dressings often fail to provide an optimal environment for tissue regeneration and sustained therapeutic delivery. Injectable hydrogels have emerged as promising biomaterials due to their ability to maintain a moist wound environment and support cell infiltration. This study focuses on the fabrication, optimization, and physicochemical characterization of an injectable alginate–chitosan for wound healing applications. Sodium alginate and chitosan were selected because of their excellent biocompatibility, biodegradability, antimicrobial properties, and mild calcium-mediated ionic crosslinking. Hydrogel formulations will be prepared by systematically varying polymer composition and crosslinking conditions to optimize structural and mechanical properties. Physicochemical characterization will include scanning electron microscopy(SEM) to evaluate pore morphology, Fourier transform infrared spectroscopy(FTIR) to confirm polymer interactions, rheological analysis to determine viscoelastic behavior and injectability, and swelling and degradation studies to assess hydrogel stability under physiological conditions. This work focuses on comparing hydrogel formulations to identify the composition that provides the best structural integrity, porosity, mechanical performance, and stability for future biological applications. This study is expected to establish a reproducible hydrogel fabrication protocol and provide essential design parameters for developing advanced biomaterial platforms for wound healing and future applications.

Mentor(s):
Arezoo Ardekani (Engineering); Elham Saberian (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1254
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Effect of Delivery Methods of Hyaluronidase on Enzymatic Degradation of Hyaluronic Acid

STEM
SURF

Authors(s):
Mia Alexandra Jensen† (Engineering)

Abstract:
Pancreatic cancer has one of the lowest 5-year survival rates of all major cancer types, at only 13%. A major barrier in treating pancreatic cancer is the dense connective tissue containing hyaluronic acid(HA) surrounding the tumor cells. The accumulation of HA not only contributes to tumor progression but also prevents systemic agents and immune cells from entering into the tumor. This limits the effectiveness of conventional systemic treatments and contributes to poor therapeutic outcomes. To combat this difficulty, this research project aims to develop a method of enzymatically degrading HA using injectable in-situ forming implants (ISFIs) that solidify in aqueous environments to achieve controlled delivery of hyaluronidase (HAase) and improve therapeutic accessibility.

In-vitro release study testing was conducted to generate release profiles for implants made from different polymers. Different delivery techniques, such as controlled release using ISFIs, or direct injection of HAase, were compared. Samples were collected on a logarithmic timescale over the course of 21 days to evaluate HAase release and changes in solution viscosity. The testing was done by dropping implant solution or drug solution containing 1% HAase into 15 mL 1.3% HA solution baths. To analyze the collected samples, MicroBCA assays will be used to determine the amount of HAase present at the selected time points. Rotational rheology will be used to monitor the change in viscosity over the course of the study when exposed to different shear rates.

It is expected to see rapid degradation in the case of the direct injection, but a slower and longer-lasting degradation in the implants, which will better support systemic therapeutics used over a longer period of time. This work provides a framework for reducing the accumulation of HA present in pancreatic tumors and enhancing current systemic treatments to increase chances of remission and long-term survival.

Mentor(s):
Jinyang Du (Engineering); Luis Solorio (Engineering)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1255

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Exploration of Finetuning Methods for Deep Learning-Based Aortic Root Segmentation on Echocardiography

STEM

SURF

Authors(s):

Julia Kang† (Engineering|Science); Julian Vuong‡ (Engineering); Ojas Chaturvedi‡ (Science|JMHC)

Abstract:

Accurate analysis of aortic root structure from parasternal long-axis views of transthoracic echocardiography is crucial to monitor disease progression in pediatric patients with aneurysms linked to genetic connective tissue disorders such as Marfan syndrome (MFS). Our lab previously developed a cascaded spatiotemporal model trained on a dataset of 90 subjects (45 controls, 45 MFS, ages 5-15) to automatically segment aortic root boundaries from ultrasound videos. In this study, we evaluated whether this model could generalize to an independent dataset (n=140) spanning five diagnostic categories: MFS, suspected MFS, bicuspid aortic valve, idiopathic thoracic aortic aneurysm, and other syndromic disorders. Given the broader range of conditions, this dataset had increased variability in structure, tissue appearance, and image quality. To address this domain shift, we applied transfer learning using three finetuning methods, updating the model's pre-trained weights with new data while preserving learned features: (A) frozen encoder with decoder retraining, (B) partial encoder freezing, and (C) progressive unfreezing, with the encoder initially frozen and later fully unfrozen. Performance was evaluated using Dice similarity coefficient, Intersection over Union (IoU) score, and Hausdorff distance (HD) on the test set, where pixels must have at least a 50% likelihood of belonging in the aortic root to be included in the final segmentation mask. All methods achieved comparable Dice (0.86) and IoU (0.76-0.77) scores. However, (B) produced the lowest HD (10.76 px vs. 11.58-11.65 px), meaning its predicted boundaries were nearly a full pixel closer to the ground truth value. These results suggest that transfer learning effectively adapts pre-trained models to more clinically diverse datasets, with partial freezing providing the strongest performance in terms of HD, and that overlap-based metrics alone may obscure meaningful differences in boundary accuracy.

Mentor(s):
Shubh Parag Mehta (Engineering); Craig Goergen (Engineering);
Benjamin Landis (Indiana University)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1256
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Agricultural-Vehicle-Based Radio-Frequency Readout System for Underground Biodegradable Sensors and Batteries

STEM
SURF

Authors(s):
Pataraphol Keeraswangporn† (Engineering)

Abstract:
In precision agriculture, when dealing with underground sensors, there are limitations such as labor cost and electronic-waste. Biodegradable sensors and batteries address this problem by providing systems that can degrade safely, eliminating electronic-waste and need for extraction. However, these systems require a reliable method for data collection. To address this need, this research aims to develop an agricultural-vehicle-based radio-frequency (RF) readout system for active communication boards powered by biodegradable batteries. The initial system uses Raspberry Pi 5, LibreVNA for RF scanning, and automated scripts for continuous data collection. One challenge with mobile sensing systems is achieving scan times fast enough to detect all nodes while the vehicle is moving. Therefore, the maximum allowable scan time was determined through geometric scan-window calculations. Assuming a triangular detection region with a 60° apex angle and 0.447m/s vehicle speed, allowable scan time was 0.395seconds. Lab trials minimized LibreVNA scan time to 0.9seconds by narrowing the frequency window to 205–213MHz, increasing resolution bandwidth to 3kHz, and disabling SignalID. Since scan time was beyond 0.395seconds, software-defined radio hardware was evaluated as a faster alternative due to its real-time analysis vs the LibreVNA's swept-tuned analysis. B200mini hardware was implemented in GNU Radio with FFT processing, peak detection, SNR estimation, local JSONL logging, and NATS publishing. Lab tests showed the SDR allowed for instantaneous scans with up to 56MHz bandwidth and detection range beyond that of the LibreVNA. This work identifies SDR-based RF sensing as the stronger path toward field-ready underground biobattery detection.

Mentor(s):
Fabio Andres Castiblanco Rubio (Engineering); Yaguang Zhang (Agriculture)

Other Acknowledgement(s):
James V Krogmeier (Engineering); Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1257
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Laser-Profilometry-Driven Digital Twin System for Defect Detection during Automated Fiber Placement

STEM
SURF

Authors(s):
Rohan Kelkar† (Engineering); Hongsen Fang‡ (Engineering)

Abstract:
Automated Fiber Placement (AFP) is a manufacturing method for autonomously creating composites structures. Composite manufacturing is notoriously slow, and AFP serves as a way of rapidly scaling composite production. However, AFP still has some drawbacks, one of which being the inability to detect or correct defects as they are created. Tow defects like gaps, wrinkles, and overlaps can significantly reduce the quality of the resulting composite. Manual inspection of parts can be time consuming and inaccurate. Therefore, a digital twin system was developed to detect defects in real-time. This method uses a 2D laser profile scanner mounted on the AFP head to gather profile data along the length of the tows as the layup proceeds. This data is then used to create a digital twin of the system that can be used for modeling and simulation. Simple defect identification algorithms are then run on the data to detect and classify the defects. The testing of these algorithms shows that this system accurately detects common AFP defects. This research worked on developing a digital twin for the AFP system using the laser profile scanner. This work can be used as a precursor to a real-time monitoring program that will adjust the robot to mitigate errors as they develop. To begin this process, a more robust digital twin that integrates several different sensors to create a comprehensive snapshot of the system at each moment in time should be developed.

Mentor(s):
Dianyun Zhang (Engineering); Yao Sun (Engineering)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1258
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Deployment of Autonomous and Passive Micro-Morphing Aerial Vehicles (MMAVs)

STEM
SURF

Authors(s):
Kai X Keller† (Engineering); Jamie Chanadol Henson† (Engineering); Nhuan Boi Duong‡; Haoyu Zhang‡ (Engineering)

Abstract:
Widespread deployment and scaling of micro-aerial vehicles (MAVs) remain limited by tight constraints on mass, power, and controllability. Most conventional designs rely on active propulsion and dense sensor suites, which limit maneuverability and increase complexity. This research addresses controlled descent and autonomous guidance in a sub-0.15 kg MAV using continuous geometry morphing. Through variable wing sweep and morphing mechanisms, the vehicle reshapes itself mid-flight to transition between an actively controlled glide and a passively stabilized autorotation. In autorotation, one wing flips over to induce a samara-like spin, allowing the vehicle to descend slowly with minimal energy expenditure. A compact, two-degree-of-freedom mechanism at each wing drives these structural transitions. Wing geometry was optimized using Lifting-Line Theory (LLT) and the Vortex Lattice Method (VLM) to balance aerodynamic performance across both flight modes. Flight testing demonstrates repeatable deployment into a consistent initial state, along with commanded downrange drift and steering during descent. Future work centers on GNC algorithms to close the loop for autonomous path planning, and refined aerodynamic models for wind response.

Mentor(s):
Yooseung Choi (Engineering); Ran Dai (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1259
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Imaging and analysis of pSmad signaling following optogenetic BMP activation in zebrafish embryogenesis

STEM
SURF

Authors(s):
Emma M Kindwall† (Engineering)

Abstract:
Morphogens govern cell fates by creating gradients that activate transcriptional factors to express certain genes. The bone morphogenetic protein (BMP), a morphogen, plays a vital role in establishing the dorsal-ventral axis and determining cell fate in Danio rerio (zebrafish) embryo development. Smad proteins within the BMP signaling pathway act as the intracellular signal carriers. This highly conserved pathway is dependent on the dephosphorylation rate of the Smad network. The levels of phosphorylated Smad (pSmad) within zebrafish embryos will be quantified after immunostaining, imaged using a Bruker Luxendo MuVi SPIM lightsheet microscope, and processed by storing the average fluorescence intensity associated with each nucleus to observe the signaling gradient across each embryo. This new imaging and processing pipeline will allow us to collect high-quality data of later stage embryos, which cannot be reliably imaged on confocal microscopes due to photo-bleaching and signal drop-off of embryo structures developed later than 6 hours post fertilization (hpf).

The overall rate of dephosphorylation will be tested in wild-type and mutant zebrafish embryos using a reversible optogenetics tool to increase signaling levels and observe the depletion over time. The rate has been approximated in wild-type fish previously; however, feedback loops may react differently to extremely high levels of pSmad signal. Utilizing this tool in mutant embryos that cannot produce any BMP signaling will allow the signal to remain within, or closer to, physiological levels. Studying the pathway in simpler models allows for a greater understanding of the mechanisms involved in human diseases affecting bone and tumor growth.

Mentor(s):
Nissa Larson (Engineering); Linlin Li (Engineering); David M Umulis (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1260
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Automated Radio Evaluation Suite: Modular Testing Architecture

STEM
SURF

Authors(s):
Joseph Timothy Kritenbrink† (Engineering)

Abstract:
Next-generation communication networks demand rapid, repeatable, and precise radio frequency (RF) measurements, but traditional lab setups are slow and manual, and commercial automation tools are often costly for research labs. The Automated Radio Evaluation Suite (ARES), an open-source, MATLAB-based platform, addresses this gap by automating testing workflows for two critical components of modern wireless systems: antennas and power amplifiers. Previously, ARES was tightly coupled to specific instruments and manufacturers, restricting its use to a single lab environment. Our work overcomes these limitations through the addition of a four-layered, object-oriented redesign that standardizes how the ARES software communicates with instruments regardless of manufacturer. With the addition of an instrument template, new hardware can now be added with no changes to the core codebase, requiring nothing more than a configuration file entry and its corresponding command dialect. A new simulated transport layer also allows developers to write and test code without physical access to the bench, removing a significant development bottleneck. To demonstrate these capabilities, a vector network analyzer previously incompatible with ARES was successfully integrated and validated alongside a suite of signal generators, spectrum analyzers, and power supplies — transforming ARES from a single-lab tool into a globally deployable RF measurement suite. ARES has also been expanded to support simultaneous multi-port measurements, unlocking advanced testing for next-generation antenna configurations such as multiple-input multiple-output (MIMO) systems. This development lays the crucial groundwork for future capabilities, paving the way for advanced wireless testing and next-generation radar systems that will expand the platform's reach across both industry and research.

Mentor(s):
Alex Santiago-Vargas (Engineering); Dimitrios Peroulis (PWL)

Other Acknowledgement(s):
Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1261
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

From outputs to confidence: Quantifying trust in science agents

STEM
SURF

Authors(s):
Caleb Eunho Lee† (Science)

Abstract:
Finite element (FE) analysis is the core of computational engineering, enabling the design and verification of complex physical systems. While agentic Large Language Model systems have shown potential in automating these technical workflows, their tendency to hallucinate incorrect mathematical formulations makes them unreliable for high-consequence scientific applications, such as drug discovery. This research addresses the need for trustworthy and auditable artificial intelligence by developing a framework to quantify confidence in autonomous scientific outputs. We utilized an existing agentic system fine-tuned for Finite element methods as a testbed to replicate a corpus of 50 computational physics papers. The agent's reasoning process was instrumented across four critical stages: data extraction, weak-form derivation, code implementation, and results verification. From these traces, we collected objective evidence regarding the completeness of the extracted data, the consistency of the mathematical reasoning, and the internal uncertainty of the model. These observables were then used to train a classification model designed to predict whether a final result is trustworthy based on expert-assigned labels. This research treats trust as a measurable property of the simulation workflow rather than merely evaluating end-task success. The resulting framework provides a blueprint for deploying autonomous agents in regulated scientific environments, ensuring that their reasoning is provenance-aware and their conclusions are verifiable for engineering use.

Mentor(s):
Hector Gomez Diaz (Engineering); Mahmoud Golestanian (Engineering); Jing Gao (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1262
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

AURAMCP: Enhancing nanoHUB's FAIR Workflows and Data through MCP Servers

STEM
SURF

Authors(s):
Yoon gi Lee† (Engineering)

Abstract:
Agentic research assistants have become extremely powerful as drivers of autonomous scientific workflows because of their adaptability, tool-integration capabilities, and reasoning/planning abilities. AURA, nanoHUB's Autonomous Universal Research Assistant, exemplified this by using a multi-agent structure to interact with the tools in the nanoHUB platform, code execution environments, and the Materials Project database. Its main innovation was that these tools are discovered through metadata at runtime instead of hardcoded toolsets. However, AURA is still limited by its custom LangGraph implementation, embedded connections to the nanoHUB infrastructure, and its underlying prompts custom-made for GPT-5.2. This means at its current standing, it is not portable; other agents or clients cannot easily communicate with AURA, and AURA struggles to integrate with external tools. Thus, to improve the system's interoperability, we introduce AURA's Model Context Protocol (MCP) server, AURAMCP. Under AURAMCP, users can interact with an MCP server exposing nanoHUB (Sim2L / Rappture) workflows as standardized, documented, callable tools. These servers can be utilized by modern AI models different from the original AURA implementation. Improvement in the AI models' space has shown that newer models have the potential of orchestrating these types of systems going beyond AURA's original scope and enabling the discovery of new tool chains or capabilities.

Mentor(s):
Juan Carlos Verduzco Gastelum (Centers & Institutes); Alejandro H Strachan (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1263

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Deformation of Fracture Networks Under Normal Loading

STEM

SURF

Authors(s):

Anastasia Patricia Lesniewski† (Liberal Arts|Science); Connor Siurek* (Science)

Abstract:

Fracture networks in the Earth's subsurface are subjected to changes in stress from natural and engineered processes. Understanding how a fracture network deforms under stress is of critical importance to the prediction of subsurface fluid flow in geothermal applications. Previous laboratory studies have primarily focused on the deformation of single orthogonal fracture intersections under normal stress. However, natural and engineered processes often induce shear stress, and the response of multi-intersection networks to complex loading remains unquantified. Here, we explore how a fracture network composed of nine "T" intersections responds to normal and shear loading to determine how fracture geometry affects deformation, connectivity, and potential fluid-flow pathways. Building upon established experimental methods, 3D-printed samples (FormLabs 4, 25 um print resolution) with randomly generated rough surfaces were used to create T-fractures with intersection offsets of 50 um, 100 um, and 150 um. Using an in-situ stress rig, high-resolution X-ray imaging (Zeiss Versa 510 X-ray Microscope) was performed for normal loads (100 N, 400 N, and 800 N) with and without shear stress. Fracture thickness meshes were extracted from the reconstructed 3D volumes using Dragonfly segmentation. These data are analyzed to quantify structural and volumetric changes along both the fracture intersections and individual fracture planes, evaluating how network deformation alters the flow path geometry. While experiments and data analysis are currently ongoing, these findings will improve understanding of how complex loading affects connectivity across multi-intersection networks.

Mentor(s):

Laura J Pyrak-Nolte (Science); Alexandra Blair Clark (Science)

Other Acknowledgement(s):

David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1264
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Tuning Metal Identity and Nitrogen Coordination in M-N-C Substrates for Enhanced Pt Nanoparticle Stability

STEM
SURF

Authors(s):
Guanting Li† (Science)

Abstract:
Metal-/nitrogen-doped graphene catalysts (M-N-C) are a promising class of materials for electrochemical energy conversion, owing to their ability to drive the hydrogen evolution reaction and the oxygen reduction reaction, which are essential for fuel cells. These single-atom catalysts (SACs) facilitate those reactions by acting as a support for Pt nanoparticle catalysts. However, it is unclear which SAC support offers the best catalytic performance while also having a sufficiently low formation energy to be readily produced during synthesis. Density functional theory calculations were carried out to elucidate the possible synergy among the number of coordinating nitrogen atoms (1 to 4) and identities of the center metal site (Co, Cu, Zn, N-C). Atomistic models representing clean surfaces were constructed for calculating formation energy, and calculations were performed using VASP. The results demonstrated an inverse relationship between formation energy and the nitrogen coordination number, and N-C systems have much higher formation energies than all other center metal sites. The criterion of a catalyst support for the Pt nanoparticle is the binding energy. A more negative binding energy value indicates a stronger interaction between the support and Pt cluster. Atomistic models, consisting of a 13-atom cuboctahedral Pt cluster adsorbed on the SACs, were constructed. The results can be used to calculate binding energies, and further analysis can be conducted to investigate the relationship between the identity of the metal sites and the number of coordinating nitrogen atoms. This project computationally evaluated M-N-C single-atom catalysts with DFT, thereby providing insights to guide the future rational design with tailored functionalities.

Mentor(s):
Leyu Liu (Science); Zhenhua Zeng (Science)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1265
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Skip Diene Synthesis Through Reductive Heck-Type Reactions

STEM
SURF

Authors(s):
Ailuen Liu† (Science)

Abstract:
Skipped dienes are alkene compounds with one sp3-hybridized carbon between two double bonds. They are an important part of polyunsaturated fatty acids, which are vital to maintaining cellular membrane fluidity and preventing cardiovascular problems in the human body. In the field of organic synthesis, synthesizing skipped dienes selectively over conjugated dienes remains a challenge because conjugated dienes are thermodynamically favored. Previous work has developed the synthesis of skipped dienes from chiral secondary allylic alcohols, halogenated alkenes, and alkynes, but the use of terminal alkenes is underdeveloped. This project relies on a single-step, Heck-type coupling mechanism to synthesize skip dienes from the reaction of terminal alkenes with a cobalt vinylidene intermediate. Different ligands and additives were tested using high-throughput methods to optimize the reaction to selectively yield the skipped diene over other products, such as methylenecyclopropanes. Nuclear magnetic resonance (NMR) spectroscopy was used to determine which products were formed. Mono- and disubstituted alkenes were tested. While reactions using alkyl 1,1-disubstituted alkenes yielded little or no product, alpha-methylstyrene and its derivatives yielded skipped dienes containing a terminal alkene.

Mentor(s):
Mina Carpenter (Science); Christopher H Uyeda (Science)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1266

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

High-Throughput Electrochemical Synthesis of Amides on Ni(OH)2

STEM

SURF

Authors(s):

Katherine Mader† (University of Texas at Austin)

Abstract:

Amide bonds (a carbon-oxygen double bond next to a nitrogen atom) are in many important synthesized chemicals, including up to 25% of pharmaceuticals. However, traditional amide synthesis remains extremely wasteful, and thus expensive. Instead of using traditional expensive chemical additives to synthesize amides, solid metal electrocatalysts could drive amide synthesis in a reusable, waste-free manner, and interest in finding such an amide-selective catalyst has remained a growing field of research. This research studies nickel electrocatalysts for amide (benzanilide) synthesis from benzyl alcohol and aniline, using high-throughput methods (i.e. instruments that allow mass amounts of experiments at once) to quickly optimize multiple electrochemical conditions and increase amide production. This project aims to find a way to synthesize a catalyst that is compatible with high-throughput instruments, as well as the optimized conditions at which highest amide production is achieved on our nickel catalyst. Our findings on catalyst synthesis would allow the future optimization of electrocatalysts to be compatible with high-throughput instruments, and thus the quicker future optimization of mixed-metal catalyst composition for amide synthesis. Finally, a mixed-metal catalyst optimized for amide production would be reusable, and thus significantly less expensive and wasteful for the pharmaceutical production industry.

Mentor(s):

Amina Asghar (Science); Christina W Li (Science)

Other Acknowledgement(s):

Mah Gull (Science)

Poster Presentation Abstract Number: 1267
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Orientation Dependent Excitonic Coupling and Purcell Enhancement in MoOCl2-TMDC Heterostructures

STEM
SURF

Authors(s):
Ryan Y Manley† (Engineering)

Abstract:
The field of nanophotonics focuses on controlling light at the nanoscale to develop advanced computing and quantum technologies. This requires materials capable of tunable, nanoscale light-matter interactions. Molybdenum oxychloride (MoOCl2) is uniquely suited for this purpose. As a van der Waals crystal, it can be exfoliated into ultra-thin, two-dimensional flakes. Within its atomic plane, MoOCl2 exhibits extreme anisotropy, acting like a reflective metal in one direction and a transparent dielectric in the other. This property allows MoOCl2 to support highly confined light waves called hyperbolic plasmon polaritons. In this project, we investigate how excitonic emission from a two-dimensional semiconductor, tungsten diselenide (WSe2), couples into these polariton modes in MoOCl2. We use near-field optical microscopy and low-temperature photoluminescence spectroscopy to measure this interaction. By altering the polarization of light relative to the different crystal axes of the MoOCl2, we can observe how the orientation affects the overall light emission. This orientation-dependent behavior is the key to controlling the energy transfer. Building on this, we explore how the extreme anisotropy allows MoOCl2 to act as a highly directional nanoscale optical cavity. This cavity architecture not only selectively routes the emitted light but also drives strong Purcell enhancement, forcing the WSe2 to release its energy significantly faster and more efficiently. By proving that we can simultaneously enhance and precisely route quantum emission, this work establishes MoOCl2 as a robust platform for on-chip nanophotonics, bridging the gap toward ultra-compact photonic circuits and deterministic quantum light sources.

Mentor(s):
Vladimir M Shalaev (Engineering); Alexandra Boltasseva (Engineering); Arnab Banerjee (Science)

Other Acknowledgement(s):
Abhishek Bharatbhai Solanki (Engineering); Andres Eduardo

Llacsahuanga Allcca (Science); Mohan Bikram Neupane (Science); Karthik Pagadala (Engineering); Jia Lin Cheoh (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1268
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Developing Soft Growing Robot Delivery of Insect Scale Robots for Non-Destructive Inspection

STEM
SURF

Authors(s):
Dominic Nathaniel Muniz† (Engineering); Ana Clara de Medeiros Morais‡ (Engineering)

Abstract:
Current non-destructive evaluation methods for airfoils include borescopes, industrial radiography, CT scanning, and other inspection techniques. While these methods are effective, they can be costly, time-intensive, susceptible to human error, and require disassembling the airfoil for inspection. This project aims to create autonomous alternatives for inspection by developing a tip mount for a vine robot to assist in delivering an insect-scale robot, developed by collaborators at CU Boulder. Current work focuses on redesigning and testing the tip mount to ensure it can support the electronics and payload required for deployment without affecting the vine robot motion. The vine robot will then be tested in an airfoil like constrained environment to determine whether it can successfully transport the insect-scale robot through inspection spaces. The expected outcome is successful delivery of the small-scale robot carrying a sensor payload, enabling a new way to inspect airfoils, with potential applications such as natural disaster response and general confined space inspection.

Mentor(s):
Laura Helen Blumenschein (Engineering); Priyanka Balkrishna Bhovad (Engineering); Ethan Michael DeVries (Engineering); Jack Rearden Ferlazzo (Engineering)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1269
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Three Dimensional (3D) Imaging and Analysis of Damage in Sn-Ag-Cu Solder Ball Grid Arrays Under Thermal Cycling

STEM
SURF

Authors(s):
Abhishek Manoj Nair† (Engineering|Libraries)

Abstract:
With demand for artificial intelligence and microelectronics increasing, ensuring dependable interconnect performance between silicon (Si) chips and printed circuit boards (PCBs) is important. Generally, these interconnects consist of Sn-Ag-Cu (SAC) solder joints arranged in a Ball Grid Array (BGA) package. SAC is vulnerable to thermal fatigue due to the coefficient of thermal expansion (CTE) mismatch between PCBs and Si chips, which generates shear stress in the solder. Cyclic temperature changes result in crack nucleation and growth, combined with void evolution, eventually leading to solder joint failure and subsequent device failure.

Previous studies have been limited by destructive characterization, limited fields of view, and two-dimensional (2D) analysis. Thus, the 3D damage evolution within BGA packages under thermal cycling is not well understood. This study aims to better understand the 3D development of cracks and voids in SAC solder joints under thermal cycling, including the effect of joint location on damage evolution. To accomplish this, a non-destructive, 3D characterization technique called X-ray Computed Tomography (XCT) was utilized to image a BGA package before and after thermal cycling. XCT resliced images were semantically segmented using Avizo 3D software. The segmentation allowed for thermal cycling damage within the solders to be quantified. By examining the 3D damage evolution within solder joints, this research advances the understanding of the effects of thermal cycling on solder joints in microelectronics.

Mentor(s):
Kosuke Ando (Engineering); Satyaroop Patnaik (Engineering); Nikhilesh Chawla (Engineering)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1270

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

AutoMD: An LLM-Based Agent System for Automating Molecular Dynamics Workflows

STEM

SURF

Authors(s):

Nathan Nguyen† (Engineering|Science)

Abstract:

[Abstract Redacted]

Mentor(s):

Arezoo Ardekani (Engineering); Prasheel Shivanand Nakate (Engineering)

Other Acknowledgement(s):

Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1271
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Optimizing DNA Tetrahedron Assembly for Blood-Brain Barrier Drug Delivery

STEM
SURF

Authors(s):
Rebecca Rose Phelan† (Engineering); Nasser H Sanwari* (Engineering|Science)

Abstract:
The blood brain barrier (BBB) is a highly selective membrane that restricts the movement and passage of substances from the bloodstream into the brain. Delivering the therapeutics across the BBB would help develop treatments for neurodegenerative and other brain-related diseases. DNA tetrahedral nanostructures are rigid structures formed by DNA strands and are promising for drug delivery across the BBB. The rigidity of this shape allows DNA tetrahedra to maintain a defined shape, which makes them more stable. DNA tetrahedra are biocompatible structures that can be functionalized to deliver therapeutic cargo past cell membranes. However, characterization of different conditions under which DNA tetrahedra form has not been extensively investigated. To address this gap, we tested combinations of Mg concentrations, DNA concentration, circularization of the central strand, and annealing regimes. To characterize the yield, we ran native polyacrylamide gel electrophoresis (nPAGE) to verify successful assembly of the structure. The yield of each condition was calculated using ImageJ. The results of this study showed that higher Mg concentrations, higher DNA concentrations, a circularized central strand, and slow annealing regime consistently produced higher yields. The results of this work will help optimize the characterization and assembly of other DNA tetrahedra for future drug delivery applications across the BBB.

Mentor(s):
Grigorii Aleksandrovich Rudakov (Engineering); Tamara L Kinzer-Ursem (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1272

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

An Experimental Study on Ice Droplet Breakup Within the Purdue 3-Inch Shock Tube

STEM

SURF

Authors(s):

Caleb Jonathan Radtke† (Engineering); Alex Perry† (Engineering)

Abstract:

The interactions produced between ice droplets in the atmosphere and hypersonic vehicles is poorly understood. These particles floating in the atmosphere create a hazard for hypersonic vehicles by shattering upon impact with a shockwave. This research aims to record and observe preliminary data of ice droplet break up and establish a basis for possible predictions with future ice break up models. Experiments were conducted in the Purdue 3-Inch Shock Tube using high-speed schlieren videography and high-speed pressure fluctuation sensors. Ice droplets were produced using an acoustic levitator to hold water droplets individually and liquid nitrogen is used to freeze the droplets to ice crystals. The Purdue 3-Inch Shock Tube is able to create an artificial shockwave and observe it through a window built into the tube. Using a Z-Schlieren system with a laser, shadowgraphy is used to observe the shock waves and droplet breakups at 100,000 frames per second and create images that we can view droplet break-ups frame by frame by utilizing high speed camera programs. Through visual analysis, results are compared to other ice droplet images to see if the droplets can be categorized by shape, rotation, and how large they are through the droplets falling and the droplet breakups. This first of its kind experiment presents a novel step into droplet breakup studies by addressing the challenges of shock tube experimentation and preliminary data gathering of ice droplet breakup phenomena relevant to hypersonic objects.

Mentor(s):

Matthew Leight (Engineering); Varun Aggarwal (Engineering)

Other Acknowledgement(s):

Adam Carson Lay (Engineering); Abigayle Elaine Moser (Engineering); Brandon C Chynoweth (Engineering); Joseph S Jewell (Engineering); Zachary Allen McDaniel (Engineering); Siddharth Bhatnagar (Engineering); Chandler J Moy (Engineering)

Poster Presentation Abstract Number: 1273

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Evaluating State-of-the-Art LLMs on Postoperative Commentary for Automated Surgical Feedback

STEM

SURF

Authors(s):

Rushil Ramchand† (Engineering)

Abstract:

Video-based feedback accelerates improvement of surgical skill, but expert review remains prohibitively time-consuming. While artificial intelligence (AI) could automate this process, translating verbal reasoning into structured, machine-actionable records is critical. Postoperative verbal commentary can be used as an annotation signal, and large language models (LLMs) are increasingly used to categorize it. However, deploying these models without a specialized evaluation standard risks introducing structural errors as general AI benchmarks fail to capture the nuances of surgical reasoning. To address this, we evaluated four state-of-the-art LLMs (OpenAI GPT 5.5, Claude Opus 4.8, Google Gemini 3.1 Pro Preview, Alibaba QWEN 3 Max) to assess whether a single model demonstrated superior classification accuracy over competing models. We constructed an evaluation benchmark using postoperative commentary grounded in a clinically validated dataset. We tasked the models with a multi-class categorization task: mapping unstructured text segments into specific domains of surgical feedback. Additionally, the models were given a highly structured, many-shot (100-example) prompt framework incorporating Chain-of-Thought (CoT) reasoning, ordered decision checklists, and a contrastive example bank. Inference was standardized across all architectures, and outputs were validated against the clinical ground truth annotated by medical experts for each information chunk. While all four LLMs demonstrated similar classification capacity, Claude Opus 4.8 achieved the best performance (Accuracy: 80.8%, Cohen's κ: 0.661 ± 0.022). By demonstrating the varying capabilities of LLMs on postoperative commentary classification, these findings provide an empirical basis for selecting the optimal model for automated surgical video-based feedback. This optimization directly refines the text-processing components required to scale the construction of annotated surgical video datasets.

Mentor(s):
Zheyuan Zhang (Engineering); Muhammad ibtsaam Qadir (Engineering); Fiona Kolbinger (Engineering)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1274

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Using µCT to Visualize Bone Degradation Caused by PTOA

STEM

SURF

Authors(s):

Amrita Rani Raparti† (Engineering)

Abstract:

Post-Traumatic Osteoarthritis (PTOA) is a degenerative joint disease caused by traumatic joint injury such as an anterior cruciate ligament (ACL) tear. To study the early progression of PTOA, a noninvasive ACL rupture (ACLR) is performed via a tibial compression in mice at skeletal maturity, under institutional approval. Mice are euthanized on days 1, 3, 7, 28, or 42 after injury. Sham mice, for which no injury occurs, are used as a control group. Experimental outcomes include micro-computed tomography (µCT) to visualize and quantify bone degradation as a measure of PTOA progression. µCT outputs a 3D map of the mineralized tissues. This image is manually segmented using Dragonfly, an image processing, visualization, and data analysis software. Morphometric analysis quantifies bone structure changes in four segmented regions of interest: tibial epiphysis, femoral epiphysis, tibial subchondral plate, and femoral subchondral plate. Bone volume over total volume (BV/TV) is calculated and expected to decline with degradative changes in trabecular bone and increases in subchondral plate porosity. Although the scope of the project consists of multiple time points, the current focus lies on day 28 after injury. Utilizing sham and injured mouse models allows us to develop a deeper understanding of PTOA pathophysiology. We expect to confirm that the development and progression of PTOA would be more severe in the injured leg compared to the sham leg. This will help enable our future studies in therapies to prevent or slow degeneration after joint injury because this research will work to anchor the characteristics of PTOA progression without intervention.

Mentor(s):

Deva Chan (Engineering)

Other Acknowledgement(s):

Ryan Michael Meister (Engineering); Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1275

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

VISIBLE: Visualizing Infant Developmental States Through Noninvasive Multisensory Bioelectronics

STEM

SURF

Authors(s):

Andrea Rocha Barajas† (Engineering)

Abstract:

Infant development during sleep is difficult to monitor continuously because many physiological changes occur outside routine clinical observation. Parents and clinicians often rely on intermittent measurements or visible behavioral cues, which may miss gradual changes in thermal stability, autonomic regulation, and sleep-related movement. Wearable monitors can provide continuous data, but adhesive electrodes and body-mounted sensors may reduce comfort, disturb natural sleep, and increase caregiver burden. This project addresses the need for an infant monitoring approach embedded in the sleep environment rather than attached directly to the body.

VISIBLE aims to develop a passive, noninvasive multisensory bioelectronic sleeping mat for contact-minimized monitoring of infant developmental states during natural sleep. The selected measurements capture complementary information while remaining compatible with a soft sleep platform: thermistors track skin-temperature dynamics related to thermoregulation and possible hydration-dependent changes, photoplethysmography estimates heart rate as a proxy for autonomic activity, and a pressure sensor array measures posture, motion, and pressure redistribution associated with sleep activity.

The current work focuses on integrating these sensors into a sleeping mat prototype, developing signal-acquisition electronics, and characterizing whether each sensing pathway can produce interpretable signals under expected infant-sleep conditions. Because full infant validation is beyond the current project timeline, this study establishes the prototype architecture and prepares comparison procedures for future validation against reference temperature, heart-rate, and motion sensors. The expected outcome is a feasible platform for collecting multimodal infant sleep data with less disturbance than conventional wearables.

Mentor(s):
Dhiya eddine Belkadi (Engineering); Muhammad Mustafa Hussain (Engineering); Min Sung Kim (Engineering); Yusuf Kolawole Adebakin (Engineering)

Other Acknowledgement(s):
Jorge Enrique Neira Garcia (Engineering)

Poster Presentation Abstract Number: 1276
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Investigating Particle Diffusometry during Conjugation of Biotinylated Products to Streptavidin-Coated Particles

STEM
SURF

Authors(s):
Shreeya Roy† (Engineering)

Abstract:
Particle diffusometry (PD) offers a portable alternative to current disease diagnostics by detecting changes in the diffusion coefficient caused by conjugating biomarkers to streptavidin-coated particles. However, PD results are inconsistent because streptavidin-coated particles form aggregates in solution, leading to difficulty in distinguishing aggregation from conjugation of biotinylated products. For future applications in diagnostics, results should reliably indicate whether conjugation has occurred. To minimize aggregation, we varied buffer composition, salts, and detergents, and tested additional steps of sonication and incubation. We collected data by imaging with a microscope and analyzed it with a Fourier transform, autocorrelation, and cross-correlation functions to estimate the diffusion coefficient of the particles. We compared results from PD with Dynamic Light Scattering (DLS) to assess buffer performance. Results suggest aggregation is reduced when particles are suspended in a Tween-20 solution and then diluted in a solution of 100mM HEPES, while also sonicating after each dilution. Future steps include ensuring that aggregation is prevented across various conditions and modifying the technique to conjugate biotinylated products to streptavidin-coated particles. We expect to see an increase in particle size and a decrease in diffusion coefficient when conjugation is successful. By reducing aggregation, changes in size and diffusion coefficients detected by PD can be linked to conjugation, improving the consistency and confidence with which biomarker presence is detected.

Mentor(s):
Donghoon Lee (Engineering); Karin F K Ejendal (Engineering); Tamara L Kinzer-Ursem (Engineering)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1277
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Evaluating LiDAR Parameters for Immersive and Educational VR Cave Environments

STEM
SURF

Authors(s):
Hiya Samanta† (Science); Anushka Bhave‡ (Polytechnic)

Abstract:
Field trips are integral to geoscience courses. However, select locations, such as caves, are often unsuitable for field trips due to accessibility and safety concerns. While virtual reality (VR) offers a promising alternative, collaborative design workshops with Purdue geoscience faculty have provided insights on how delivering a pedagogically effective VR experience requires high visual realism to reliably identify geological formations within caves. LiDAR, a light sensing technology used to create 3D point maps, provides spatial data collected from real caves that can be implemented into the VR space to create a realistic user experience. Nonetheless, creating a high resolution VR model from a LiDAR dataset can place substantial loads on the limited rendering resources of mobile VR headsets, especially the Meta Quest.

This study aims to determine the target thresholds for cave-specific LiDAR data parameters needed to achieve educational goals and explore optimizations to mitigate Meta Quest rendering glitches while maintaining realism.

Using open-source and collaborator-acquired cave LiDAR datasets, we analyze the contribution of various parameters, such as point cloud density and RGB attributes, towards accurately representing internal cave structures. Preliminary results indicate that point cloud density has the greatest impact on perceived realism for small-scale geological features. Findings from the analysis will be used to construct an optimized pipeline for converting LiDAR into virtual cave models with smoother rendering as well as inform requirements for future data gathering. The final models will be evaluated through testing sessions with students and faculty to assess effectiveness. This work offers a replicable framework for the future reconstruction of LiDAR datasets into VR applications on affordable hardware, expanding access to field-based geoscience learning.

Mentor(s):
Anastasia Kouvaras Ostrowski (Polytechnic); Caue Sciascia Borlina (Science); Ali Bramson (Science)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1278
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Accelerating Scientific Literature Review with Agentic AI: Multi-Agent Knowledge Distillation and Plot Digitization

STEM
SURF

Authors(s):
Fang Rui Shen† (Science)

Abstract:
The rapid expansion of scientific literature has substantially increased the effort required to identify, evaluate, and synthesize relevant research findings. In addition, quantitative data presented in published figures are frequently unavailable in tabular form, limiting their accessibility for analysis. This work presents an agentic AI framework that accelerates literature review by coordinating a swarm of autonomous agents to perform retrieval, analysis, and structured knowledge extraction from scientific publications. Rather than producing conventional summaries, the system distills features of interest into structured representations that support downstream research workflows. The accuracy of the distilled information is verified using an evaluation layer, factuality metrics, LLM-as-judge assessment, and human evaluation to measure the quality, consistency, and faithfulness of the generated knowledge representations. To complement textual analysis, the framework incorporates a plot digitization workflow that recovers quantitative data directly from published figures, with the fidelity of the extracted numerical data assessed through human evaluation. The outputs of the agent swarm are integrated into a unified knowledge base that combines synthesized insights with extracted numerical data, providing a comprehensive representation of the literature. By automating both qualitative knowledge distillation and quantitative data extraction, our system substantially reduces the time and effort required for literature synthesis and improves scalability across scientific research.

Mentor(s):
Ali Mashhadian (Engineering); Arezoo Ardekani (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1279
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Q-JSR: A Hybrid Classical-Quantum Framework for Multi-Class Instance Segmentation in Aerial Imagery

STEM
SURF

Authors(s):
Connor Siurek† (Science); Arsh Gupta† (Science)

Abstract:
Dense urban aerial imagery from satellites and drones is increasingly used in urban planning, disaster response, and autonomous navigation. A core task here is instance segmentation: identifying and delineating every object, such as a building, tree, or vehicle, in a scene. This requires correct labeling and precise boundaries, even when objects overlap, cast shadows, or resemble one another. The Join-Split-Resize (JSR) framework represents an image as a graph of superpixels, small pixel regions, and iteratively merges or splits adjacent regions until each group corresponds to one object. JSR performs well on single-class scenes but loses accuracy in multi-class settings, since the number of possible decisions grows exponentially and JSR's sequential, greedy decisions cannot be revised once made.

This proposal introduces Q-JSR, a hybrid classical-quantum framework that replaces JSR's combinatorial decision stage with the Quantum Approximate Optimization Algorithm (QAOA), a gate-based quantum method for combinatorial optimization. Each merge or split decision is encoded as a qubit, and a cost function combining boundary strength, shape regularity, and cross-class consistency is optimized jointly rather than sequentially. A topology-aware mixing operator preserves the image's spatial structure, and the circuit is initialized using classical image features to bias the search toward promising configurations. To address current qubit limits, we explore vector quantization of local merge patterns to compress the decision space.

We evaluate Q-JSR against classical JSR using quantum circuit simulation on aerial segmentation benchmarks across single-, two-, and three-class settings, comparing joint quantum optimization to greedy sequential processing and identifying when quantum search offers measurable gains for overlapping classes and ambiguous boundaries.

Algorithmic modifications may occur in both versions of this abstract as the research progresses.

Mentor(s):
Daniel G Aliaga (Science); Eric Samperton (Science)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1280
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

From Sulfur to Selenium: Hydrogen Evolution in Metal Intercalated Nanosheets Catalysts

STEM
SURF

Authors(s):
Yuwen Song† (Engineering)

Abstract:
Hydrogen gas, a clean energy barrier, is a sustainable alternative to non-renewable energy sources with no CO2 emissions. One fundamental process that drives electrocatalytic hydrogen production is hydrogen evolution reactions (HER). Precious noble metals (Pt, Pd, Ir, Ru) and their alloys are the standard catalysts in HERs, but they are extremely scarce, which limits their industrial use. Therefore, scientists turned to other materials such as transition metal dichalcogenides (TMD) as an alternative. Intercalation of the guest species (molecules and ions) into the van der Waals gaps of the layered TMDs can tune their electronic properties via orbital hybridization and electron transfer without lattice distortion of the host material (MoS2 and MoSe2). Previously, our group has developed a solution-phase synthesis method to intercalate transition metal ions into bulk WS2 through a two-step process. It shows that lithiation has caused a phase transition due to charge transfer, and metal precursors are intercalated as a metal ion complex into the lithiated nanosheets via cation exchange. This work aims to investigate how the size of chalcogen elements (S, Se) influences the structural and catalytic properties of TMDs, by performing pre- and post-HER analyses. We have determined the morphological and elemental changes of the intercalated nanosheets using different characterization techniques such as powder X-ray diffraction (PXRD), transmission electron microscopy (TEM), and energy-dispersive X-ray (EDX). Future work will focus on studying the structural changes in the catalyst after hydrogen evolution reaction.

Mentor(s):
Christina W Li (Science); Mah Gull (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1281

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Contribution of roots vs shoots to adaptive cold acclimation in Arabidopsis thaliana

STEM

SURF

Authors(s):

Colleen Ryan Squier† (Agriculture); Stephanie Tirado Rojas* (Agriculture)

Abstract:

Freezing tolerance is a major determinant of plant survival and distribution, but climate change is reshaping the freezing stress plants experience. Plants cold acclimate through exposure to decreasing, nonfreezing autumn temperatures that trigger physiological adjustments for winter survival. Although warming winters due to climate change may seem beneficial, reduced snow cover exposes previously insulated soil and roots to freeze–thaw cycles, increasing tissue damage and overwinter mortality. Despite this, most research on cold acclimation focuses on aboveground tissue, leaving root-specific acclimation poorly understood. Cold acclimation involves a cost that has been linked to the C-repeat binding factor (CBF) pathway. New evidence suggests that much of CBF expression may occur in roots, indicating that roots could play a central role in previously described costs. Range-edge Arabidopsis thaliana populations with natural CBF2 functional variation allow us to test this cost-benefit relationship: a Sweden population (North) carries a functional allele (increased cold acclimation capacity), while an Italian population (South) carries a nonfunctional allele (decreased cold acclimation capacity). Using these natural populations along with transgenic lines (Swedish CBF2 loss-of-function and Italian CBF2 gain-of-function), we isolate CBF2's contribution to acclimation costs in roots versus shoots. Comparing responses within and between organs, populations, and genotypes, we can evaluate how CBF2-mediated acclimation balances cold stress tolerance against investment in potentially costly cryoprotective solutes. To measure this, we assess growth, biomass partitioning, and osmotic potential (solute accumulation). Growth-solute trade-offs in roots vs. shoots will indicate a possible source of previously described cold acclimation costs. These costs will determine whether northern populations persist or are displaced by faster-growing southern genotypes as the climate warms.

Mentor(s):
Stephen Craig Mills (Agriculture); Christopher G Oakley (Agriculture)

Other Acknowledgement(s):
Nuela Enebechi (Engineering); Emily Nicole Lancaster (Agriculture); Juan Diego Rojas Gutierrez (Agriculture); Denise L Caldwell (Agriculture); Ian Rimer (Agriculture); Lucille Esther Karakas (Agriculture)

Poster Presentation Abstract Number: 1282
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Modeling Vanadium Dioxide for Neuromorphic Computing

STEM
SURF

Authors(s):
Vincent Stavig† (Science)

Abstract:
As vanadium dioxide undergoes a reversible insulator-to-metal transition (IMT), it exhibits hysteresis in resistance. During the transition, the resistance changes in abrupt “avalanches” over entire orders of magnitude. These correspond to changes in the domain morphology of insulating and metallic regions. Because of these properties, VO2 holds promise for applications in neuromorphic (brain-like) computers, where compute and storage functions are co-located. This fundamentally new computer architecture is highly efficient for AI tasks. Near criticality, the domain morphology is scale invariant, resulting in a fractal distribution of domains across a sample. A model that can quantitatively link the microscopic domain morphology and fractal structure to macroscopic transport quantities (such as resistance) has not been previously reported. In this work, we develop a resistance model for VO2 that accounts for the fractal structure of insulating and metallic domains down to the unit-cell scale. First, 2D random field Ising model (RFIM) simulations are used to create a pixel grayscale-resistance mapping. Scanning near-field optical microscopy (SNOM) images of a VO2 sample are then converted into a resistor network, where resistance values emanating from each node are determined by the grayscale mapping. Then, the macroscopic resistance of the network is calculated using the bond propagation algorithm. We have achieved a quantitative match of experimental data across the entire transition using this technique. This model is immediately useful to experimentalists while also providing theoretical insight, strongly suggesting that fractal domain structure extends beyond the resolution of current imaging.

Mentor(s):
Erica Carlson (Science); Matthew Davis Golden (Science); Po-Yu Chen (Science)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1283

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Characterization of Cathodic Arc Neutralization for Hall-Effect Thruster Beams

STEM

SURF

Authors(s):

Christopher Robert Stemporzewski† (Engineering)

Abstract:

Electric propulsion devices require a source of electrons, known as a cathode, to neutralize the ion beam they expel. Traditional cathode designs face a myriad of challenges, mainly the need for a gaseous propellant source. This project investigates the use of cathodic arc for neutralizing a Hall thruster beam. Cathodic arc uses a solid cathode to generate an electron rich plasma of metal vapor which can be used for neutralizing an ion beam. A setup consisting of a DC power supply, a replaceable cathode puck, a copper plate serving as an anode, and a small mechanical trigger pin to initiate arcing was tested under vacuum. Arc voltage was measured using a relevant voltage probe, and arc current was determined by measuring the voltage drop across a 10 mOhm shunt resistor. Multiple cathode materials were tested, including copper and zinc, in order to evaluate the lower current limit at which a stationary arc can be sustained. After ignition, the arc would sustain between anode and cathode, characterized by arc voltages of about 40 V, arc current in the range of 15-60A, and arc durations in the range of 0.5-1 seconds. More investigation is needed to evaluate arc characteristics with various cathode materials. An initial test of cathodic arc neutralizer operation in tandem with a Hall-effect thruster was performed.

Mentor(s):

Alexey Shashurin (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1284

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Identifying Drug Treatments for Functional Recovery After Spinal Cord Injury in Zebrafish

STEM

SURF

Authors(s):

Raveena Venkateshwaran† (Science); Owen Joseph Jungblut‡ (Engineering); Sriyesh Senthil‡ (Science)

Abstract:

Spinal Cord Injuries (SCI) are a prevalent condition affecting over fifteen million people globally. Although the number of affected individuals continues to increase, effective treatments remain limited due to the central nervous system's restricted regenerative capacity. Histone deacetylase (HDAC) inhibitors have shown potential to improve functional recovery after SCI in rodent models largely through upregulation of gene expression; however, the molecular and cellular mechanisms by which specific HDACs regulate SCI regeneration are not well understood. This study determined the effects of sodium butyrate, a pan-HDAC inhibitor, and HDAC3-IN2, a HDAC3-selective inhibitor, on functional recovery and axonal regeneration after SCI in zebrafish larvae. We hypothesize that sodium butyrate and HDAC3-IN2 treatment enhance recovery, evidenced by improved motor function and increased axonal regeneration compared to controls. Spinal cord transections were performed at a standardized midpoint between the posterior end of the swim bladder and the anal pore at five days post-fertilization (5 dpf). Following injury, larvae were treated with either sodium butyrate, HDAC3-IN2, or control solution. Recovery was assessed through two approaches, two days post-injury: functional recovery via swim distance using a visual motor response assay, and axonal regeneration via anti-acetylated tubulin immunostaining, where drug conditions were compared to controls. Preliminary findings suggest a dose-dependent trend for sodium butyrate; a higher concentration yielded a greater percentage of samples with axonal bridging and an increased cumulative swim distance in visual motor response assays. While these differences did not reach statistical significance when compared to other concentrations, the initial data from multiple trials warrant further validation. Ultimately, this study supports the need for future experiments to fully characterize the therapeutic potential of HDAC inhibition in SCI.

Mentor(s):
Daniel Suter (Science); Jorge Emanuel Hernandez Dominguez (Science)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1285
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Design and Automated Characterization Infrastructure for CMOS+X Integrated Systems

STEM
SURF

Authors(s):
Henan Wang† (Engineering)

Abstract:
Emerging computing systems increasingly combine conventional complementary metal oxide semiconductor (CMOS) circuits with emerging devices to improve computing performance and energy efficiency. Before these chips can be deployed, they require reliable electrical characterization. However, current testing workflows often rely on extensive manual instrument setup and custom software for each new chip, making evaluation slow and difficult to reproduce. This project develops an automated characterization framework that simplifies customized testing while remaining adaptable to a wide range of CMOS+X integrated circuits.

The project centers on a modular software framework built on National Instruments PXI instrumentation. Instead of rewriting measurement programs for every design, the framework separates reusable testing logic from chip-specific configuration files, allowing devices with different pin counts and test requirements to be supported through simple configuration changes. It provides configurable measurement workflows, standardized hardware abstraction, and automated instrument control, enabling new measurement routines to be added with minimal software changes. Supporting analog and digital circuit design projects were also completed to better understand future CMOS+X system requirements.

The platform has successfully demonstrated automated electrical measurements on discrete test structures and is being extended for future fabricated chips. The expected outcome is a scalable characterization framework that enables researchers to rapidly customize tests for different integrated circuits without redesigning the underlying software architecture. By separating the technical framework from user-defined configuration parameters, it aims to make chip characterization accessible to researchers with limited programming experience while providing a robust foundation for future CMOS+X research.

Mentor(s):
Zeshu Wang (Engineering); Haitong Li (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1286
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Predicting Intrinsic Clearance Through Quantum-Informed Embedding of Molecular Surface in Machine Learning

STEM
SURF

Authors(s):
Alissa Weigand† (Pharmacy)

Abstract:
Intrinsic Clearance (CLint) measures how well a liver can metabolize a drug and is essential in early-stage drug development. By knowing a drug's CLint value, pharmacists may determine its viability, concentration, and dosage frequency. If able to predict CLint values accurately, researchers could reduce experimental costs and accelerate the identification of promising drug candidates before moving to clinical trials. While methods to encode molecular structure for Machine Learning (ML) prediction exist, they commonly focus on encoding structural information over quantum-electronic information. Structure-based encodings make approximations of what quantum electronic information directly captures along the molecular surface. Directly capturing electronic attributes is important due to their influence on intermolecular interactions, which largely determine a molecule's reactivity and metabolism. A newer approach, MEMS (Manifold Embedding of Molecular Surface), accounts for this by using quantum-informed encoding to improve predictive performance in ML models. This study evaluates whether encoding quantum-electronic surface information via MEMS can improve CLint prediction over structure-based ML approaches. Using a curated dataset of 1069 small molecules, we gathered molecular surface information via quantum mechanical methods (Density Functional Theory) and encoded it with MEMS before training a ML model to predict CLint values. We hypothesize that MEMS will outperform structure-based encodings for the ML prediction of CLint values. If successful, this would support quantum-informed encodings as a viable approach in predicting pharmacokinetic properties in small molecules and further aid researchers in the drug development process.

Mentor(s):
Tonglei Li (Pharmacy); Koushiki Basu (Pharmacy)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1287

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Characterizing Optical Radiation in Solid Fuel Ramjets

STEM

SURF

Authors(s):

Katie Wilkinson†

Abstract:

Solid fuel ramjets (SFRJs) are air-breathing propulsion systems operating at supersonic speeds, offering a reliable, mechanically robust alternative to turbine engines in certain high-speed propulsion applications. Solid fuel lines the combustion chamber as hot, compressed air flows through the center, mixing with the fuel vapors to sustain combustion. Heat transfer to the solid fuel controls the regression rate and overall engine performance. However, radiative heat transfer's contribution to the total heat transfer at the fuel surface currently remains largely unquantified since combustion environments are challenging to replicate while maintaining optical access for diagnostics in a controlled laboratory environment. It is hypothesized that radiation contributes significantly to the total heat transfer in SFRJs since the fuel-rich combustion results in low flame temperatures near the fuel surface and high mass fractions of radiating soot. This work develops diagnostics to quantify the contribution of radiative heat transfer in SFRJ conditions. Fuel slabs with embedded optical fibers are burned inside an optically accessible combustion chamber of a slab burn testing rig. This enables repeatable combustion testing with optical access, which is difficult to achieve in traditional SFRJ combustion systems. Absolute optical irradiance is measured as the fuel surface regresses past the optical fiber. Complementary high-speed imaging and other in-development diagnostics help correlate the flame dynamics above the fuel surface to dynamic radiative heat transfer. This work establishes new experimental procedures to measure radiative feedback during solid fuel combustion in SFRJ conditions. The measurements support model validation and understanding of radiative heat transfer in SFRJs, extending previous research beyond strand-burn experiments toward SFRJ combustion environments.

Mentor(s):

Colton Dean Willhardt (Engineering); Daniel Robert Guildenbecher (Engineering)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1288
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Characterization of Benzothiazolium Ligand Binding to MYC G-quadruplex DNA using Biophysical Methods

STEM
SURF

Authors(s):
Lorelei B Xia† (Pharmacy)

Abstract:
The oncoprotein MYC is a master cancer driver and commonly overexpressed in more than 70% of human cancers. However, it is deemed undruggable due to the absence of a well-defined binding pocket for small molecules. Instead, this research targets the MYC promoter G-quadruplex (MycG4), a DNA secondary structure formed in the MYC promoter. MycG4 represses transcription of MYC, and its stabilization by small molecules further suppresses transcription of MYC. Previously, our lab determined the solution structure of MycG4-benzothiazolium complexes. To further understand the structural basis of ligand binding, we characterized the binding properties using fluorescence and circular dichroism (CD) spectroscopy. Fluorescence spectroscopy was used to determine the binding dissociation constant (Kd) by titrating ligands into fluorescently labeled MycG4 DNA. Using CD spectroscopy, the melting temperature (Tm) of MycG4 was determined in the presence and absence of ligand to assess the extent to which the ligand stabilizes MycG4. These measurements were determined for each ligand to analyze how the chemical structure affects ligand binding. Experimental results were consistent with the benzothiazolium-MycG4 complex structures and revealed additional insights into the molecular basis of ligand binding. By integrating biophysical measurements, we established a structure-activity relationship for benzothiazolium ligand binding and identified key binding determinants.

Mentor(s):
Jinho Jang (Pharmacy); Danzhou Yang (Pharmacy)

Other Acknowledgement(s):
Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1289
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

SCOUT: An in-vivo Methane Sensing System for Real-time Monitoring of Enteric Emissions in Cattle

STEM
SURF

Authors(s):
Zihan O Zeng† (Engineering|JMHC)

Abstract:
Enteric methane from cattle is a major contributor to agricultural greenhouse gas emissions and reflects rumen fermentation, which shapes feed efficiency and animal health. Current whole-animal methane measurement methods, including breath-based sniffers and external gas sampling systems, estimate total emissions but sample intermittently and only after gas has left the animal and mixed with ambient air. These approaches cannot capture internal rumen dynamics, the minute-to-minute changes in ruminal methane concentration driven by feeding, rumination, and fermentation state. Here we present an in-rumen methane sensing system that continuously monitors ruminal methane concentration. The resulting signal shows a stable baseline, transient fluctuations, and shifts tied to meals, rumination, posture, and other rumen-state transitions. We also developed a Navier-Stokes-based model that connects measured ruminal methane concentration to gas transport and emission pathways, from which we estimate total methane output via respiration and eructation. Combining continuous sensing with mechanistic modeling lets us trace whole-animal emissions back to the rumen events that produced them. With this resolution, methane phenotyping can move from a single daily emissions number to a time-resolved profile per animal, useful for ranking cattle by methane yield per unit feed intake, testing how quickly a dietary additive suppresses methane production, and attributing emissions to specific behaviors instead of averaging them out over a day. These applications are secondary to the primary contribution, a method for measuring and interpreting methane dynamics within the rumen.

Mentor(s):
Yuelin Deng (Polytechnic); Upinder Kaur (Agriculture|Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1290

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Fabrication and Characterization of Injectable and Microporous Hydrogels for Potential Applications in Wound Healing

STEM

SURF

Authors(s):

Francine Yu He Zhang† (Engineering)

Abstract:

Hydrogels are biocompatible materials that can be engineered for drug and cell delivery and to promote cell growth in both microgel and bulk gel form. Specifically, Granular hydrogels are biocompatible biomaterials assembled from microparticle building blocks that combine injectability and microporosity into a tunable and modular design. When injected directly into tissue, granular hydrogels form a porous scaffold that supports cell infiltration, growth, and regeneration. Although many injectable hydrogels have been developed for MI, it remains challenging to ensure their timely degradation, which is important to achieve long-term repair. The goal of this work was to fabricate hyaluronic acid-based bulk and granular hydrogels and characterize their mechanical properties and degradation rate. Norbornene-modified HA (NorHA), carbic anhydride-modified NorHA (NorHA-CA), and oxidized NorHA-CA (oxNorHA-CA) were used for the study. Hydrogels were fabricated by exposure to light in the presence of a crosslinker (DTT) and photoinitiator (LAP), either in bulk or microparticle form. Young's moduli were measured using a Dynamic Mechanical Analyzer. Degradation was characterized via mass loss measurements of hydrogel samples incubated in phosphate-buffered saline (PBS) at 37 C. All hydrogel groups were fabricated to match the stiffness of heart tissue (~15 kPa). Microgels with different sizes were achieved by adjusting microfluidic flow parameters. The oxNorHACA hydrogels degraded at three days and NorHACA degraded at ten days. NorHA did not degrade within the two-week study. This research successfully fabricated granular hydrogels with varying degradation rates. Future work will explore these hydrogels for therapeutic delivery to promote tissue repair.

Mentor(s):

Nicole Elizabeth Mertens (Engineering); Tuba Marjan (Engineering); Taimoor Hasan Qazi (Engineering)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1291
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Improved Radiation Testing Methodology and Characterization of COTS Memory Devices with varying Memory and Package Size

STEM
SURF-SCALE

Authors(s):
Louis Vincent Buonaiuto† (Engineering)

Abstract:
Commercial-off-the-shelf (COTS) microelectronics are increasingly used in space applications because their low cost, accessibility, and short lead times make them practical alternatives to radiation-hardened components. However, space's intense cosmic radiation poses a challenge. Since COTS devices are designed for terrestrial use, their radiation reliability is unknown.

Thermal neutrons, a component of space radiation, can induce single-event effects (SEEs) in microelectronics. These effects include bit flips in memory which compromise data integrity and system operation. This matters because memory devices like electronically erasable programmable read-only memory (EEPROM) store critical data that spacecraft rely on, including flight path information and system configurations. A bit flip in memory can corrupt that data, compromising navigation and essential functions.

This research evaluates EEPROM reliability for space applications by studying failure rates under a thermal neutron source generated by the Purdue University Nuclear Reactor Laboratory's subcritical pile. EEPROMs with SOIC or TSSOP packages and varying memory size (1 Kbit – 512 Kbit) are exposed to a thermal neutron source to validate if package type and memory size affect failure rate.

Previous research data collection was disrupted when testing multiple EEPROMs simultaneously. This research developed a robust testing procedure that accounts for different types of data collection failures. This enabled quick iteration of test code but it limited testing to a singular EEPROM. During testing, an EEPROM is irradiated while a Raspberry Pi records bit failure, distinguishing stuck bits (hard errors) from recoverable bits (soft errors), until all the bits reach hard error state.

This research expects to validate that larger SOIC EEPROMs degrade faster than smaller TSSOP EEPROMs. Future work will extend this procedure to multiple EEPROMs to gather a greater variety of package/EEPROM data.

Mentor(s):
Andrew Owen Fewell (Engineering); Peter Bermel (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Poster Presentation Abstract Number: 1292
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Association of Cumulative Lead Exposure and APOE ε4 Status with Cognitive Decline in Older Adults

STEM
SURF-SCALE

Authors(s):
Elisa Chen† (Science|JMHC); Grace Ann Kowis‡ (HHS|Liberal Arts)

Abstract:
Lead is a well-established environmental neurotoxin, and chronic lead exposure has been associated with accelerated cognitive decline. The most commonly used biomarker for lead (Pb) exposure is blood Pb. However, blood Pb only reflects short-term exposure. In this project, bone Pb is used as a cumulative Pb exposure biomarker to study the relationship between lead exposure, Alzheimer's disease and related dementias, and genetic susceptibility. Skull bones were collected postmortem from 190 individuals enrolled in the Memory and Aging Project conducted by the Rush Alzheimer's Disease Center. A unique portable x-ray fluorescence (XRF) method was developed to quantify Pb in these bones. DNA was extracted from peripheral blood or frozen postmortem brain tissue for the same individuals to determine APOE genotypes, the most significant genetic risk factor for Alzheimer's disease, and cognitive z-scores were determined using multiple cognitive assessments. Linear mixed-effect models with random intercepts, random slopes, and splines were used to evaluate the association between lead and genetic biomarkers and cognitive trajectories. Longitudinal analyses demonstrated that higher bone lead concentrations are associated with a faster rate of cognitive decline across multiple cognitive domains, specifically with a significant negative late-stage interaction for overall cognition. Cross-sectional analyses at baseline assessment for overall average cognition and episodic memory revealed evidence of a significant three-way interaction between age, lead concentration, and APOE ε4 status, indicating that individuals carrying the APOE ε4 gene are more susceptible to lead-related cognitive decline at older ages. This research suggests that bone Pb quantified by portable XRF is an excellent biomarker for cumulative lead exposure and that chronic lead exposure contributes to age-related cognitive changes in a way that may modified by the presence of the APOE ε4 gene.

Mentor(s):
Linda Nie (HHS); Ellen M Wells (HHS); Carolina Gonzalez Canas (HHS); Justin Farmer (Rush University Medical Center)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Poster Presentation Abstract Number: 1293

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Coupled Phase-Field and Finite Element Modeling of Copper Pad Deformation in Hybrid Bonding Anneal

STEM

SURF-SCALE

Authors(s):

William Eunseok Jo†

Abstract:

Modern computer chips are pushing performance higher by stacking chips directly on top of one another instead of side by side. Traditional solder connections are too bulky for the tiny, densely packed links these designs need. A newer technique, copper-copper hybrid bonding, instead uses tiny copper pads that touch and fuse directly, connecting chips at a much smaller scale. Before bonding, pads are polished flat, but the resulting surface can end up dished, level, or slightly protruding, sometimes unintentionally and sometimes by design. During the heating step that fuses chips together, copper expands and bulges outward, helping close the gap between pads. This bulging matters because it affects whether the chips form a reliable connection. This research examines how the shape of a copper pad changes during heating, before the pads make contact. We built a phase-field model that tracks how copper atoms move along the pad surface over time to lower their energy, producing the bulging. The model compares how bonding temperature, the surrounding insulating material, and starting shape affect bulge and edge behavior. A separate thermoelastic simulation models how much the surrounding material expands and constrains the pad as it heats. Results show temperature and initial shape of the pad strongly affect how quickly copper bulges outward, since higher temperatures let atoms move more easily. Material simulations show that insulating dielectric stiffness and coefficient of thermal expansion both influence the copper bonding profile: higher Young's modulus increases mechanical constraint and higher thermal expansion produces greater initial thermoelastic displacement. Overall, this research builds a simulation framework for predicting how copper pads change shape during hybrid bonding anneal. The results point to surface diffusion, initial pad shape, and insulating material choice as key factors for making these ultra-small chip connections more reliable.

Mentor(s):

Shubhra Bansal (Engineering); Haohan Guo (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Poster Presentation Abstract Number: 1294
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Analysis of Laser Wakefield Acceleration and the Beam-Loading Effect in Higher Dimensions

STEM
SURF-SCALE

Authors(s):
Keegan M Kita† (Science)

Abstract:
Laser wakefield accelerators (LWFAs) are at the forefront of advancing particle acceleration. Compared to traditional radio frequency (RF) accelerators, LWFAs offer a less expensive and more compact design that exceeds the RF accelerator breakdown limit. LWFAs have commercial and research applications, including medical imaging and particle collision, because they can produce photon, neutron, and electron beams. Additionally, they can act as a source of radiation which can be used for radiation hardening of microelectronics and semiconductors. However, LWFAs are subject to dephasing, pump depletion, and diffraction, which limits their energy gain. These uses require using LWFAs for electron acceleration; understanding the theory behind the accelerators is needed to maximize electron acceleration. Through analysis of the beam loading effect, the optimal characteristics of the beam, such as electron bunch density (EBD), can be found to produce minimal energy spread and maximize energy gain. Leveraging recent theories on the optimal EBD using 1-D approximations, the analytical equations for higher dimensions for optimal EBD can be found. These results can be verified through simulations that model Maxwell's wave equations to theoretical expectations. This demonstrates how using beam loading can produce a stronger particle beam with short electron bunches and significant charge.

Mentor(s):
Alexander Gregory Sinelli (Engineering); Allen L Garner (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Poster Presentation Abstract Number: 1295
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Radiation Cascade Simulations in GST-C Using Molecular Dynamics

STEM
SURF-SCALE

Authors(s):
Aryan Rauniyar† (Engineering); Agustin Abt† (Engineering)

Abstract:
Phase-change memory (PCM) made from Germanium-Antimony-Telluride (Ge2Sb2Te5) doped with small amounts of Carbon, is a leading candidate for next-generation electronics, yet its reliability in radiation-harsh aerospace and nuclear environments remains a critical concern. The atomic-scale mechanisms of radiation damage and subsequent amorphization are poorly understood. This study aims to examine GST-C systems at the device-scale level, using machine learned Allegro interatomic potentials to maintain similar accuracy to ab initio “physics-first” calculations where these system scales would otherwise be inaccessible. This work investigates primary knock-on atom (PKA) cascade dynamics in crystalline GST-C using molecular dynamics simulations to model radiation-induced defects from the environment. We examine the effects of system size, radiation intensity, and phase structure when recovering from unintended amorphization. To simulate the system, we use the Allegro potential trained on density functional theory (DFT) data encompassing multiple phases, temperatures (300–2000 K), and carbon concentrations (0–18 at.%) of the GST-C system. Post-cascade damage is quantified by defect populations through the examination of characteristics like bond angles, bond lengths, and atom coordination. The study aims to quantify and characterize the healing rate, energy distribution, and material properties under unintended effects of radiation and its impact on material functionality. This provides critical structural and kinetic insights, establishing a predictive framework for engineering radiation-hardened phase-change memory devices, especially in the field of nanocircuits.

Mentor(s):
Ethan Wayne Holbrook (Engineering); Alejandro H Strachan (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering); Rushik Desai (Engineering); Baptiste Tongasoa Martin (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1296

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Developing a Gate Boosted Pulse Generator to Drive Gas Discharge Tube Based Nonlinear Transmission Line System

STEM

SURF-SCALE

Authors(s):

Luke Alexander Trahin† (Engineering); Samuel Christian Olenick* (Engineering)

Abstract:

Pulsed power systems are critical for numerous applications, such as driving radio frequency (RF) systems and driving diodes to generate bremsstrahlung and x-rays for testing radiation hardness. One application of pulsed power is to drive nonlinear transmission lines (NLTLs) to produce RF radiation for directed energy systems. NLTLs are typically made of either lumped elements (capacitors that vary with voltage and/or inductors that vary with current) or a distributed line with inclusions that have nonlinear permittivity and/or nonlinear magnetic permeability. The RF system output depends on the electrical and/or magnetic properties of the NLTL. NLTL systems are normally made up of fixed components, which hinders tuning their output. Prior work used a distributed line that could be replaced with a line of identical dimensions but different composition to tune RF output; however, this prohibits dynamic tuning. This project will use gas discharge tubes (GDTs) as nonlinear capacitors in a lumped element NLTL. This effort will explore NLTL systems based on GDTs, but the first step is to design a pulsed power system to drive this system. We will design a pulse generator based on a gate booster circuit to deliver a 1 kV pulse with a rise-time of 1-4 ns. Once the pulse generator can properly output a 1000V pulse to a 50-ohm load, the gate booster can test NLTL systems. The pulsed power system is necessary to test the GDT-NLTL systems to generate tunable RF output.

Mentor(s):

Allen L Garner (Engineering); Alexander Gregory Sinelli (Engineering)

Other Acknowledgement(s):

CJ Holdeman (Engineering); Brodie Ames (Engineering); Cameron James Buerke (Engineering)

Poster Presentation Abstract Number: 1297

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Effects of Equine Pituitary Pars Intermedia Dysfunction on Forelimb Bone Mineral Density and Calculated Bone Strength

STEM

Veterinary Scholars Summer Research Program

Authors(s):

Teegan Acres† (Purdue University)

Abstract:

Horses with pituitary pars intermedia dysfunction (PPID) have hormone imbalances that might decrease systematic calcium, causing bone resorption. Additionally, many similarities between equine PPID and human Parkinson's disease (PD) have been discovered, including altered systemic calcium in PD, showing that research on PPID might benefits horses and humans alike. If these changes are sufficiently severe, horses with PPID are at risk of catastrophic fractures. This study examines the third metacarpal bone (MC3), proximal sesamoid bones (PSB) and phalanx one through three (P1-3) to identify correlations between presence of PPID and bone density, as well as calculated indicines of bone strength. Terminal donations to Purdue University Veterinary Hospital were used with a total of 19 horses (38 forelimbs). PPID status and severity was determined through pituitary pathology identified on gross necropsy. The CT cross sections were taken for MC3, PSB, P1, and P2 at 25%, 50%, and 75% along the length the given bone for three total cross sections per bone using the XCT2000 pQCT. For the P3 bone, nine scans (3 scans at 1 mm apart at each site) were taken due to the highly cortical nature of P3 and due to PPID affecting P3 strength via development of endocrinopathic laminitis. Both the trabecular and cortical bone strength of each examined bone will be estimated using the scans. The tensile strength of the bone will also be calculated through the XCT2000 program. Additionally, ligament and tendon density will be examined for all horses. We hypothesize that the horses with PPID will have lower bone density which would indicate that horses with PPID have a higher fracture risk in weight bearing bones. This study could guide future treatments for horses with PPID, with recommendations for calcium or vitamin D supplementation or restricted activity levels. Clarifying an additional link between PD and PPID will lead to further information to help horses and humans.

Mentor(s):

Emma Dell Stapley (Vet Med)

Other Acknowledgement(s):
Timothy B Lescun (Vet Med); Jesus A Hermida Casas (Vet Med); François-René Bertin (Vet Med)

Poster Presentation Abstract Number: 1298
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Advancing Better Therapies: Screening Pyrrolopyridine-Hydrazone Derivatives Against Clostridioides difficile

STEM
Veterinary Scholars Summer Research Program

Authors(s):
Katrina Mason† (PWL)

Abstract:
Modern antibiotics primarily disrupt the gut microbiota of the human gastrointestinal tract, increasing susceptibility to opportunistic pathogens. Clostridioides difficile (C. difficile) is a Gram-positive, spore-forming, obligate anaerobic bacillus that is primarily found in the human gastrointestinal tract. It can cause a potentially fatal infection characterized by severe diarrhea and colitis. This study evaluated the preliminary in vitro antimicrobial activity of custom-synthesized pyrrolopyridine-hydrazone derivatives against C. difficile to support the development of gut-targeted therapies for C. difficile infection (CDI).

The synthesized compounds were screened using a broth microdilution assay under anaerobic conditions to determine the minimum inhibitory concentrations (MICs) against C. difficile ATCC 43255. The Clinical and Laboratory Standards Institute (CLSI) guidelines were followed.

Initial screening identified a distinct subset of nine compounds that demonstrated growth inhibition. Within this active group, four specific derivatives demonstrated the highest relative potency, inhibiting bacterial growth at an MIC of 64 µM, while five additional compounds inhibited growth at 128 µM. These findings narrowed the compound library to a subset of candidates for future structure-activity relationship (SAR) analysis and further development of more potent compounds.

Although the lead derivatives exhibited modest in vitro antimicrobial activity, this initial screening established an SAR framework and identified promising candidates for further structural optimization. Continued development of these pyrrolopyridine-hydrazone derivatives could contribute to more site-specific therapies for CDI while minimizing disruption of the intestinal microbiota.

Mentor(s):
Ahmed Abdelkhale Hassan (Vet Med)

Other Acknowledgement(s):
Lijia Zhang (Vet Med)

Poster Presentation Abstract Number: 1299

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Investigating the mechanism of an emulsion-based vaccine adjuvant

STEM

Veterinary Scholars Summer Research Program

Authors(s):
Quynh Lam Nguyen† (Science)

Abstract:
Adjuvants are substances added to vaccines to enhance the immune response. MF59 is a squalene-based oil-in-water emulsion adjuvant that is used in certain human influenza vaccines. While it has been shown that MF59 induces chemokine production and promotes the recruitment and activation of antigen-presenting cells, the cellular and molecular mechanisms underlying these effects remain incompletely understood. We hypothesized that MF59 induces activation of immune cells through a time-dependent program of transcriptional changes. We treated human THP-1 monocytes with MF59 (1:100) for 4, 8, and 24 hours and used RNA-sequencing, followed by qPCR validation, to track how gene expression shifted over time. We also investigated surface expression of CD83, CD80, CD86, CD40, and CD54 by flow cytometry, and probed p38/MAPKAPK2, ERK, and STAT1 signaling by Western blot. RNA-sequencing and qPCR validation revealed a dominant immune/APC and chemokine-driven transcriptional signature, characterized by the significant up-regulation of the recruitment signal CCL4 (MIP-1β). This transformation was accompanied by significantly enhanced surface expression of the hallmark maturation marker CD83, as determined by flow cytometry. However, Western blot analysis of intracellular signaling kinetics showed that MF59 did not significantly increase STAT1/pSTAT1, pMAPK2/MAPK2, pNF-kB/NF-kB phosphorylation at either two hours timepoints 4hr and 8hrs. Our findings demonstrate that MF59 functions as a primary driver of the monocyte transition to an antigen-presenting cell by activating a specific innate immune program that prioritizes cellular recruitment and functional maturation. However, the absence of significant STAT1, MAPK, and NF-κB phosphorylation suggests that MF59-mediated immune activation may occur through alternative signaling mechanisms or later-stage regulatory pathways. Future investigations will evaluate the association between this activation and metabolic remodeling.

Mentor(s):
Harm Hogenesch (Vet Med)

Other Acknowledgement(s):
Nikolaos Neokosmidis (Vet Med); Michelle Anne Poe (Vet Med)

Poster Presentation Abstract Number: 1300

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Segmentation and Validation of Computed Tomography Scan Measurements on Equine Laryngeal Cartilages

STEM

Veterinary Scholars Summer Research Program

Authors(s):

Vianca A. Rios Brito† (PWL)

Abstract:

Laryngeal hemiplegia is an upper respiratory disorder that affects 10% to 30% of horses. The condition results from the loss of nerve fibers in the laryngeal nerve, impairing abduction of the arytenoid cartilage during inspiration; leading to reduced airflow and severe performance limitations. The standard treatment for laryngeal hemiplegia is prosthetic laryngoplasty surgery, in which the paralyzed arytenoid cartilage is mechanically abducted utilizing sutures. Current preoperative planning consists of assessing laryngeal function via endoscopic evaluation, which provides limited quantitative information regarding cartilage morphology and the “ideal” level of arytenoid abduction in clinical patients. Computed tomography (CT) scans have proved to be useful in providing this information for human surgery; in horses the validity of CT derived measurements and segmentation of the equine laryngeal cartilages remains poorly documented. This study will determine the validity of CT derived measurements by comparing values obtained from segmented CT scans to those determined by direct measurement of dissected laryngeal cartilages. Ten horses euthanized for reasons unrelated to this study will be enrolled. A head CT will be performed following euthanasia to image the laryngeal cartilages. Postmortem laryngeal dissection will be completed by isolating the cricoid, arytenoid, thyroid and epiglottic cartilages. For each cartilage values will be measured and recorded for length, width, height and volume. Images from each CT scan will be segmented utilizing the 3D Slicer software to generate computerized renderings of the larynxes; measurements will be collected from the models for comparison. Seven horses are currently enrolled in this study, and preliminary results will be presented. Results may establish the accuracy of CT scans on equine laryngeal cartilage morphology for use in surgical planning on clinical patients.

Mentor(s):

Michelle L Tucker (Vet Med)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1301

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Pets in the Classroom: A Conventional Content Analysis of Teachers' Experiences with Classroom Pets

Social Science

Veterinary Scholars Summer Research Program

Authors(s):

Thanya Thotakura† (Vet Med)

Abstract:

Classroom pets are used to enhance learning environments and support students' academic, emotional, and social development. Previous research has shown positive outcomes associated with classroom pets and animal-assisted interventions, yet less is known about how teachers integrate classroom pets into everyday classroom life, including both the positive and negative aspects. Understanding these experiences is important for informing teachers considering classroom pets and aiding teachers in successfully integrating classroom pets. This study explored the lived experiences of teachers who have integrated classroom pets as part of their educational practices. Teachers were recruited through the Pets in the Classroom program. Eligibility criteria required study participants to be Kindergarten through 12th grade teachers based in the United States with a pet that primarily resided within the classroom. Participants (n=10) took part in semi-structured interviews delving into their experiences incorporating classroom pets into teaching and learning. A total of 9 species of classroom pets were represented. Interviews included 9 female teachers and 1 male teacher, with the average number of years taught being 17.9 years (SD: 8.1). The interviews were analyzed through a conventional qualitative content analysis to identify recurring patterns and themes. Preliminary results revealed recurring themes of logistical considerations of pets in the classroom, impact of pets on building classroom culture; and support for students socially, emotionally, and academically. These findings suggest that classroom pets may serve as meaningful tools for promoting student engagement, strengthening classroom communities, and supporting positive student-teacher interactions. Ultimately, findings highlight the educational value of pets within classrooms and support the need for continued research in this area.

Mentor(s):

Leanne Nieforth (Vet Med); Sarah Jean Reega (Vet Med)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1302

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Impact of Chronic Variable Stress on Neurobehavioral Function Following DMM Surgery in Mice.

STEM

Veterinary Scholars Summer Research Program

Authors(s):

Xander L Tuttle† (Vet Med)

Abstract:

Post-traumatic osteoarthritis (PTOA) is the most common form of arthritis, affecting nearly 600 million people worldwide. The symptoms of PTOA include joint pain, stiffness, and decreased mobility. There is a strong association between PTOA and mental health problems, though causation has not been established. PTOA outcomes are more severe in populations with lower socioeconomic status where levels of psychosocial stress levels are increased though the pathophysiology is unknown. We hypothesized that chronic variable stress (CVS) and joint injury induced by destabilization of the medial meniscus (DMM) would change neurobehavioral outcomes and modulate PTOA progression. Adult C57BL/6J mice underwent either DMM or sham (S) surgery and were assigned to either chronic variable stress (CVS) or control treatment (C) (IACUC approved). Locomotor testing and depression/anxiety-like behavioral testing were conducted. Females in the DMM+CVS group exhibited decreased locomotor activity when compared to the Sham+Control group. Females in the Sham+Control group had higher locomotor activity than males in the Sham+Control group. In both males and females, CVS decreased locomotor activity when compared to Control. Males exposed to DMM group had increased anxiety-like behaviors when compared to the Sham group. These findings exhibit sex-dependent neurobehavioral responses to CVS and DMM. The greater effects of CVS when compared to DMM exhibit that stress may play a larger role in affecting central modulators involved in behavioral responses during PTOA, ongoing studies are evaluating these differences in the context of structural PTOA.

Mentor(s):

Dianne Little (Vet Med)

Other Acknowledgement(s):

Camryn Renee Pamedis (Science); Savannah Lee Theurer (Science); Wendy Ann Koss (Centers & Institutes); Robyn R McCain (Centers & Institutes)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1303

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Hypoxia-Driven Lipid Uptake Increases Metastatic Potential

STEM

Veterinary Scholars Summer Research Program

Authors(s):

Cheyenne Renee Waddell† (Agriculture)

Abstract:

Metastasis is one of the leading causes of mortality in breast cancer (BC), highlighting the importance of understanding the mechanisms that drive disease progression. One factor known to promote tumor progression is reduced levels of oxygen, known as hypoxia. Hypoxia leads to the accumulation of the transcription factor, Hypoxia Inducible Factor 1-alpha (HIF1α) in TNBC supporting gene expression changes that regulate cell survival under low-oxygen conditions. Increased HIF1α activity in BC also promotes metastasis, suggesting that HIF-dependent gene expression changes play important roles in the aggressive behavior of BC. In addition to regulating cell survival, we have demonstrated that hypoxia also alters cellular metabolism. Our previous work showed that HIF- 1α decreases expression of pyruvate carboxylase, a key enzyme in the conversion of pyruvate to oxaloacetate to replenish the TCA cycle. Here, we sought to address the hypothesis that hypoxia increases lipid metabolism, thereby enhancing metastatic potential of BC cells.

To address this hypothesis, we used the 4T1 model of metastatic BC, to generate an shRNA-mediated depletion of HIF1a. We validated this knockdown with immunoblotting and confirmed HIF1α depletion under hypoxic conditions. We also used immunoblotting to assess levels of HIF target proteins. To assess lipid droplet formation in hypoxic conditions, we used BODIPY, a neutral lipid stain. Preliminary results demonstrated increased lipid droplet accumulation in wild-type 4T1 cells treated with cobalt chloride ($CoCl_2$), a HIF1α stabilizer. This effect was mitigated in HIF1α-depleted cells. These findings suggest that HIF1α contributes to hypoxia-induced lipid uptake in BC and supports a potential role for altered lipid metabolism in promoting hypoxia-induced metastatic progression. Future studies will further characterize this model and the effects of lipid uptake on metastatic phenotypes, such as invasion, migration, and metabolic plasticity.

Mentor(s):

michael Wendt (Vet Med); Sydney P Quijano (Vet Med)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1304
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Collective Memory in Bacterial Communities: Could It Help Reverse Antibiotic Resistance?

STEM

Authors(s):
Israel Adenuga† (Homewood-Flossmoor High School); Alessandra Orr† (Homewood-Flossmoor High School); Jolissa Abeh† (Homewood-Flossmoor High School)

Abstract:
Purpose: Antibiotic resistance is becoming one of the greatest challenges in modern medicine. Most studies explain resistance through genetic mutations in individual bacteria, yet bacteria naturally exist in communities where they communicate, cooperate, and adapt together. This investigation explores whether bacterial communities possess a form of collective memory and whether that memory could create weaknesses that make resistant bacteria easier to treat.

Methods: A literature review was conducted using peer-reviewed articles on biofilms, quorum sensing, bacterial communication, stress adaptation, and antibiotic resistance. The information was analyzed to identify evidence of persistent community responses following environmental changes and to evaluate whether these responses resemble memory-like behavior.

Results: Current literature suggests that bacterial communities can maintain coordinated behaviors after environmental stress through biofilm organization, chemical signaling, and physiological adaptation. These observations provide support for the possibility of collective memory within bacterial populations.

Conclusion: Collective memory may represent an additional factor influencing antibiotic resistance beyond genetic mutations alone. Understanding how bacterial communities store and use previous environmental information could lead to new approaches for improving antibiotic effectiveness.

Mentor(s):
Ernest Francis Talarico, Jr. (PNW); Evan Roberts (Homewood-Flossmoor High School); Kathryn Stolzenbach (Homewood-Flossmoor

High School); Corinne Zimmerman (Homewood-Flossmoor High School); Caitlin Gallagher (Homewood-Flossmoor High School)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1305

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Sustainable Additive Manufacturing Using Thermoplastic Starch Bioplastic Filament

STEM

Authors(s):

Basil Alojan† (Engineering)

Abstract:

Fused deposition modeling (FDM) is one of the most widely used additive manufacturing techniques. However, most commercially available filaments, including polylactic acid (PLA), offer limited biodegradability under ambient conditions. Thermoplastic starch (TPS), produced by plasticizing starch with glycerin, acetic acid, and water, presents a renewable, compostable, and fully biodegradable alternative with low-cost, food-grade ingredients. However, developing TPS as a viable FDM filament remains challenging due to its viscoelastic behavior, which differs significantly from PLA in melt flow characteristics, making consistent filament diameter, mechanical integrity, and printability difficult to achieve. In this study, TPS formulations were prepared using potato starch, glycerin, white vinegar, and distilled water. Each formulation was mixed, heated to 65°C under continuous stirring, and pressure cooked for 20 minutes. Filament was extruded using a FILABOT EX2 at a controlled rate through a size-limiting gate and re-spooled. Printability was evaluated via hot plate flow tests, mass loss tests, and direct extrusion on a 3D printer, with mechanical properties measured using dogbone specimens. An average filament diameter of approximately 1.71 mm was achieved, and hot plate and mass loss tests revealed formulation-dependent differences in flow behavior and thermal stability. TPS was successfully extruded and used to print basic 3D objects, though filament diameter consistency and layer adhesion remained variable across formulations. These findings demonstrate that TPS bioplastic filament is a promising sustainable alternative for FDM printing, with further refinement of formulation ratios and extrusion parameters needed to meet the dimensional and mechanical requirements.

Mentor(s):

Amanda P Siegel (Engineering); Andres Tovar (PWL); Andrew Nuetzel (Perry Township Schools)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1306
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Bridging Electrical and Optical Characterization of Gallium-Doped ZnO for Tailorable Epsilon-Near-Zero Photonics

STEM

Authors(s):
Saishri Bagde† (Engineering); Muhammad Mahdi Marzan‡; Geetika Chitturi‡ (Engineering|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Alexandra Boltasseva (Engineering); Miroslava Marinova Marinova (Engineering); Kyu Ri Choi (Engineering)

Other Acknowledgement(s):
Jae Ik Choi (Engineering)

Poster Presentation Abstract Number: 1307
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Using Community-Based Art Activities to Support Psychosocial Wellbeing Among Immigrant Youth: A Four-Week Pilot Study

Humanities

Authors(s):
Aarushi Gupta† (Science)

Abstract:
Immigrant youth may experience unique psychosocial challenges related to cultural adjustment, identity development, social belonging, and community integration. Community-based art programs may provide an accessible approach to supporting emotional expression, resilience, and connection; however, limited research has explored these approaches among rural immigrant youth populations.

This pilot study examined the implementation of a four-week art-based program designed to explore experiences of psychosocial wellbeing among immigrant youth in Daviess County, Indiana. Participants engaged in weekly art activities focused on four themes: fear and anxiety, connectedness with self/family/nature, self-integrity and perseverance, and gratitude and meaning-making.

Participants completed surveys assessing depressive symptoms, emotional stress, anxiety, life satisfaction, meaning and purpose, sleep quality, peer relationships, and family relationships at baseline and throughout the intervention. Weekly reflections were collected to understand participants' experiences and perceptions of the activities.

Quantitative data will be analyzed using descriptive statistics and repeated-measures comparisons to examine changes in psychosocial wellbeing outcomes over time. Qualitative reflections will be analyzed thematically to identify patterns related to emotional expression, coping, identity, and social connection.

Overall, findings from this pilot study may provide insight into the potential role of community-based art programming in supporting immigrant youth wellbeing and inform future youth-centered interventions. This work highlights the importance of culturally responsive, accessible, and community-engaged approaches that create

supportive spaces for immigrant youth to express themselves, develop resilience, and strengthen connections within their communities.

Mentor(s):
Nasreen Lalani (HHS)

Other Acknowledgement(s):
Jennifer L Stefancik (HHS)

Poster Presentation Abstract Number: 1308
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Body Mass Index and Clinical Outcomes of Elderly Patients with Acute Myocardial Infarction

STEM

Authors(s):
Thomas James Haack† (PNW)

Abstract:
PURPOSE. Vietnam demographics are rapidly changing, as 14% of the population will be over 65 by 2034. Because of this shift, ischemic heart disease has become a leading cause of mortality. This study seeks to investigate the "obesity paradox", in which overweight or mildly obese patients demonstrate better outcomes after AMI compared with those with normal or low BMI.

METHODS. A total of 551 patients ≥60 years-old diagnosed with AMI were enrolled between June 1, 2024, and June 1, 2025. Patients were categorized into four BMI groups: underweight, normal weight, overweight, and obese. BMI classification followed the Asia-Pacific Protocol. Patients were indicated for management based on the Vietnam National Heart Association Acute Coronary Syndrome Guidelines. Data collection included ECG, troponin, Killip classification, GRACE score, blood laboratory data, demographic data and detailed medical history. P-value <0.05 was considered statistically significant.

RESULTS. Patients with BMI classified as overweight and mildly obese typically had a lesser length of hospital stay, lower mortality rate, and lower hospitalization rate for heart failure. Patients with a lower BMI tended to have worse heart failure at presentation, lower left ventricular ejection fraction, and increased occurrences of ejection fraction less than 40%.

CONCLUSION. BMI should be used as an early signal rather than an isolated risk factor in elderly patients presenting with AMI. Patients with low BMI represent a high-risk group that warrants increased attention, as they tend to be older, more frail, functionally dependent, and have worse cardiac function at presentation.

Mentor(s):
Ernest Francis Talarico, Jr. (PNW); Hassan Naji (PNW)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1309
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Towards tracing coastal oxygenation patterns through Eastern oyster shells

STEM

Authors(s):
Mia R Hannah† (Science)

Abstract:
Changes in marine [O2] levels are thought to be a key driver of major evolutionary events and ecological transitions on both modern and geological timescales, so accurate reconstruction of past [O2] is crucial. Existing [O2] proxies rely on the sensitivity of a given element to large declines in [O2] but may not be sensitive to hypoxia ([O2] < 2 mg/L). Additionally, as these proxies rely on the gradual buildup of an element in response to an [O2] decline, the proxy can be decoupled from [O2]. In contrast, oysters are physiologically sensitive to but ultimately tolerant of hypoxia, such that their shell chemistry may record changes in ambient [O2] over their lifetimes. Here, we explore how the chemistry of Eastern oyster (Crassostrea virginica) shells change in response to hypoxia exposure. Oysters were exposed to normoxic or hypoxic conditions for one or two 4-week growth phases. Pre- and post-exposure shell masses were used to calculate the mass of the shell added per growth phase. Shells were sub-sampled, powdered, cleaned, and dissolved for ICP-MS analysis. Na, Sr, Mg, Mn, Fe, Ba, and U concentrations were analyzed and normalized to Ca concentrations. Compared to the control, Mn/Ca was elevated in shells grown in hypoxic conditions. Shell growth was negatively correlated with shell Mn/Ca. The shell Mn/Ca increase under hypoxia is consistent with Mn(IV) from seawater being reduced to Mn(II) by the oyster microbiome before being incorporated into the shell. Shell growth lowers Mn/Ca in the residual fluid, potentially dampening the proxy signal. However, our data suggest that this dampening is lowest at the low growth rates typical of hypoxia-induced metabolic suppression. As there is minimal lag time between a decrease in [O2] and a rise in [Mn2+] inside the oyster, shell Mn/Ca of fossil Eastern oysters, paired with information about shell growth, could be a promising proxy for hypoxia - in modern environments, the historical past, and in the geological record.

Mentor(s):
Roger Nicholas Bryant (Science)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1310

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Cognitive Effects of Exoskeleton Use on Hazard Identification Performance in Construction Workers

STEM

Authors(s):
Ahmed Khan† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Hyewon Seo (Engineering); Behzad Esmaeili (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1311
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Novel Therapeutic Advancements Against Enterococcal Infection

STEM

Authors(s):
Olivia Lucille Kimmick† (Science); Alessia Lin Heiser† (Science)

Abstract:
One major challenge in modern medicine is hospital-acquired bacterial infections that are becoming increasingly resistant to antibiotic treatment. The rise of the ESKAPE pathogens (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, and Pseudomonas aeruginosa) has made this issue even more difficult to combat. Vancomycin-Resistant Enterococcus faecium (VRE), is a clinically significant pathogen associated with hospitalization. Antibiotic treatment of VRE is limited by both the intrinsic and acquired resistance harbored by the bacterium. New effective antibiotics are needed to help combat VRE antimicrobial resistance. In this study, novel compounds were obtained and screened against the VRE strain Enterococcus faecium HM-952. In vitro, antimicrobial susceptibility was tested by assessing the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). The results showed that numerous compounds have strong bactericidal activity against Enterococcus faecium HM-952 and warrant further testing. These strong candidates are planned to go through more in vitro tests to examine their mechanisms of action and pinpoint their targets, while also studying more strains and concentrations for a broader panel of results. The goal of these experiments is to advance these compounds towards in vivo testing in mouse infection models. Ultimately, this experiment hopes to provide a promising therapeutic solution against the continuously evolving Enterococcal infections.

Mentor(s):
Ahmed Abdelkhale Hassan (Vet Med)

Other Acknowledgement(s):
Ahmed Abdelaleem Abdelhafeez Mohammed (Vet Med); Mahmoud Adel Mohamed Sayed Ahmed (Vet Med)

Poster Presentation Abstract Number: 1312
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Deciphering physiological and molecular insights in heat-resilient insect-resistant wheat for sustainable agriculture

STEM

Authors(s):
Jada E Laskowski† (Agriculture)

Abstract:
Durum wheat (Triticum turgidum L.) is an economically important cereal crop used for pasta and semolina production. The Hessian fly (HF; Mayetiola destructor, Say) is a devastating pest of wheat causing significant loss to wheat productivity. Planting resistant wheat is the most effective and economical strategy to manage this pest. However, rising temperatures compromise this resistance, leading to breakdown in protection and subsequent yield losses. In a previous study we identified a temperature independent HF resistant durum wheat line that provides a valuable resource for addressing this challenge. This study compared temperature independent and temperature sensitive HF resistant durum wheat cultivars of African origin using hyperspectral imaging and proteomics to uncover physiological and molecular factors underlying the breakdown of resistance. Spectral analysis predicted distinct functional traits in response to HF attack. Proteomic profiling identified differentially expressed proteins and associated biological pathways linked to insect resistance as well as susceptibility factors expressed under elevated temperatures. The functional characterization of physiological traits and molecular proteins from this work provides targets for engineering heat resilient, insect resistant cereal crops for sustainable agriculture.

Mentor(s):
Subhashree Subramanyam (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1313
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Comparative Study of AI Agent Team Structures for Engineering Problem Solving

STEM

Authors(s):
Andrew Yicheng Li† (Engineering)

Abstract:
AI agent teams have been applied to linear elastic finite element analysis, where centralized coordination and dedicated reviewer agents were found to reduce team efficacy. These systems, however, analyzed pre-existing models rather than produced new ones. Whether the same structural penalties hold when AI agents must generate designs remains untested. This study asks which agent team structures best suit open-ended engineering problems. In Phase 1, single- and multi-agent systems built in Replit were compared on mathematical reasoning and maze-solving tasks, with multi-agent systems consistently outperforming single agents in speed and accuracy. Phase 2 evaluates four three-agent teams in a 2 × 2 design crossing coordination topology, central planner versus leaderless peer-to-peer, with role assignment, fixed versus undifferentiated. Teams are tested on 2D truss design, 3D bridge design, and thermoplastic starch film formulation using Python 3.12 and AG2, formerly AutoGen. Designs are validated externally through ANSYS finite element analysis for stiffness and factor of safety and through universal testing machine characterization for tensile strength and elongation at break. We hypothesize that leaderless teams will produce higher-performing designs and that fixed roles will become more beneficial as task complexity increases.

Mentor(s):
Andres Tovar (PWL); Amanda P Siegel (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1314
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

A systematic review of EEG research on error processing in schizophrenia

STEM

Authors(s):
Seona James Mathew† (PWL); Lorellei Estella ro Fletcher† (JMHC); Morgan Denae Furlow† (Science)

Abstract:
Schizophrenia, defined by the Diagnostic and Statistical Manual for Mental Disorders Fifth Edition, consists of abnormalities of the brain including but not limited to disorganized thinking, abnormal motor behaviors, delusions, hallucinations, and other negative symptoms. In the early 20th century, research has been evolving the definition and our general knowledge on the disorder, using different quantitative diagnostic procedures, as well as using a foundation of prescreening interviews, clinical interventions, and using advancing technology. The electrocephalogram (EEG) is a noninvasive method of measuring electrical activity, event related potentials (ERPs) generated in response to specific stimuli or events. The EEG utilizes different tasks to record ERPs that are clinically significant for further diagnosis and interventions. This literature analysis will dive deep into computational models designed to detect signs of potential symptoms, severity, and areas in cognition where schizophrenia is the primary focus. Clinical models will be reviewed as well as longitudinal and functional correlations of studies done on ERPs, including Error Related Negativity (ERN) and Error Positivivity (Pe). Research has found consistent blunted ERN and Pe congruent with negative symptoms, poor daily functioning, and unstable relationships. By using the EEG with clinical diagnostic assessments, this review will highlight many neurophysiological processes related to the disorder. Findings suggest use for future treatments and opens possibilities for more research on the disorder.

Mentor(s):
Daniel J Foti (HHS)

Other Acknowledgement(s):
Reilly Diemond (HHS); Abigail Kathleen Moline (HHS); Kamryn Michelle Witkowiak (HHS); Molly H Sapperstein (HHS); Lilliya Qing Larson (HHS)

Poster Presentation Abstract Number: 1315
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Effects of Drying Time and Plasticizer Content on Thermoplastic Starch Adhesive Strength

STEM

Authors(s):
Milagros Melhem Bertagni† (PWL)

Abstract:
Thermoplastic starch (TPS), made from gelatinized starch, water, white vinegar, and glycerin, is a low-cost, biodegradable candidate to replace petroleum-based polymers. Graphite can be added as a conductive filler, enabling TPS use in neural electrode contacts and interconnects. Despite its growing use in plastic films, TPS adhesive properties remain largely unexplored. This study evaluates how plasticizer content and drying time affect TPS adhesive strength. TPS films were prepared from a common potato starch base gelatinized with deionized water, glycerin, and white vinegar, cast at a controlled thickness, and bonded to a fixed substrate. Glycerin content was varied, and formulations with no graphite and a 1:1.5 TPS-to-graphite volume ratio were evaluated while all other components were held constant. Adhesive strength was measured as pull-off force using a tensile testing machine over three successive drying days. Adhesive force increased sharply with drying time, rising several-fold from day one to day three. Glycerin content had a non-monotonic effect: adhesion peaked at 2.30 wt% and declined at higher loadings, consistent with over-plasticization. An intermediate plasticizer content combined with multi-day drying maximized adhesion, with a maximum adhesive force of 74.5 N. Future work will evaluate whether additional additives can further improve adhesion.

Mentor(s):
Andres Tovar (PWL); Amanda P Siegel (Engineering); Ken Yoshida (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1316

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

The Hands Who Foster: Demographics of Animal Foster Volunteers

Social Science

CTSI R25

Authors(s):

A'Mya Murray Coleman† (HHS)

Abstract:

Animal fostering programs are not only very important for shelter animals' welfare but also have the potential to impact human volunteers. Because of these potential impacts, it is important to know the volunteer demographics to ensure they get the proper support when fostering. Proper support may influence the impacts that fostering has on the volunteers. Positive impacts may lead to better foster volunteer retention which in turn enables more animals to get help. However, little is known about the demographics of the volunteers who foster animals. Therefore, this study investigates the research question, "What are the demographics of volunteers who foster animals?" Data were collected using a cross-sectional mixed-methods survey of foster volunteers from 29 animal shelters and rescues in the United States. Recruitment was achieved through partnerships with shelters and rescues in varied regions. Partners distributed a survey to their current and previous foster volunteers. The survey contained open-ended questions related to the fostering experience, as well as quantitative measures of grief, human-animal bond, volunteer demographics and animal behavior. Data were analyzed using descriptive statistics. A total of 1158 volunteers responded to the survey. Responses indicated that participants were primarily White or European American (79.3%), women (90.3%), middle-aged (mean: 45.82 years), and from the West -Pacific region (35.5%). On average, respondents had been fostering animals for 2 years and had fostered 30 animals. The most common type of animal fostered were cats (67.3%). Understanding demographics is important because it helps to inform how to best support foster volunteers with resources specific to their demographics. Findings lay the foundation for resource development for majority represented fosters, but also less represented groups, ensuring that the potential impacts of fostering and related supports are accessible to all foster volunteers.

Mentor(s):

Leanne Nieforth (Vet Med)

Other Acknowledgement(s):
Emilie Mae MacInnis (Vet Med)

Poster Presentation Abstract Number: 1317

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

CHARACTERIZATION OF MAST CELL TUMORS IN CANIS LUPUS FAMILIARIS

STEM

Authors(s):

Samuel J Patchin† (PNW)

Abstract:

Purpose: Mast cell tumors (MCTs) are the most common malignant skin cancer in dogs. They typically present as cutaneous or subcutaneous nodules diagnosed through fine needle aspiration. Prognosis is generally favorable with early detection and treatment. However, the biological behavior of MCTs is not completely understood, ranging from low-grade tumors with minimal metastatic potential to high-grade tumors that are aggressive and more likely to spread to regional lymph nodes or internal organs. The purpose of this study is to survey known cases of MCTs to better characterize this neoplastic process.

Methods: A review of current clinical approaches to canine MCTs was conducted, focusing on diagnostic evaluation through fine needle aspiration and cytologic assessment, followed by histopathologic grading to determine tumor aggressiveness. Treatment, which includes surgical excision, chemotherapy, radiation therapy, and targeted therapies were evaluated in relation to tumor grade and metastatic risk.

Results: Using the 3-tier Patnaik System or the 2-tier Kiupel System, MCTs demonstrate significant variability in biological behavior. MCTs are more aggressive in younger dogs (i.e., young adults/puppies) and certain breeds, and this may be due to a higher likelihood of genetic mutations in the c-KIT gene. Early detection and complete surgical excision are associated with improved prognosis. Occult metastasis remains a clinical concern, particularly in high-grade cases. Adjunctive therapies may improve outcomes in advanced or metastatic disease.

Conclusion: Accurate diagnosis and histopathologic grading are essential for guiding therapeutic decision making and predicting clinical outcomes in canine MCTs. Early intervention and appropriate treatment selection significantly influence overall prognosis.

Mentor(s):

Ernest Francis Talarico, Jr. (PNW)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1318
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Examining the effects of foliar-applied Bacillus subtilis on tomato phyllosphere microbiome and disease outcome

STEM

Authors(s):
Madeline Marie Peterson† (Agriculture)

Abstract:
Fungal pathogens remain a major challenge in tomato production, particularly for organic growers with limited chemical control options. Plants protect themselves from pathogens through various pathways, including induced systemic resistance (ISR), where the plant is aided by Plant Growth-Promoting Bacteria (PGPB) to resist a broad range of root and foliar pathogens. Since foliar tissues are often affected by pathogens that elicit an immune response, introducing a new microbe to the foliar microbiome may influence this ISR as well. Bacillus subtilis, a well-known PGPB when applied to the plant roots, was tested here as a foliar treatment to determine whether it also modulates the phyllosphere microbiome and is associated with reduced disease incidence. In a single-site, single-season farm trial, B. subtilis was applied to the leaves of Solanum lycopersicum ‘Sakura’ over several weeks with a control group receiving no bacteria treatment. Leaf samples were collected bi-weekly to determine types and quantities of bacteria and fungi present in the foliar microbiome, and disease scores were taken weekly and will be analyzed statistically between treatments. Foliar microbiome sequencing has been submitted and results are pending, while qPCR to quantify B. subtilis abundance has not begun. Based on findings from other studies, it is expected that treated plots will have a higher population of B. subtilis and a lower population of pathogenic fungi than untreated plots. Understanding this link would help clarify whether foliar-applied microbes can serve as a broader strategy for shaping plant-associated microbiomes to support plant defense.

Mentor(s):
Lori Hoagland (Agriculture); Laura Elisa Garcia Giraldo (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1319

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

BMP4-mediated induction of trophoblast stem cell identity from bovine embryonic stem cells

STEM

Authors(s):

Aditya Pillai† (Science|JMHC)

Abstract:

Placental dysfunction contributes to early pregnancy loss and limits reproductive efficiency in livestock. The placenta develops from trophoblast cells, which mediate embryo–maternal interactions, implantation signalling, nutrient exchange, and endocrine communication. However, the molecular programs governing trophoblast lineage specification remain poorly defined, partly because early in vivo tissues are difficult to access and robust in vitro models are limited. During early development, the embryo forms a blastocyst, composed of an outer trophoblast layer that forms the placenta and an inner cell mass that gives rise to the embryo proper. Although these lineages arise from common precursor cells, their divergence remains poorly understood in livestock species. In particular, it is unclear whether bovine embryonic stem cells (ESCs) can be directed toward a trophoblast stem cell (TSC)-like state. Here, we investigated whether TSC identity could be induced from bovine ESCs. BMP4 was used to promote trophoblast lineage differentiation, and a custom-made medium previously shown to maintain bovine TSCs was used to support the induced TSC-like cells. Following induction, cells showed morphological changes consistent with trophoblast lineage transition. Trophoblast identity was further supported at the mRNA and protein levels. Immunocytochemistry demonstrated the expression of trophoblast-associated markers CDX2, GATA3, GATA2 and KRT8. These findings indicate that BMP4 signalling can promote trophoblast lineage induction from bovine ESCs. To our knowledge, this is the first report of inducing trophoblast differentiation from ESCs in a livestock species. This work establishes an in vitro model for studying early trophoblast development and may improve understanding of placental development, early pregnancy failure, and reproductive efficiency in cattle.

Mentor(s):

Viju Vijayan Pillai (Vet Med); Shyamkumar TS (Vet Med)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1320
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Transient Modeling and Validation of a Passive Membrane Dehumidification Module for Energy-Efficient Industrial Drying

STEM

Authors(s):
Alvan Ramee† (Engineering)

Abstract:
Industrial drying represents a massive opportunity for global energy savings; as a critical process across diverse sectors like food processing, pharmaceuticals, textiles, and lithium-ion battery manufacturing. Convective drying alone accounts for 12–25% of total industrial energy consumption in developed countries. Actual industrial drying operations are inherently transient and subject to fluctuating ambient conditions, variable product moisture loads, and startup cycles. Thus, conventional open-loop heating systems incur massive thermodynamic penalties. While closed-loop heat pump dryers offer a more efficient alternative, their performance drops significantly under varying dynamic loads. To maximize efficiency, a novel system pairing membrane-based dehumidification with a high-temperature heat pump has been proposed. This technology leverages vapor-selective membranes to isolate and extract water vapor from the recirculating process air via partial pressure gradients, removing moisture without energy-intensive cooling below the dew point. While steady-state analyses show high potential, capturing the crucial dynamic behavior of these paired systems requires a robust transient model. To fill this gap, this project develops a transient framework for the MemDry system using Dymola's object-oriented environment, focusing specifically on building and integrating the passive membrane module. This work details the mapping of complex multi-component mass transfer equations into Modelica and outlines the methodology for validating the module's transient response against both experimental data and an existing MATLAB numerical framework.

Mentor(s):
Md Ashiqur Rahman (Engineering); David Warsinger (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1321

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Investigating If The D to Y Mutation Relived Auto Inhibition By The Distal C Terminal Domain in Phospholipase C β4 Using BRET

STEM

PICR

Authors(s):
Gregorio Romagnoli Oliveira† (Science)

Abstract:
Phospholipase C (PLC) enzymes regulate a variety of cellular functions by generating the second messenger diacylglycerol and inositol-1,4,5-triphosphate. Generally, PLCs retain low basal activity and require upstream activation. The subfamily of PLCβ, which when dysregulated has been heavily linked with cardiovascular disease, require activation by the heterotrimeric G protein subunits Ga or Gβγ. However, a constitutively activating mutation, D630Y, in PLCβ4 was found to cause Uveal melanoma. The purpose of this study is to test whether this point mutation disrupts an inhibitory interface between the lipase core and the large dynamic carboxyl terminal coiled-coiled domain (dCTD), which is unique to PLCβ isozymes. This study will utilize an intramolecular bioluminescence resonance energy transfer (BRET) assay to identify if there is a difference in the BRET ratio of the amino terminus (Nt) and carboxyl terminus (Ct) between PLCβ4 wild type and D630Y mutant. BRET utilizes a donor tag and an acceptor tag for a proximity-based energy transfer where the emittance energy of the donor corresponds to the excitation energy of the acceptor, therefore, quantifying proximity based on the change between the ratio of donor and acceptor emittance (BRET ratio). To accomplish this the Ct and Nt of PLCβ4 were tagged with either luminescent Nano luciferase (Nluc) or the fluorescent mVenus protein, and vice versa, using Takara In-fusion cloning, and whole plasmid sequence with Plasmidsaurus. These constructs will be sent to Augusta University where our collaborator performs the BRET assay.

Insight into the D630Y mutation mechanism of action will be valuable for novel treatments of uveal melanoma, a currently untreatable cancer with a high mortality rate. In a broader outlook, the Aspartic acid of interest in this study is structurally conserved across all mammalian PLC's, so insight into the mechanism of the D to Y mutation is important for understanding all PLC's.

Mentor(s):
Angeline M Lyon (Science); Leon Filip Laskowski (Science)

Other Acknowledgement(s):
Hanna Danielle King (Science)

Poster Presentation Abstract Number: 1322

Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Lighting conditions shape visual perception of objects across pasture, aviary, and enriched colony housing systems

STEM

Authors(s):

Julian Leonard Smith† (Agriculture)

Abstract:

The purpose of this study was to understand how variable lighting affects hens' ability to visually perceive housing system resources. From a management standpoint, being able to distinguish what a hen sees and interacts with improves production, welfare, and behavior. Using a chicken-specific visual model, we predicted how an object would be perceived by a hen and compared visual perception between aviary and pasture environments. As well as between tiers in enriched colony cages. Using an Ocean Insight Jaz Spectroadiometer, we collected 10 measures of ambient light at the hen's breast height, pointing North, East, South, and West. These measurements were collected inside colony cages at the top, middle, and bottom, inside and outside a pasture unit, and at the top and bottom of an aviary room. 10 percent reflectance measurements were taken and averaged for various objects hens may interact with in pasture and colony cage environments. We found that, in the aviary and enriched colonies, objects were almost indistinguishable from the background unless highly colored. Hens have a fourth cone linked with their vision, allowing them to see UV light. Outside on the pasture, we found that the reflective measurements showed almost everything was distinguishable, including the feathers, legs, combs of other hens, perches, eggs on the ground, feeders, and the walls. Showing higher distinction outside the pasture unit than inside. Understanding how variable lighting affects a hen's ability to perceive their environment should be considered when selecting objects and layouts of a hen's environment.

Mentor(s):

Sara Elizabeth Cloft (Agriculture); Darrin M Karcher (Agriculture); Patrice E Baumhardt (Science); Esteban Fernandez-Juricic (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1323
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Topological Properties of Multi-Species Exclusion Processes

STEM

Authors(s):
Esha Sury† (Science); Dhruv Upreti† (Science)

Abstract:
The multi-species exclusion process (MSEP) on a one-dimensional ring is an interacting particle system in which particles of different species exchange positions according to prescribed transition rates. From this process, one can generate directed polymer configurations whose large-scale fluctuations are connected to the Kardar-Parisi-Zhang (KPZ) universality class, which describes the growth of rough interfaces. Using nonlinear fluctuating hydrodynamics (NLFH), the MSEP can be decomposed into hydrodynamic normal modes, with the number of independent modes equal to one less than the number of particle species. These modes may relax according to different universality classes, such as KPZ or diffusive scaling. In this project, we apply topological data analysis (TDA) to point clouds generated from time-varying projections of the directed polymer configurations into lower-dimensional space. Persistent homology is then used to measure how the topology of these projected configurations changes and relaxes over time. By studying how the characteristic relaxation time of these topological signatures scales with system size, we estimate the dynamical critical exponent of the process. This provides a geometric approach to detecting hydrodynamic relaxation and identifying universal scaling behavior in multi-species exclusion processes.

Mentor(s):
Erika Birgit Kaufmann (Science); Ralph Martin Kaufmann (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1324
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

The Effect of Unit Distance on Flock Integration in Free-Range Laying Hens on Pasture

STEM

Authors(s):
Shanell Andria Taylor† (Agriculture)

Abstract:
In our study, we monitored how the distance between two free-range laying hen pasture units influences flock integration and the movement between the two hen groups. Understanding how unit distance affects hens' behavior can improve future pasture management and resource use. This study evaluated the effect of unit distance on flock mixing in pasture laying hens. These two units, previously separated from each other, were reoriented to share one large pasture. We placed the two units approximately 297 feet apart and later relocated to 9 feet apart. Hens from each unit were identified using different colored leg bands, allowing movement between the two units to be observed throughout the study. Trail camera footage was utilized to capture hen movement after morning release, and egg production from the different units were compared to track number of hens per unit. We observed little to no flock mixing when units were farther apart. However, when an unexpected feed issue occurred in one unit, hens moved to the second unit after hearing the feeders there. This led us to conclude that resource availability can influence flock movement. After relocation of units to just 9 feet apart, hens began to move freely between the units, resulting in a complete flock mixture. These findings suggest that the distance between pasture units plays a significant role in flock mixing, while the hens' access to resources such as feed can promote movement between units.

Mentor(s):
Sara Elizabeth Cloft (Agriculture); Darrin M Karcher (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1325
Presentation Time: Session 2: 12:00-1:00pm in PMU Ballrooms

Assessment of Grasping Pipelines for Assistive Robotic Manipulation

STEM

Authors(s):
Jacob Junjie Zhang†

Abstract:
Assistive robotic arms, such as the wheelchair-mounted Kinova Jaco arm, require effective and user-friendly control methods to enable individuals with upper-limb disabilities (from spinal cord injuries, stroke, or other conditions) to perform Activities of Daily Living—self-care tasks such as eating, grooming, and household cleaning. Current control methods include joysticks, eye-tracking systems, brain-computer interfaces, and voice control. While these methods do enable functional control of the robotic arm, they have limitations, requiring significant physical effort, being susceptible to environmental noise or user fatigue, or providing limited speed and precision. Vision-based robotic grasping pipelines offer a promising alternative by enabling robotic arms to grasp objects autonomously, reducing the cognitive and physical burden on the user. However, despite recent advances, relatively little work has compared pipelines across different architectures—which include vision-language-action (VLA), feature fields, and affordance-based pipelines—especially in the context of assistive robotics. In this project, we review current control methods for assistive robotic arms and focus specifically on the advantages and limitations of applying various vision-based grasping pipelines for assistive robotics. As future work, we propose an in-depth experiment assessing the suitability of various state-of-the-art grasping pipelines for assistive robotics applications. Ultimately, we hope this work informs the development of more capable and accessible assistive robotic manipulation systems that enable users to independently perform daily tasks and improve their overall quality of life.

Mentor(s):
Shaiv Mehra (Engineering); Bradley S Duerstock (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1400
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

ISF-DUIRI: From Fungi to Fiber — Sustainable Mycelium Paper and Packaging

STEM
DUIRI

Authors(s):
Noah Daniel Brooks† (Agriculture|Engineering|JMHC)

Abstract:
The growing usage of unsustainable plastic packaging has contributed vastly to carbon emissions as well

as non-degradable garbage in landfills that will exist as trash for many years. To combat this problem,

we are developing a sustainable mycelium paper alternative to traditional plastic packaging. This study

was conducted using Phycomyces Blakesleeanus as a model organism. We culture mycelium samples

into thick sheets of mycelium that float on the surface of the broth. Then these sheets are dried into paper

samples for use in testing.

This study aims to determine whether Phycomyces Blakesleeanus mycelium paper would be a viable

alternative to traditional packaging methdods, both through analysis of the growing process and analysis

of the resulting paper. This entails qualitative data on the ease of P. Blakesleeanus to culture, and

eventually quantitative data on the hydrophobicity, and durability.

Mentor(s):
Tian Li (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1401

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Ultrasound Assessment of BAPN-Induced Thoracic Aortic Aneurysm Progression in Juvenile Mice

STEM

DUIRI

Authors(s):

Kayla A Fischer† (Centers & Institutes); Eesha Khalid Faruqi† (HHS); Julian Vuong‡ (Engineering)

Abstract:

Thoracic aortic aneurysms (TAA) are abnormal aortic wall expansions that can rupture and cause life-threatening internal bleeding. Detection is difficult due to their slow growth rates and few symptoms, especially in pediatric patients. Mice share anatomical and physiological similarities with humans, making them effective models for studying disease progression. This study aimed to understand the disease progression of TAAs in juvenile mice. Beta-aminopropionitrile (BAPN), a lysyl-oxidase inhibitor of collagen and elastin cross-linking, weakens aortic structural integrity and induces thoracic aortic aneurysms, particularly in the ascending aorta where pressure from left ventricular outflow is highest. Mice (n=8) were studied from four to twelve weeks of age. Treated mice (n=6; 4 male, 2 female) received 0.5% BAPN water, while control mice (n=2, male) received regular water. Weekly aortic imaging was performed using a 40 MHz center frequency ultrasound transducer (Vevo 3100, FUJIFILM VisualSonics). We measured systolic and diastolic diameters at the root, ascending aorta, aortic arch, and descending aorta, and Green-Lagrange circumferential strain was calculated. Pulse wave velocity was measured at the root, ascending aorta, and after the brachiocephalic, left common carotid, and left subclavian branches. After eight weeks, mice were euthanized and the aorta was extracted. A segment of the excised aorta was processed for histologic analysis. Preliminary data (n=8) showed a negative trend for circumferential strain from weeks four to twelve, while systolic and diastolic diameters increased. BAPN male mice showed increased effective diameter over the study, while the control male mice and the BAPN female mice showed no significant variation in effective diameter. These preliminary results help us to understand TAA disease progression in juvenile mice, potentially enabling earlier diagnosis and better treatment for pediatric patients with connective tissue disorders.

Mentor(s):
Meera Pancholi Doran (Engineering); Craig Goergen (Engineering)

Other Acknowledgement(s):
Cortland Hannah Johns (Engineering); Shubh Parag Mehta (Engineering)

Poster Presentation Abstract Number: 1402

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Political and Military Aspects of NATO's Flexible Response

Humanities

DUIRI

Authors(s):

Robert Humphreys† (Centers & Institutes)

Abstract:

Using historical methods, my project explores the implementation of NATO's Flexible Response during the 1970s. First, my project reviews the existing literature, mainly contributed by political scientists during the 1980s and 1990s. Second, I will assess these findings against newly available primary sources. The main research question concerns the political goals of Flexible Response versus its military objectives. My initial hypothesis is that the existing literature has underestimated the salience of military objectives in the implementation of Flexible Response.

While often described as primarily political in existing work, US Theater Nuclear Forces (TNF) deployed in Europe as a key component of Flexible Response had clear potential for military use, as well as doctrine and protocols to support such use. Existing literature discusses whether TNF were used primarily for alliance cohesion and reassurance or, in fact, as a military tool to bridge gaps in NATO deterrence strategy. For example, US leaders wanted TNF to act as a "firewall" so that a war in Europe would not immediately escalate to strategic nuclear exchange between the United States and the Soviet Union. European allies like West Germany saw TNF serving a different purpose: "coupling" US security to its own so that any Soviet attack risked engaging the entire US nuclear arsenal. Looking at the Nuclear Planning Group (NPG) and other intra-alliance politics, NATO used "consultative sharing" instead of physical "hardware sharing" to satisfy West German security concerns and global nuclear proliferation fears.

Ultimately, this research will assess the relative weight of military and political purposes of TNF in Flexible Response by reviewing documents from the British National Archives and NATO Archives. This primary research is likely to illuminate novel military considerations and implications of Flexible Response.

Mentor(s):

Austin Rory Cooper (Liberal Arts)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1403

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

A Multi-Modal iOS App for Interview Transcript Capture and LLM-Based Entity Extraction in Opioid Recovery Pathway Mapping

STEM

DUIRI

Authors(s):

Prisha Marpu† (Centers & Institutes)

Abstract:

Communities responding to the opioid epidemic often lack accessible, data-driven ways to understand how individuals with Opioid Use Disorder (OUD) move through fragmented, siloed systems of care, obscuring high-risk transitions, relapse loops, and service gaps within local Recovery Oriented Systems of Care (ROSC). We present a AI-enabled system that transforms multimodal interview data into structured and easy-to-understand visual maps, building on the Taking Action to Address Substance Use in Communities (TASC) framework. The system adopts a client-server architecture. The client side is a native iOS application featuring a multi-modal input hub, a single screen where users can capture text, image, and audio input through a unified transcription flow. Image input is processed using on-device OCR via Apple Vision, while audio input is transcribed using Apple Speech ,supporting server-based recognition, dictation mode, and auto-punctuation. Transcripts are then synced to a FastAPI backend AI server that utilizes LLM to extract structured, clinically relevant entities from interview text. The AI server identifies and classifies transcript segments into system-mapping elements, including states, barriers, facilitators, and touchpoints. Extraction uses a hybrid pipeline. OpenAI's GPT API is first queried using a clinically framed prompt, with a deterministic keyword-based classifier as a fallback. Extracted entities are represented as an interactive state-transition network in which nodes represent recovery states and edges represent transitions, enabling stakeholders to identify recurring relapse loops, bottlenecks, and service gaps. Integrated with a convenient mobile app, this LLM-augmented pipeline automatically converting qualitative recovery interviews into visual state-transition maps that help communities identify relapse patterns, service gaps, and intervention opportunities.

Mentor(s):
Nan Kong (Engineering); Yingjie Chen (Polytechnic); Haopeng Zhou (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1404

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Investigating the Combined Effects of ADNP Mutations and PFNA Exposure on Human Neuronal Development and ASD

STEM

DUIRI

Authors(s):

Amanda Nesbitt† (Centers & Institutes)

Abstract:

Genetic susceptibility, environmental exposures, and their interactions are long perceived to contribute to the risk of Autism Spectrum Disorder, also known as ASD, affecting roughly 6 million individuals in the US. Mutations in the ADNP (Activity Dependent Neuroprotective Protein) gene are one of the established genetic risk factors for ASD. ADNP mutation has an estimated disease penetrance of nearly 100%. Patients carrying ADNP mutations often exhibit intellectual disability, hypotonia, and significant speech and language delays. Exposure to environmental chemicals, such as per- and polyfluoroalkyl substances (PFAS) can potentially elevate the risk of disease on-set by recent epidemiological studies supporting the strong association of PFAS, particularly PFNA exposure and ASD via multi-country cohort studies. We thus evaluated how PFNA alters neuronal developmental using hiPSC derived neurons. We have obtained patient-derived hiPSC lines from siblings, one with the ASD mutation and one without. We designed an exposure scheme mimicking developmental exposure. We will then characterize neuronal activities along with changes in mitochondrial membrane potential, oxidative stress, and neuronal morphology. We hypothesize that PFNA exposure will impair neuronal development and increase mitochondrial dysfunction in ADNP-mutant neurons as compared to untreated control neurons. Understanding these genetic and environmental interactions may provide insight into the genetic causes of ASD as well as continuing to identify environmental factors that can increase ASD susceptibility.

Mentor(s):

chongli Yuan (Engineering); Xihui Zhao (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1405

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

ABETutor: Domain-Constrained AI Tutoring System

STEM

SURF

Authors(s):

Paridhi Agarwal† (Engineering); Akshith Garapati* (Engineering)

Abstract:

Large Language Models (LLMs) have demonstrated significant potential in advancing personalized learning, and yet deploying them within specialized engineering domains requires overcoming critical failure modes, including mathematical hallucinations, pedagogical passivity, and unverified external sourcing. The ABETutor is a secure, domain-constrained, AI-integrated Intelligent Tutoring System (ITS) deployed within the ABE 557/558 Process Design curriculum.

A multi-tiered Retrieval-Augmented Generation (RAG) pipeline coupled with a specialized, fine-tuned training dataset built upon a strictly curated course knowledge base. The first retrieval layer of the pipeline executes a macro-targeted semantic search to map user queries to specific textbook chapters and sections, while the second layer isolates the localized content, parametric constraints, exact equations, and physical constants. This multi-tiered retrieval ensures strict alignment with course-approved reference data, maintaining precise rendering of complex engineering notation without symbol corruption. To prevent the passive generation of direct solutions, the system incorporates structured teaching dialogues and sample prompting strategies that enforce a deterministic Socratic questioning framework. This architecture guides students through complex, multi-stage quantitative problems by dynamically modulating hint scaffolding based on a rolling model of student understanding.

For faculty, a live diagnostic dashboard aggregates student interaction vectors to provide real-time visibility into class-wide conceptual bottlenecks. Configured to meet strict deployment and security requirements, ABETutor is hosted entirely on secure university infrastructure. The resulting system offers a cost-effective, scalable, and adaptable framework for customized engineering tutoring that ensures high accuracy, strict content relevance, and measurable pedagogical effectiveness.

Mentor(s):
Martin R Okos (Agriculture|Engineering); Dharmendra Saraswat (Agriculture|Engineering); Daniel N Hauersperger (Agriculture)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1406

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Using UK Biobank Data to Investigate the Link Between Type 2 Diabetes and Alzheimer's Disease

STEM

SURF

Authors(s):

Zoe Amerman† (Engineering)

Abstract:

It is well-established that there is a connection between Type 2 Diabetes (T2D) and Alzheimer's disease (AD), but the specifics of the connection are not well-understood. Previous research has traced in detail the metabolites (metabolism-involved molecules) associated with T2D and AD. However, the previous research doesn't go into detail on the metabolic pathways that could lead to increased risk of developing AD given already prevalent T2D. Using cross-sectional metabolomic and genomic data for T2D patients, as well as dates of onset for later AD from the UK Biobank, this research aims to identify metabolic factors that could link T2D and AD, as well as quantify the risk in T2D patients of developing AD. A hypothesis in this research is that among patients with T2D, there will be detectable differences in the metabolic profiles of those that later go on to also develop AD compared to those that do not. To explore this hypothesis, logistic regression (a means of distinguishing AD and non-AD cases) and Cox regression (a means of distinguishing which factors influence a later outcome) among other data analysis methods will be used on the cross-sectional and later onset data. The intended result is for some metabolic factors to be identified that could increase the risk of AD in T2D patients, and for a quantitative "risk score" for developing AD to be calculable. Next steps would involve incorporating more sources of data into the analysis, such as neuroimaging data.

Mentor(s):

Guang Lin (Engineering|Science)

Other Acknowledgement(s):

Jia Lin Cheoh (Engineering); Junyi Wu (Science)

Poster Presentation Abstract Number: 1407

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Optically Reconfigurable Physically Unclonable Functions

STEM

SURF

Authors(s):

Ruhaan Batta† (Engineering|Polytechnic)

Abstract:

Physically Unclonable Functions (PUFs) that utilize the unpredictable, random optical responses of nanomaterials have become a promising platform for advanced hardware security. The naturally occurring, complex physical variations within the system offer a near-infinite encoding space for unique challenge-response key generation. Because these keys lack underlying mathematical patterns, they are highly resistant to predictive machine-learning attacks. However, existing optical PUFs are immutable after fabrication; if an adversary intercepts their static visual pattern, their security is irrevocably compromised. Here, we propose a dynamically reconfigurable PUF (r-PUF) consisting of carbon black nanoparticles randomly dispersed in a solid polymer film. We employ an automated laser-writing method that traces the system and delivers localized heat to the conductive nanoparticles, thereby melting the polymer and forming microscopic bubbles. This rapid phase change physically scrambles the carbon particles into new, randomized geometric webs within the re-solidified polymer. Using optical microscopy images of the system, we train an autoencoder with deep contrast learning to detect particle patterns and filter out visual noise, producing robust r-PUF keys. Furthermore, we integrate our nanoparticle system into transferable stickers that can be readily attached to secure and universally deployable r-PUF solutions for real-world security applications. Ultimately, this dynamic solution overcomes the vulnerability of static PUFs, offering a highly resilient, reconfigurable anti-counterfeiting solution.

Mentor(s):

Junyuan Lu (Engineering); Jingang Li (Engineering)

Other Acknowledgement(s):

Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1408

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Nickel Powder and Foil with Reaction-Synthesized Porous Surfaces

STEM

SURF

Authors(s):

Helen Sophia Brzozowski† (Engineering); Emily Danielle Kushner* (Engineering)

Abstract:

Raney nickel (Ni) particles are used as industrial catalysts in oil refining, fat hydrogenation, and biomass conversions. These particles are comprised of a dense Ni core surrounded by a porous Ni shell with a high specific surface area (SSA). The processing of Raney Ni involves energy-intensive steps (i.e., melting of Ni-Al liquid using temperatures around 1600°C; mechanical methods to pulverize the resulting Ni-Al alloy) and the use of strongly-caustic sodium hydroxide. An alternative, lower-temperature, more environmentally-friendly approach for generating Ni particles with a Raney Ni structure and high SSA is explored in this research. With this new process, Ni is first partially oxidized in air at an elevated temperature to generate a dense nickel oxide (NiO) layer of uniform thickness on the Ni surface. The partially oxidized Ni is then exposed to magnesium (Mg) vapor to convert the NiO layer into MgO and Ni products (via a magnesiothermic displacement reaction). Selective dissolution of the MgO layer in an acidic solution can then yield a porous Ni layer on dense Ni. In this work, Ni foil specimens are being used to evaluate changes in the chemistry, phase content, and micro/nanostructure of the foil surfaces at various stages of reaction (oxidation, magnesiothermic reaction, MgO dissolution) via use of electron microscopy, optical profilometry, and X-ray diffraction analyses. The SSA of porous Ni-bearing particles generated by this process are also being evaluated using Brunauer–Emmett–Teller analysis to be compared to the SSA of the inital Ni powder and Raney Ni.

Mentor(s):

Kenneth H Sandhage (Engineering); Joseph Flanagan (Engineering); Kevin P Trumble (Engineering)

Other Acknowledgement(s):

Jihoon Park (Engineering); Sudipta Mondal (Engineering); Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1409

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Experimental Characterization of Vent-Gas Ignition During Lithium-Ion Battery Thermal Runaway

STEM

SURF

Authors(s):

Nicolas Bustamante† (Engineering)

Abstract:

The global shift towards decarbonization has resulted in lithium-ion batteries (LiBs) becoming a dominant technology for energy storage since they bring substantial environmental and economic benefits. However, the rapid increase of their usage in systems such as electric vehicles (EVs) has driven focus to their drawbacks as well. Thermal runaway (TR), an uncontrollable venting of toxic, flammable gases has always been an inherent problem for LiBs undergoing thermal or mechanical abuse. While the composition of the vented gas has been studied, there is still a lack of understanding of what governs vent-gas ignition. Numerous ignition sources have been hypothesized, such as autoignition (where temperatures are high enough to spontaneously ignite), and particle ignition (molten fragments of the battery act as a localized heat source). This study will investigate LiB fire safety under abuse conditions through controlled abuse experiments with the goal of analyzing the two ignition modes. To achieve this, an abuse chamber was designed to induce TR via the controlled heating of a battery cell. The chamber will have several modular components to isolate and control specific physical parameters that directly influence vent-gas characteristics. This vent-gas will then be studied through a number of non-intrusive methods, including optical analysis from high speed and infrared cameras. After that, next steps involve using post-processing techniques to extract relevant information regarding what causes autoignition vs particle ignition. The results from this study will aid in developing a physics-based understanding of ignition mechanisms and can have direct influence on improving the safety of EVs.

Mentor(s):

Li Qiao (Engineering); Samarpan Farmer (Engineering)

Other Acknowledgement(s):

Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1410
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Complex biological process modelling using Bayesian Optimization

STEM
SURF

Authors(s):
Eeshwar Ram Chalasani† (Engineering)

Abstract:
Bone Morphogenetic Protein signaling controls tissue patterning during vertebrate embryogenesis by directing receptor proteins on the cell surface to assemble into tetramers that activate gene regulatory pathways. In zebrafish, this process involves only a small number of signaling molecules, which introduces substantial random variability in how and when receptor complexes form. Existing computational approaches must choose between stochastic simulations that are physically accurate but too slow for repeated analysis, or deterministic equations that are fast but ignore this variability entirely. A modeling framework that is both biologically realistic and computationally efficient is needed to enable meaningful parameter exploration and optimization of these dynamics.

This study constructs a 54-species mechanistic model describing every possible receptor binding state across three BMP ligand types, from single-receptor intermediates to the complete four-receptor tetramer using ODEs. The model was calibrated to a reference stochastic simulation by fitting effective ligand concentrations based on a starting amount of moles. Stochastic variability was then incorporated using the Chemical Langevin Equation, a noise model in which the amplitude of random fluctuations at each time step is computed directly from the current reaction rates rather than being a fixed number. Principal component analysis compressed each 500-point receptor trajectory to six shape coefficients, and an independent Gaussian Process regression model was trained on each coefficient with noise level. Bayesian optimization will be applied to find the best parameter pairing.

The results of this study should show a surrogate model with parameters that can accurately mimic testing data in shape and variability at a fraction of the time.

This work demonstrates that a mechanistic differential equation model combined with a chemically derived noise model and a Gaussian Process emulator provides a physical

Mentor(s):
Linlin Li (Engineering)

Other Acknowledgement(s):
David M Umulis (Engineering); Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1411

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Investigating the Role of Neutral Hydroxyl Groups and Sodium on Aluminum Siting in MFI Synthesis

STEM

SURF

Authors(s):

Anna S Chambers† (Engineering)

Abstract:

Zeolites are porous, crystalline materials that are made of a framework of silicon, aluminum, and oxygen. They serve as critical catalysts in hydrocarbon reactions that provide usable fuel. The tetrahedral sites (T-sites) within the zeolite lattices are locations in which aluminum can be substituted, requiring a Brønsted acid site for charge balancing. One zeolite in particular, MFI, contains 12 crystallographically unique T-sites. The placement of aluminum in the MFI T-sites can be biased through synthetic methods. MFI can be made with neutral organic structure directing agents (OSDAs), such as pentaerythritol, which could provide a more sustainable path for MFI synthesis. Previously, it has been hypothesized that PET pushed aluminum towards channels, where it was charged balanced by sodium. However, recent work shows other possibilities. To determine the nature of aluminum biasing in MFI zeolites, the role of sodium and the neutral OSDA pentaerythritol on aluminum siting is being explored through the synthesis and characterization of MFI materials. Crystalline samples were characterized with x-ray diffraction, nitrogen physisorption for micropore volume, elemental analysis, and toluene methylation to probe aluminum distribution. To isolate the effect of sodium, OSDA-free MFI was synthesized and characterized. Finally, to completely understand the role of PET, NMR was used to characterize the organic post-synthesis. In efforts to determine if the functional group could be biasing aluminum, MFI was synthesized with a carboxylic acid, followed by NMR characterization. This study compares the aluminum siting between OSDA-free and neutral OSDA MFI. These systematic studies are expected to give insights towards the intermolecular interactions governing aluminum siting in the system.

Mentor(s):

Sarah Gustafson Wagers (Engineering); Rajamani P Gounder (Engineering)

Other Acknowledgement(s):
Roger Saunders (PWL); Waire Olawolu (Engineering)

Poster Presentation Abstract Number: 1412

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

HEROIC: Heterogeneous Robot Intelligence through Conceptual Communication and Gradient-based Control

STEM

SURF

Authors(s):

Mihir S Chauhan† (Science); Aarav Jain‡; Addison Francis Zucek‡ (Science); Manmeet Singh Dang‡ (Science)

Abstract:

Open-vocabulary object search in unknown outdoor environments requires heterogeneous robot teams to reason about geometry, semantics, and uncertainty while coordinating under partial observability. These challenges arise across robotics domains, from disaster response and search-and-rescue to defense reconnaissance, where operators issue ambiguous natural-language commands without pre-mapped goals. Classical geometric planners and frontier explorers ignore semantic cues, while end-to-end vision-language policies hallucinate targets and commit to unsafe trajectories under noisy detections. We propose HEROIC, a heterogeneous air-ground teaming framework that combines a deterministic geometric backbone with four small learned priors and exclusively natural-language peer communication. Each agent runs a three-stage perception pipeline – openvocabulary detector, learned false-positive classifier, and vision-language model auditor – that progressively trades latency for trust, writing into a shared 2.5D obstacle map and an evidence-graph semantic occupancy grid. A learned salience prior biases exploration toward goal-consistent regions from within-mission observations alone. A Theory-of-Mind partner model with a learned arrival-time estimator drives a communication gate (COMMGATE) and gates peer-rendezvous on geometric feasibility. Verified candidates flow to gradient-based controllers: an EGO-style trajectory optimizer (UAV) and a control-barrier-function safety filter (UGV). COMMGATE and the ETA estimator are refined online during deployment; the false-positive classifier and salience prior are trained offline and frozen. We validate HEROIC in Isaac Sim outdoor environments held out from all training data. Results show consistent improvements over frontier, single-stage VLM, and classical SLAM baselines, with ablations confirming the value of each learned component. These findings highlight a framework for trustworthy semantic navigation by heterogeneous robot teams.

Mentor(s):
Aniket Bera (Science)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1413
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Mosaic Background Reconstruction for Fencing Video Preprocessing

STEM
SURF

Authors(s):
Andrew Thomas Choung† (Engineering); Jacob Lee Prior* (Engineering)

Abstract:
Fencing is a fast-paced sport in which decisive actions can occur within a few seconds, making automated match analysis challenging. Consequently, few computer vision tools currently exist for fencing. Thus, this research aims to develop a computer vision model to track and isolate fencers' movement across a video. The model consists of a hierarchical image processing pipeline, using optical flow to iteratively define background regions, distinguishing them from foreground objects. Detected background regions are used to estimate a global movement model, which, using defined reference points, are then used to construct a homography model of the image space. An image mosaic can then be formed by stitching the retained background regions, effectively reconstructing the image background, eliminating moving foreground elements. This mosaic provides a reference to track the fencers across the video. This study compares the accuracy of the algorithm across a range of video resolutions, tracking the model's accuracy and robustness in estimating environmental and camera motion. Furthermore, the algorithm will be employed on a dataset of fencing matches, analyzing its efficacy in improving current action recognition models. Overall, this research proposes a background reconstruction model to support more reliable fencing video processing and analysis.

Mentor(s):
Amy R Reibman (Engineering)

Other Acknowledgement(s):
Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1414

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Utilizing AC Field-Generated Pearl Chains to Deter Early-Stage Biofilm Formation

STEM

SURF

Authors(s):

John G Christian† (Engineering)

Abstract:

Bacterial biofilms pose a consistent threat to several facets of major global industries. These include implanted medical devices, energy infrastructure, and food processing. Once a biofilm develops on a surface, the bacteria within become up to 10,000 times more resistant to antibiotics than free-floating bacteria, making these bacterial infections incredibly difficult to remedy and a major source of global economic loss. This research seeks to determine the viability of using "pearl chains" to disrupt biofilm formation. Pearl chains are long single-file chains of cells that form due to induced dipole-dipole interactions caused by AC electric fields. Induced dipole-dipole interactions occur when a cell is polarized by an AC electric field such that positive and negative charges within the cell separate spatially. This polarization causes neighboring cells to exert an electrostatic force on one another resulting in the pearl chain effect. The initial phase of research focused on experimentally determining lower bounds for the electric field strength and frequency required to induce the pearl chain phenomenon in Staphylococcus epidermidis cells. Experimental results suggest that pearl chains can be observed at frequencies as low as 5 Hz and field strengths as low as 75 V/cm. Current research focuses on identifying the physical mechanisms governing groups of bacteria under the experimental conditions that generate pearl chains. Using the governing physical mechanisms and experimentally determined cell properties, a simulation will quantify particle interactions under AC electric fields. Subsequently, the force required to disrupt bacterial adhesion will be determined, and viability for pearl chains as a biofilm deterrent will be evaluated. If the induced polarization effects caused by AC electric fields prove potent in disrupting the early stages of biofilm development, pearl chaining functionality may be included as part of industrial devices in several sectors.

Mentor(s):
Ashwin Ramachandran (Engineering); Raghav Ram (Engineering); Shubhonil Sarkar (Engineering)

Other Acknowledgement(s):
Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1415
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Build Large AI-Ready Database for Interface Science

STEM
SURF

Authors(s):
Wen Xun Chua† (Science)

Abstract:
Metal-supported ultrathin materials are important in catalysis and interface engineering because their stability and properties can differ significantly from their bulk counterparts. However, it remains difficult to systematically organize and compare many calculated interface systems across different substrates, overlayers, compositions, structures, and energies. This project addresses that problem by developing an interactive database for density functional theory calculated metal, oxide, and hydroxide interfaces. Data from computational interface studies were converted into structured files and organized by substrate identity, overlayer composition, surface structure, lattice parameters, magnetic properties, total energy, and interface formation energy. These entries were then used to build a searchable platform that allows users to filter materials, view structural information, and compare trends in interface stability. The current database helps identify metal-supported ultrathin materials that may be more stable than their corresponding bulk phases. This work provides a first step toward organizing interface data for future machine learning studies in materials screening and catalyst discovery.

Mentor(s):
Shaista ijaz Khan (Science); Zhenhua Zeng (Science); Yilin Lu (Science); Leyu Liu (Science)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1416

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Functionalized DNA Tetrahedra to Enhance Cellular Uptake for siRNA Delivery Across the Blood–Brain Barrier

STEM

SURF

Authors(s):

Abigail R Deaton† (Science|JMHC)

Abstract:

The blood-brain barrier (BBB) is a highly selective biological barrier that regulates molecular transport between the bloodstream and brain, preventing the delivery of most therapeutics and limiting treatment of neurological diseases. DNA tetrahedra (TDN) are promising nanocarriers because of their biocompatibility, structural stability, programmability, and ability to encapsulate therapeutic cargo such as small interfering RNA (siRNA). However, unmodified TDN exhibit limited uptake by brain microvascular endothelial cells because the negatively charged DNA backbone is electrostatically repelled from the negatively charged endothelial cell membrane, reducing TDN effectiveness for siRNA delivery across the BBB. To overcome this limitation, TDN were functionalized with cholesterol, the cationic lipids DOTMA or DOTAP, or the cationic polymer DEAE-dextran. It was hypothesized that cholesterol would increase membrane affinity, while the cationic modifications would reduce electrostatic repulsion, resulting in greater intracellular uptake and more efficient siRNA delivery than unmodified TDN or free siRNA. Human brain microvascular endothelial (HBEC-5i) cells were cultured as an in vitro BBB model. Cells were stained to visualize nuclei and plasma membranes before incubation with fluorescently labeled TDN under each functionalization condition. Confocal microscopy was used to visualize TDN uptake, and fluorescence intensity analysis quantified differences among the surface modification strategies. Functionalized TDN exhibited statistically significant increases in cellular uptake and siRNA delivery compared with unmodified TDN. These findings demonstrate that surface engineering enhances interactions between DNA nanostructures and BBB endothelial cells and support TDN functionalization as a promising strategy for improving nucleic acid delivery across the BBB.

Mentor(s):

Grigorii Aleksandrovich Rudakov (Engineering)

Other Acknowledgement(s):

Tamara L Kinzer-Ursem (Engineering); Lipi Roy (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1417

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Identifying the Role of Platinum in Decreasing Methanization during Polymer Upcycling on Bimetallic RuPt Alloy Catalysts

STEM

SURF

Authors(s):

Renee Duan† (Engineering)

Abstract:

Catalytic carbon–carbon (C–C) hydrogenolysis is a promising route for polymer upcycling, breaking down plastic waste into valuable fuels and chemicals, a key step toward a circular plastics economy reducing waste and pollution. Hydrogen and hydrocarbons react on a metal catalyst surface, cleaving the C–C bonds of long, branched polymer chains to produce shorter hydrocarbons. Ruthenium catalysts are among the most active for C–C bond cleavage, but controlling the extent of cleavage, which determines the product distribution, remains a central challenge. Selective upcycling requires favoring internal over terminal cleavage that yield low-value methane and tuning the stability of surface-bound intermediates so a desired number of cleavages occurs before hydrogenation and desorption. This work investigates how a bimetallic ruthenium platinum (RuPt) alloy alters the mechanism and product selectivity of hydrogenolysis relative to monometallic ruthenium, using isobutane as a model compound for branched polymers. Silica-supported RuPt catalysts are synthesized by incipient wetness impregnation with varying compositions and impregnation sequences. Then, the selectivity of this catalyst is tested through kinetic experiments comparing the product distributions of isobutane hydrogenolysis on RuPt compared to Ru and density functional calculations which compute the energies of elementary steps and intermediate structures of isobutane hydrogenolysis on these two surfaces. Together, comparing the results on RuPt and Ru will elucidate how alloying mechanistically alters surface interactions and product distributions. Platinum incorporation is expected to suppress consecutive and terminal cleavage, shifting selectivity toward longer-chain products such as propane and ethane. These results will assess the potential of RuPt alloy catalysts for selective polymer upcycling and guide future work on catalyst optimization and extension to larger feedstocks.

Mentor(s):
Andrew James Simonson (Engineering); Collin Michael Queen (Engineering); David Hibbitts (Engineering)

Other Acknowledgement(s):
Waire Olawolu (Engineering)

Poster Presentation Abstract Number: 1418

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Development and Characterization of a 3D DIPG Spheroid Model to Study Tumor-Immune Interactions in the Brain

STEM

SURF

Authors(s):

Rohan Joseph Eapen† (Pharmacy)

Abstract:

Diffuse intrinsic pontine glioma (DIPG) is a pediatric brain tumor with a median survival of 8 to 11 months. Because of its diffuse infiltration of the brainstem, neurosurgical resection is not feasible, and palliative radiation is the primary therapeutic option. More recently, targeted therapies and immunotherapies have emerged, but most remain largely ineffective. A major challenge in developing immunotherapies for DIPG is the lack of reliable preclinical models that recapitulate the aggressive and heterogeneous tumor microenvironment. The goals of this study are to develop and optimize a patient-derived (SF8628) 3D spheroid model to investigate how human natural killer (NK) cells and microglia (the brain's most abundant immune cells), influence tumor behavior and NK cell cytotoxicity. To generate spheroids, SF8628 cells are cultured using ultra-low attachment (ULA) and hanging-drop methods in different conditions (0.24% methylcellulose and 3% Matrigel). Once established, spheroids are evaluated by microscopy for morphology and structural integrity, then co-cultured with human NK cells and microglia. NK cell killing capacity against DIPG spheroids is assessed using lactate dehydrogenase (LDH) assays, and immune infiltration is visualized by microscopy. Morphological results show that DIPG spheroids generated in complete culture media (DMEM) using ULA produced the most consistently well-defined spheroids. Ongoing LDH assays and microscopy of DIPG spheroid co-cultures are evaluating the effects of microglia on NK-cell cytotoxicity and NK infiltration of spheroids. Overall, this 3D spheroid model provides a biologically relevant platform for studying NK cell immunotherapy and tumor-immune interactions in DIPG. Future work will extend this platform to multicellular DIPG organoids to better represent the tumor microenvironment.

Mentor(s):

Sandro Matosevic (Pharmacy); Tyler Parker Fritsch (Pharmacy); Zachary Ashton Chu Leung (Pharmacy); Soumyajit Das (Pharmacy)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1419
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Assessment of Quantity- and Quality-Related Skeletal Properties in a Murine Model of Alcohol Use Disorder and Type 2 Diabetes

STEM
SURF

Authors(s):
Ava Fuchs† (Engineering); Isabelle Anne Hunt‡ (Engineering); Jennifer Marie Bowles‡ (Engineering); Sachenka Katrina Angel Aranguena‡ (Engineering)

Abstract:
Alcohol use disorder (AUD) and type 2 diabetes (T2D) are significant public health concerns, as each are widespread and have been reported to increase a variety of negative health outcomes including fracture risk. Moreover, an estimated 1 in 8 people with AUD have T2D worldwide, which may further increase fracture risk and other detrimental outcomes in this combinatory disease state. Despite the threat these diseases pose to the skeleton, preclinical and clinical research on skeletal outcomes in combined AUD and T2D remains limited, hindering the ability to predict and prevent fracture in this population.

To address this, a mouse model of combined AUD and T2D was established using a high-fat liquid diet and streptozotocin (STZ) to induce T2D. Twenty percent of the calories in the liquid diet were replaced with ethanol to induce AUD. Experimental groups included a control, AUD only group, T2D only group, and combined AUD+T2D group. Whole-body dual energy x-ray absorptiometry (DEXA) scans were performed throughout the study and immediately before cardiac exsanguination and cervical dislocation to assess bone mineral density (BMD) and body composition. Right tibias underwent microcomputed tomography scanning (μCT) to quantify cortical and trabecular measures. They underwent four-point bend testing to failure to measure whole-bone mechanical properties. Following breaking, the tibias were prepared for fluorescent advanced glycation end product (fAGE) analysis to assess bone fAGE accumulation.

It is anticipated that the combined AUD+T2D animals will have greater declines in bone mineral density (BMD), cortical measures, trabecular measures, and mechanical properties along with greater fAGE accumulation than either disease alone. Model refinement has begun

through the implementation of a non-liquid diet model but end-point measure will not be acquired until November 2026.

Mentor(s):
Joseph Wallace (Engineering); Olivia Nicole White (Engineering); Dyann Marie Segvich (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1420
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Predictability of Atmospheric Blocking in Future Climates using Convolutional Neural Networks

STEM
SURF

Authors(s):
Parthav Garg† (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Lei Wang (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1421

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Association Between Hemodynamics and Vessel Wall Enhancement in Intracranial Aneurysms

STEM

SURF

Authors(s):

Diego Alejandro Hernandez Acosta† (Engineering)

Abstract:

Intracranial aneurysms (IAs) are abnormal dilations of the cerebral arteries that weaken the vessel wall and, in some cases, rupture, leading to subarachnoid hemorrhage. Although direct assessment of aneurysm wall integrity in vivo remains challenging, high-resolution vessel wall magnetic resonance imaging (VW-MRI) enables visualization of vessel wall enhancement (VWE), an imaging biomarker associated with inflammation, wall remodeling and rupture risk. VWE has been increasingly investigated in intracranial aneurysms, however, its association with aneurysm progression and the influence of local hemodynamic conditions remain unclear. This study aims to evaluate the spatial association between computational fluid dynamics (CFD)-derived hemodynamic parameters and VWE identified on high-resolution VW-MRI in patients with intracranial aneurysms. Time-of-flight magnetic resonance angiography (TOF MRA), 4D flow MRI velocity measurements, and high-resolution VW-MRI were acquired for each patient by collaborators at Northwestern University. The TOF MRA images were segmented to reconstruct patient-specific vascular anatomy and provide an anatomical reference for identifying VWE regions, while vessel wall images were independently segmented to characterize areas of enhancement along the aneurysm wall. The resulting vascular geometries, along with 4D flow MRI-derived inflow conditions, were used to develop patient-specific CFD models in the open source modeling platform SimVascular. Hemodynamic simulations are used to quantify wall shear stress (WSS), oscillatory shear index (OSI), and relative residence time (RRT). Their spatial distributions are then compared with VWE regions to assess the association between flow separation and contrast uptake into the vessel wall. This analysis will help clarify the relationship between local hemodynamic forces and aneurysm wall enhancement, providing insight into the mechanisms that may contribute to aneurysm instability.

Mentor(s):
Vitaliy L Rayz (Engineering); Farshid Goudarzian (Engineering); Grace Elizabeth Palahnuk (Engineering); Defne Ekici (Engineering)

Other Acknowledgement(s):
Kostiantyn Kondratiuk (Engineering); Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1422

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Prebiotic Reaction Network Characterization for Ammonia-free Alanine Formation on Titan.

STEM

SURF

Authors(s):

Rinat Ilyussizov† (Science)

Abstract:

A central question in astrobiology is whether prebiotic chemistry, a precursor to life, can occur outside of Earth. One of the promising candidates for extraterrestrial prebiotic chemistry is Saturn's moon Titan, whose post-impact melt ponds resemble early Earth environments. Previous studies have shown that ammonia-free alanine formation is thermodynamically favorable under these conditions; however, the exact reaction pathway, necessary for experimental validation, is unknown. One of the main challenges that the field faces is the intractable number of possible reactions and interactions in networks initialized by as few as one species. Modern reaction network exploration tools, such as YARP (Yet Another Reaction Program), allow us to navigate this space. Using YARP 3.0 powered by EGAT, an ML-accelerated transition-state estimator, and validating key steps with DFT/CCSD(T), well-established quantum chemistry tools, we outline the most kinetically feasible pathways to beta- and alpha-alanine in a network without external ammonia. The preliminary results indicate that while alpha-alanine is thermodynamically preferred (energetically favorable), beta-alanine is more kinetically accessible (has a lower reaction barrier), with routes to both compounds involving in situ ammonia formation. In parallel, we develop a protocol for underivatized amino acid detection in solution with UHPLC-Orbitrap-MS, enabling experimental validation. Critically, we find that a retention-time difference between alanine isomers is sufficient for chromatographic distinction. We conclude that beta- and alpha-alanine selectivity in prebiotic environments cannot be predicted from thermodynamics alone and further experimental work is needed to probe computational results.

Mentor(s):

Ben K D Pearce (Science); Ishaan Madan (Science)

Other Acknowledgement(s):

Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1423

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Bone-Targeted Radioligand Therapy for Multiple Myeloma

STEM

SURF

Authors(s):

Juyeon Im† (Science); Yunsuk Lee‡ (HHS); Tara Ruslen Blanc‡ (Science)

Abstract:

Multiple myeloma (MM) is a bone marrow cancer that can cause severe bone pain and fractures. It mainly affects older adults, and the number of cases continues to rise as the population ages. Although treatments have improved, MM remains largely incurable because cancer cells can hide within bone tissue, survive treatment, and cause the disease to return.

To address this challenge, we developed a bone-targeted radioactive treatment that delivers radiation directly to cancerous bone, which may improve treatment effectiveness while reducing side effects. Our previous studies showed that this treatment can safely and effectively target other bone cancers in animal models, supporting its potential for treating MM. We hypothesize that it will also selectively accumulate in bone lesions caused by MM. This study will identify the best animal model for MM and determine whether the treatment reaches tumor sites, providing the foundation for future studies of its effectiveness and safety.

To establish a reliable MM model, we will compare two methods of introducing human myeloma cells into immune-deficient mice: injecting the cells directly into the leg bone or into the bloodstream. Tumor growth will be monitored using light-based imaging, which detects tumor cells, and a blood test that measures a protein released by MM cells. These methods allow us to monitor tumor growth over time without harming the animals. Once a reliable model is established, mice will receive the treatment through an injection into the bloodstream. We will then use medical imaging to determine whether the treatment reaches the tumors while minimizing accumulation in healthy tissues. Successfully establishing the model and confirming selective targeting of MM bone lesions would demonstrate that this therapy is a promising candidate for treating multiple myeloma and support its future development for patient care.

Mentor(s):
Losha Dasol Jung (Science)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering); Neel Tushar Parekh (Science); Nithin Raj Senthil Raj (Science)

Poster Presentation Abstract Number: 1424
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Tumor Stromal Targeting – PDAC Tissue-Mimicking Phantom

STEM
SURF

Authors(s):
Leonardo Isaac de Medeiros† (Engineering)

Abstract:
Pancreatic Ductal Adenocarcinoma (PDAC) is one of the most lethal types of cancer, driven by a dense tumor stroma and inconsistent drug delivery. The tumor's restrictive intake can make drug intake unpredictable, requiring specialized imaging methods to more effectively guide stromal therapy treatments. This project aims to serve as the foundation for the future in-vivo imaging utilizing Contrast-Enhanced Ultrasound (CEUS). Through the creation of tissue-mimicking phantoms that resemble PDAC, we will assess how closely the phantom mimics real PDAC tissue while optimizing imaging settings. The phantoms will consist of a multilayer agarose gel system with two different microchannel diameters embedded into the tumor-mimicking layer to serve as microvasculature. Each layer within the system will consist of different agarose concentrations to represent physiological structures surrounding the PDAC tumor. These gels will be doped with glycerol and other scatterers to mimic attenuation and noise in live tissue. The goal is to capture images of the phantom system with B-mode and Non-Linear Imaging (NLI) and to quantify flow rate through microchannels using in-house gas-core contrast agent and time-intensity curves (TIC). The data will be validated against previously established ultrasound imaging benchmarks and PDAC findings to track changes in tumor patency (vessel openness). After final validation, the imaging settings will be optimized through testing and saved for use in subsequent in-vivo experiments. The successful completion of this study will proceed with in-vivo imaging of tumor-bearing xenograft mice.

Mentor(s):
Luis Sanjuan (Engineering); Luis Solorio (Engineering)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1425
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Development of an Endothelial Microfluidic Chip Model as a Platform for Drug Delivery Studies in Cancer

STEM
SURF

Authors(s):
Delfina B Jackson† (Engineering)

Abstract:
Current preclinical models for drug development are largely based on animal studies, presenting poor translational results into human trials due to the physiological discrepancies, on top of high experimental costs and ethical concerns. In this context, Organ-on-a-Chip (OoC) emerges as a novel in vitro platform able to emulate with human cells the three-dimensional (3D) architecture and the microenvironment of organs and tissues, leading to more physiologically relevant, highly controlled, and cost-effective alternatives for preclinical studies. This project aims to develop an OoC endothelial model as a preliminary platform to assess the transport of therapeutics agents through the endothelial barrier in the context of brain cancer. The model consists of endothelial cells in a collagen type I matrix, promoting the formation of a vascular network while maintaining cell viability. The model is expected to exhibit open and connected tubular-shaped structures and characteristic endothelial cell junctions, which will be visualized by confocal microscopy. In addition, the endothelium is expected to be perfusable and selectively permeable, as evaluated by fluorescence microscopy using fluorescent tracers of different sizes. The development of a microfluidic model aims to improve predictive capability and greater potential for translation into clinical applications. Further steps include increasing the relevance by adding more cell types and cellular matrix components.

Mentor(s):
Arezoo Ardekani (Engineering); Elham Saberian (Engineering); David Perez Herrera (Science); Rizwan Ullah (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1426
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Characterization and Optimization of Mycelium-based Membrane Distillation with Feed-Side Fins

STEM
SURF

Authors(s):
Dev Vishwash Joshi† (Engineering)

Abstract:
Membrane distillation (MD) is a promising thermal desalination technology that requires membranes with specific properties: high hydrophobicity and pore sizes below one micron. Currently, commercial MD membranes are often synthetic and costly. Mycelium, which is a fungal network that grows on a wooden substrate, exhibits inherent hydrophobicity and offers the potential for tunable pore size through controlled growth duration, presenting a sustainable alternative for MD applications.

This work investigates whether mycelium-based membranes can meet the dual requirements for effective membrane distillation and whether system-level optimizations can further enhance performance.

A mycelium-coated wood membrane was fabricated and characterized through pore size distribution analysis using standard measurement protocols. The membrane will then be tested in a membrane distillation setup to evaluate permeate flux and salt rejection performance. In parallel, computational simulations are conducted to optimize feed-side fin geometry for enhanced heat and mass transfer efficiency.

This study characterizes the pore size distribution of mycelium membranes, evaluates their performance in membrane distillation, and compares these experimental results with fin geometry optimization predictions from simulation, providing recommendations for future advancement of mycelium-based MD systems.

If successful, this study will demonstrate that sustainable mycelium-based membranes are a competitive, cost-effective alternative to synthetic options, and that feed-side fin geometry optimization can significantly and independently enhance overall MD system efficiency.

Mentor(s):
Waqas Alam (Engineering); David Warsinger (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1427
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Extending Rumoca with eFMI GALEC for Embedded Controller Generation

STEM
SURF

Authors(s):
Pradyunn Vikram Kale† (Engineering)

Abstract:
Cyber-physical systems are typically developed in high-level modelling environments supporting simulation, optimization, and control analysis. However, deploying admissible Modelica control models onto embedded targets often requires manually reimplementing validated controller logic within a larger embedded software application, introducing opportunities for implementation errors, duplicated effort, and divergence between validated models and deployed software. Existing workflows therefore separate control system development from embedded software implementation, making rapid iteration difficult while reducing confidence that deployed behavior matches the original model.

This work extends the Rumoca Modelica compiler with support for the GALEC language defined by the eFMI standard. The implementation performs admissibility checking, lowers Modelica control models into GALEC, validates the result, and emits standards-compliant embedded C implementing the controller logic for resource-constrained embedded applications. By automating this portion of the deployment pipeline, the generated logic remains directly derived from the original control model, eliminating manual controller reimplementation.

The generated controller was integrated into a custom embedded software harness and deployed as the outer-loop controller of a fixed-wing autonomous aircraft, where high-level control commands were computed offboard and transmitted to the aircraft over an RC interface while the onboard flight controller maintained the low-level stabilization loop. Flight testing demonstrated autonomous flight using control logic generated from a Modelica model.

Ongoing work focuses on deploying both the outer- and inner-loop controllers directly onto the onboard flight computer, enabling complete autonomous execution from compiler-generated embedded code without relying on offboard control computation.

Mentor(s):
Micah Kurt Condie (Engineering); James Michael Goppert (Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1428
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Experimental validation of a Coupled Eulerian-Lagrangian model to predict granular discharge in industrial hoppers.

STEM
SURF

Authors(s):
Abel Paul Sholey Kallely† (Engineering)

Abstract:
Author(s)/Contributor(s):

Abel Kallely (Author), Aaron Morris (Lab mentor), Timmy Ngo (Secondary Lab mentor), Dept. of Mechanical Engineering, Purdue University.

Hoppers are containers that store and discharge particulate matter and are used widely in agriculture and pharmaceuticals. Modeling the discharge of matter through hoppers will help improve efficiency in storing and moving granular material. A coupled Eulerian (the matter moves with a stationary boundary layer, used in fluid modeling), and Lagrangian (the matter moves with the boundary layer, used in solid modeling) model (CEL) is used to predict the flow of Ottawa Sand. The objective of this project is to experimentally validate the CEL model. A mock hopper filled with Ottawa sand is set up with a transparent face and recorded with a high-speed camera at 500 fps. The raw data is then imported into PIVLab, a particle tracking software, and spatial parameters such as velocity along a line (eg: z = 5mm) and heatmaps are plotted and verified with a mass flow rate derived from a scale outputting lbs/s, to then compare with the CEL model results. The experimental velocities agree with the model at higher z values, closer to the top of the hopper; however, at z = 5cm, near the exit, the velocity extracted through PIVLab does not agree with the actual velocity derived from the scale. The model successfully predicts near-wall velocities and mass flow rate, but there is an error in the experimental setup that obstructs validation near the exit. A new flat-bottomed hopper is being built to validate the model's accuracy in predicting shear bands. During the validation of the model's shear bands, an attempt will be made to reconcile the exit velocity with the mass flow rate, which should agree due to clearer views of the exit on the new hopper.

Mentor(s):
Aaron B Morris (Engineering); Timmy Ngo (Engineering)

Other Acknowledgement(s):
Carl R Wassgren (Engineering); David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1429
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Pressure and Force Density Distributions Caused by Electromagnetic Radiation

STEM
SURF

Authors(s):
Adam Lewis Kipp† (Engineering)

Abstract:
The pressure induced by electromagnetic radiation enables various technologies, including solar sails, laser propulsion, laser cooling, and optical tweezing. This research aims to characterize the optical force density distribution and pressure throughout a dielectric slab due to oblique plane wave incidence. We analyze cases where the incident medium is air, the slab is a nonmagnetic material of finite depth, and the background material is either air or a lossy nonmagnetic material. MATLAB simulation scripts have been developed to use analytic expressions derived from the Einstein-Laub formalism to study both the spatial distribution of the optical force density and the net pressure on slab structures. These scripts map pressure and force density distributions throughout the slab as functions of incident angle, slab material, slab thickness, and wave polarization. In upcoming work, we will investigate the conditions for resonance, specifically incident angles and slab thicknesses that maximize pressure. Initial simulations used hypothetical integer-valued real and imaginary electrical permittivity components, but moving forward, we will evaluate force and pressure behaviors in the presence of real-world material properties. This will allow us to directly compare calculated results with pressure values derived from experimentally measured material deflections to determine the accuracy of our mathematical model. This research provides insight into the physics of electromagnetic radiation pressure on slabs with different electrical permittivities, offering a groundwork for nanophotonic design techniques using optomechanics principles.

Mentor(s):
Kevin J Webb (Engineering); Hatim Bamoumen (Engineering); Farhan Ishraque Zahin (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1430

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

The Lateral Olivocochlear System and its Plasticity Following Noise Exposure

STEM

SURF

Authors(s):

Hrishikesh Murli Krishna† (HHS|Science)

Abstract:

Exposure to loud noise is a leading cause of hearing loss. Top-down modulating processes can also be impacted by sound exposure, affecting how sounds are processed in different environments. This sound-induced plasticity can be beneficial or harmful, depending on the health of the auditory system and type of sound. The lateral olivocochlear (LOC) system's role in hearing protection remains unclear, but it is thought to modulate auditory nerve activity. In previous studies, LOC neurotransmitter expression changed after noise exposure, but this effect was confounded by cochlear damage. This project aims to understand the plasticity of the LOC system in response to non-pathological sound levels in mouse models. To accomplish this, mice were exposed to moderate sound levels intended to produce LOC plasticity or cochlear synaptopathy (a subtle form of inner ear damage thought to underlie hearing-in-noise difficulties). After exposure, cochleae were extracted, dissected, and immunolabeled for cholinergic and dopaminergic neurotransmitter systems or afferent synaptic elements. Cochlea images were obtained with a confocal microscope and analyzed in FIJI software to characterize LOC neurotransmitter expression and synapse survival. This study provides insight into the structure and function of the LOC system after non-damaging sound exposures. A better understanding of the LOC system and its associated plasticity can shed light on different targets to mitigate hearing loss and protect the auditory system.

Mentor(s):

Jane Ann Mondul (HHS)

Other Acknowledgement(s):

Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1431
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

The Development, Assembly, and Training of a Low-cost Bipedal Robot

STEM
SURF

Authors(s):
Yuet Ching Jolie Lai† (Engineering|Science); Gilbert Chang‡ (Engineering|Science); Zihan Lin‡ (Science); Andrew Li Niu‡ (Science)

Abstract:
Anthropomorphic robotic characters are valuable assets for studying bipedal locomotion and human-robotic interaction (HRI), but existing humanoid robotics tend to be closed-source or require expensive parts/ equipment to operate. This project aims to bring access of bipedal robotics to the public. This work presents the development and assembly of a miniature bipedal robot, inspired by Disney Imagineering's BDX droid. Components consist either of 3D printed parts created in Computer Aided Design (CAD) software or off-the-shelf electronics at a reasonable price. The robot is then trained using reinforcement learning, in which models of it repeat an action (e.g. walking) in a virtual space to prepare it to successfully reenact the action in real life. The robot's total cost is approximately $400 USD per unit, with plenty of room for improvement in the future, both in its software and hardware design.

Mentor(s):
Zachary Kalen Kingston (Science)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1432
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Design and Simulation of a 64 MHz Birdcage Antenna System with a Reflective Cap for Non-Invasive Alzheimer's Disease Therapy

STEM
SURF

Authors(s):
Hao-Chen Li† (Engineering)

Abstract:
Alzheimer's disease remains one of the leading causes of cognitive decline worldwide, and current treatments do little to slow or reverse its progression. One emerging approach applies radiofrequency energy to the brain to influence disease related protein buildup, offering a path to treatment that avoids surgery and medication. Turning this idea into a usable device requires solving a core engineering problem: delivering energy to the brain precisely and consistently, without wasting power or exceeding safe exposure limits.

This project addresses that problem through the design of a birdcage style antenna operating at 64 MHz, built and refined entirely in simulation using Ansys HFSS. Rather than a standard open top configuration, a reflective cap was added above the antenna to trap electromagnetic energy inside the structure instead of letting it escape upward. Antenna dimensions, feed placement, and capacitor values were iteratively adjusted to reach resonance at the target frequency, with each version tested for impedance matching, field behavior in a simulated head model, and localized power absorption.

The reflector improved efficiency from 10 to 15 percent to approximately 80 percent, and reduced power input from 100 to 120 watts down to 10 to 12 watts, while holding absorption within safety limits and reaching a strong impedance match. Simulations also identified capacitor values producing stable resonance across iterations. A physical prototype is planned but on hold while components are sourced.

These results suggest a simple reflective element can make brain targeted RF antennas meaningfully more power efficient without compromising safety, an improvement that could make future portable stimulation devices more practical to build.

Mentor(s):
Haitham Kanakri (Engineering); Maher E Rizkalla (PWL)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1433
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

LLM-Guided Evolutionary Discovery of Reaction Networks from Transient Data via Programmatic Search and Nonlinear Optimization

STEM
SURF

Authors(s):
Leland Li† (Engineering)

Abstract:
Discovering reliable reaction mechanisms from transient concentration data is a major challenge in kinetic modelling, catalyst design and process development. In many systems, only reactants, products and a few stable species are measured while key intermediates and steps remain hidden. Identifying these intermediates and assembling them into chemically plausible networks is difficult as the number of possible pathways grows rapidly. Existing sparse regression and neural network approaches can infer interpretable networks when intermediates are known a priori, yet they often fail to discover hidden species or produce chemically unrealistic mechanisms.

This work presents a large language model-guided evolutionary framework for automated reaction-network discovery. Candidate mechanisms are encoded as executable programs, proposed and refined by language models, screened using chemical-validity checks and compiled into reversible mass-action kinetic models. Reaction-rate parameters are estimated via nonlinear programming using an IPOPT-based solver that fits simulated concentration profiles to transient data. Before evolution, a graph-completion loop builds initial seed pathways from problem-defined reactant and product anchors. During evolution, duplicate, reverse, disconnected, and dangling networks are rejected while novel adsorbed intermediates and alternate pathways are encouraged through reward-guided search and surface-family plausibility checks.

The framework is evaluated for biodiesel transesterification, enzyme-catalysed networks and platinum-catalysed water-gas shift chemistry. These studies show that combining language-model proposal, graph-guided pathway construction, reaction-validity screening, evolutionary refinement and nonlinear kinetic fitting can recover compact, interpretable mechanisms from limited data. This approach provides a

scalable foundation for discovering kinetic models without specifying the full reaction network in advance.

Mentor(s):
Can Li (Engineering); PIYUSH SHARMA (Engineering); Quinn Huckaba (Engineering)

Other Acknowledgement(s):
Waire Olawolu (Engineering)

Poster Presentation Abstract Number: 1434

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Spatial-Light-Modulator-Generated Optical Tweezer Arrays for Neutral Atom Nanophotonics

STEM

SURF

Authors(s):

Khanh Mai† (Science)

Abstract:

Neutral atom arrays integrated with nanophotonic circuits provide a platform for strong, spatially controlled atom-light interactions in quantum optics and quantum information science, but realizing this platform requires tweezer arrays that are tightly focused, aberration-corrected, and geometrically compatible with nanophotonic device layouts. This project develops and characterizes an optical tweezer projection system based on a spatial light modulator (SLM) that combines optical characterization with computational hologram generation to address these requirements. The optical system maps phase holograms displayed on the spatial light modulator through high-resolution microscope optics into real-space tweezer arrays, linking trap quality directly to both phase-mask design and optical alignment. Spatial filtering suppresses the unmodulated zero-order beam, which otherwise introduces a bright central artifact that degrades pattern fidelity and interferes with controlled atom placement. Beam profiles are analyzed using Airy-function fits to quantify the achieved spot size and evaluate whether the aligned system approaches diffraction-limited performance. In parallel, a Python implementation of the Gerchberg-Saxton algorithm is developed to calculate custom phase masks without relying on the built-in SLM software. This hologram-generation workflow produces ring and racetrack tweezer geometries with radii of 15 to 20 micrometers and 10 to 20 trapping sites, consistent with the length scales of microring and racetrack nanophotonic structures targeted for atom trapping. Together, these results establish an optical and computational workflow for producing programmable tweezer arrays with the performance and geometric flexibility needed for nanophotonic integration. This work prepares the apparatus for single-atom trapping near nanophotonic devices and supports future experiments in many-body quantum optics and quantum communication.

Mentor(s):

Ahreum Lee (Science); Divyansh Rathore (Science)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1435

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Angle-Dependent Superconducting Transport in hBN-Encapsulated 2M-WS_2 at cryogenic Temperatures

STEM

SURF

Authors(s):

Sri Krishna Teja Mannava† (Science)

Abstract:

Superconductors are materials that carry electricity with zero energy loss when cooled to very low temperatures. Beyond powering technologies like MRI magnets, certain rare superconductors are predicted to host exotic quantum states on their surfaces that could serve as building blocks for quantum computers far more resistant to errors than today's machines. A newly discovered material, 2M-WS_2, a layered transition metal dichalcogenide (TMD), is a promising candidate: it becomes superconducting at a higher temperature than any other related TMD and is predicted to have the special electronic structure these quantum states require. However, the basic question of how electrical current flows through this material has not been fully explored, in part because atomically thin flakes of this material are susceptible to environmental exposure. In this work, we protect thin flakes of 2M-WS_2 by sealing them between h-BN insulating crystal layers and then attach superconducting metal electrodes using the same patterning techniques used to make computer chips. We cool the completed devices to cryogenic temperatures, a few degrees above absolute zero and measure how much current they can carry while still superconducting in a rotating magnetic field around them. Because this material is built from stacked atomic sheets, its superconductivity can depend strongly on the field's direction. Mapping that dependence reveals the internal symmetry of the superconducting state and tests whether it survives magnetic fields beyond conventional theoretical limits, a possible fingerprint of exotic physics. These measurements contribute to the foundation needed to evaluate 2M-WS_2 for future quantum technologies.

Mentor(s):

Andres Eduardo Llacsahuanga Allcca (Science); Leonid P Rokhinson (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1436

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Understanding the Optical Properties of MXenes

STEM

SURF

Authors(s):

Vedha Masuraha† (Engineering|Liberal Arts)

Abstract:

MXenes can best be defined as two-dimensional (2D), ultra-thin, sheet-like nanomaterials that are only a few atoms thick. Discovered in 2011, they possess an interesting combination of optical, electrical, mechanical, and electrochemical properties that make them widely applicable across diverse fields, including optoelectronics, electromagnetic shielding, wireless communication, energy storage, catalysis, and medicine. Typically, MXenes are produced via a top-down synthesis where a parent MAX phase precursor is stripped into atomic sheets through the acidic etching of the A-group element, followed by intercalation to expand interlayer spacing, and subsequent delamination into a colloidal solution of ideally single-layer flakes. Recently, high-entropy (HE) MXenes, which incorporate four or more near-equimolar transition metals within a single solid-solution 2D lattice, have garnered interest due to their ability to leverage entropy-stabilized multielement configurations to access enhanced and tunable properties. Our research systematically investigates how variations in composition and atomic structure influence the overall optical response of MXenes. To achieve this goal, this study is divided into two focus areas. First, we recorded the optical properties of novel HE MXenes to understand how compositional variation influences their optical response. Second, we examine the effects of elemental precursors (graphite and TiC carbon sources) and etching routes (different mixes of acids) on the oxidation stability of $Ti_3C_2T_x$ MXenes, a widely studied MXene, in ultraviolet-visible (UV-Vis) spectroscopy. Overall, we aim to develop a comprehensive optical characterization database for MXenes that will serve as a reference framework to support analysis, establish qualitative trends, and act as a foundation for future studies.

Mentor(s):

Babak Anasori (Engineering)

Other Acknowledgement(s):

Muhammad Sharif Uddin (Engineering); Krutarth Kiran Kamath (Engineering); Varun Aggarwal (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1437

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Optimal Blocking Precursors in Observations and a Two-layer Quasi-geostrophic Model

STEM

SURF

Authors(s):

Caden S McCollum† (Science); Zhixin Li* (Science); Zhaoyu Liu* (Science)

Abstract:

Atmospheric blocking, in which a stationary “traffic jam” interrupts the regular movement of weather systems in the atmosphere, has been linked to extreme weather events including anomalous precipitation, heat waves, and cold snaps. As a result, it is of great importance to forecast atmospheric blocks – yet modern weather models often fail to accurately predict blocking events. Previous work by our collaborator demonstrated that a Linear Inverse Model (LIM) can predict blocking in the North Pacific. However, that LIM depends heavily on tropical dynamics, so the precursor patterns of blocking in the mid-latitudes are as-of-yet undetermined. In our work, we train a LIM on data obtained from the two-layer quasigeostrophic model, a simple model of mid-latitude dynamics which excludes this tropical signal. We verify the LIM using standard statistical validation tests. We then compute the optimal blocking precursor patterns in the mid-latitudes and compare our results with empirical observations to quantify the accuracy of our model. These idealized patterns - which provide a tool for detecting real-world blocks in advance - have positive implications for the enhanced prediction of atmospheric blocks in the continental United States, Europe, Asia, and other populated mid-latitude regions.

Mentor(s):

Lei Wang (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1438

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Producing Rocket Fuel on Mars: A Thermodynamic Analysis of Separating Perchlorate Salts from Martian Brine

STEM

SURF

Authors(s):

Sahda Mohammadu Haroon† (Engineering); Isaac Parks* (Engineering); Tejas Pandit*; Princess Gloria Onyinyechi Okoli* (Engineering)

Abstract:

While perchlorate salts found across the Martian surface are toxic to humans and plants, they also serve as oxidizers for solid rocket fuel. Producing this fuel on Mars reduces the cost of transporting a fully fueled vehicle from Earth to return astronauts from the Martian surface. Perchlorate salts are distributed throughout the Martian regolith (the loose rock and dust covering the planet's surface) and can be extracted by dissolving them in water due to their high solubility. Because water is a scarce resource on Mars, efficient water recovery is essential for a closed-loop In-Situ Resource Utilization process (relying on local resources instead of expensive resupply from Earth). While previous studies have investigated perchlorate remediation, water recovery, and propellant production as separate problems, the thermodynamic limits associated with simultaneously recovering reusable water and solid perchlorate salts remain largely unexplored. Although the multi-step extraction process involves dissolving perchlorate salts from the regolith and using filtration steps to separate unwanted ions, this work specifically models the final separation of dissolved perchlorate salts from the water stream. A thermodynamic model is developed to estimate the minimum energy required to recover calcium and magnesium perchlorate salts from water. The model compares a process that takes advantage of Mars' low atmospheric pressure (approximately 0.6 kPa) to boil the solution against conventional salt recovery systems used on Earth. The analysis evaluates the theoretical energy required for each recovery pathway, including the minimum work of separation, specific energy consumption, and thermodynamic efficiency. The results establish theoretical mass and energy limits for perchlorate recovery, providing a benchmark to evaluate system feasibility and guide the design of closed-loop perchlorate extraction systems for future crewed Mars missions.

Mentor(s):
Xavier I Morgan-Lange (Engineering); David Warsinger (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1439

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Microchip integration of a novel communications technology

STEM

SURF

Authors(s):

Lucas Munoz† (Polytechnic)

Abstract:

Current technologies such as QR codes are passive in the sense that they don't need external energy sources to work. However, QR codes are limited on how much information they can store due to the resolution limitations of printers and cameras. Optical Frequency Identification (OFID) is a novel technology that could solve this problem since it allows for more information transfer through pulsed light signals. At this moment, OFID is built using discrete components which increases its area and power consumption, making it costly and bulky. To tackle this problem, this research project aims to integrate as much of the OFID system into a single microchip designed to meet low power consumption and space constraints. The first goal is to integrate the foundational building block circuits using the SKY-130 process design kit (PDK). The circuits were simulated and tested using open-source tools such as Xschem and NGSPICE. After verifying that these circuits met the requirements, the system blocks of the OFID system were integrated and simulated. Finally, the OFID system's transistor-level layout was carried out, and a post layout analysis was done to simulate how a real microchip would behave. Simulations show that integrating a system on chip (SoC) OFID technology reduces power consumption and area significantly. However, multiple components should still be mounted as discrete electronics as they present difficulties while integrating. This research demonstrates the process of transitioning OFID from discrete component technology to microchip technology. Simulations also prove to be more energy efficient, which could make it self-sustainable once completely fabricated.

Mentor(s):

Walter Daniel Leon-Salas (Polytechnic)

Other Acknowledgement(s):

Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1440
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Improving the accuracy and efficiency in Large Language Model component creation for web development and content creation

STEM
SURF

Authors(s):
Saran S Nagubandi† (Science); Aiden Moy‡ (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Jason Wu (Science)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1441

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Influence of Pore Morphology on Dehumidification Performance of Asymmetric Polyethersulfone Membranes

STEM

SURF

Authors(s):

Ishan Gopu Nair† (Engineering); Mudit Pandey* (Engineering); Harishramani Venkatasubramanian* (Engineering); Md Sadat Aarik* (Engineering); Govind Sriram Lanka* (Engineering); Ron Cheng Xuan Chay* (Science)

Abstract:

While typical condensation dehumidification is extremely energy intensive accounting for 68% of primary energy usage in commercial buildings, passive membrane dehumidification (PMD) offers a promising, energy-efficient alternative. The most common type of membrane found in passive membrane dehumidification applications typically consists of a dense hydrophilic layer coated on a hydrophobic support layer. This structure poses tradeoffs between high selectivity and high permeability, which limits dehumidification membrane performance. However, membranes fabricated through non-solvent induced phase separation (NIPS) have intrinsic asymmetric structures with a thin polymer dense skin layer and a spongy, porous, thick layer, which can enhance the membrane permeance significantly, and consequently energy efficiency. The dehumidification performances of these membranes were measured for varying feed inlet conditions across a consistent dehumidification module. The 0.1 micron avg. pore size membrane exhibited the best dehumidification performance and high mass latent effectiveness due to its higher porosity and favorable vapor transport. Morphological characterizations such as scanning electron microscopy, capillary flow porometry, porosity and thermal conductivity tests of the membranes were also conducted. Low thermal conductivity values allowed us to evaluate the membrane’s performance and showcased that the membrane had better dehumidification performance at higher temperatures up to 40 degrees celsius. A system comparison observes that the 0.1 micron PES membrane water vapor permeance outperforms other passive dehumidification membrane systems even at unfavorable pressure gradients. This provides scope for the asymmetric NIPS morphology to be utilized in passive membrane dehumidification for improved energy efficiency in comparison to other membranes.

Mentor(s):
Md Ashiqur Rahman (Engineering); David Warsinger (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1442
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

A Comparative Evaluation of Machine Learning Models for Heat Conduction Problems

STEM
SURF

Authors(s):
Malavika Nair† (Engineering)

Abstract:
Solving common partial differential equations (PDEs) is fundamental to engineering applications. Physics-based solvers provide accurate solutions but become computationally expensive across large design spaces. Machine learning (ML) offers a computationally efficient alternative, but existing studies typically evaluate architectures in isolation, making it difficult to compare their strengths, limitations, and generalization. A comprehensive evaluation framework for ML approaches is therefore lacking. This project addresses that gap by developing such a framework for the Poisson equation, asking: which ML architecture most accurately and efficiently predicts PDE-governed systems, using 2D heat conduction as a representative testbed?

We built a benchmarking framework using the Method of Manufactured Solutions, a technique which generates physically consistent problems by prescribing analytical temperature fields and deriving the corresponding source terms from the governing equation. This provides exact reference solutions while allowing controlled variation in problem complexity. We compare multiple data-driven, physics-informed, and operator-learning approaches on shared accuracy and efficiency metrics, testing each architecture with and without gradient-based loss terms, across input resolutions, and with scaling to isolate their effects on accuracy.

Preliminary results on steady-state heat conduction problems show data-driven models performing worse than physics-informed ones: Transformers achieved a best-case MSE of 0.02, outperforming U-Nets (0.05) and Graph Networks (0.45), while PINNs reached 5e-5, outperforming all data-driven approaches. This suggests embedded physical constraints improve accuracy beyond what data alone can achieve. By providing the first controlled, apples-to-apples comparison framework, this project offers evidence-based guidance for selecting machine learning models for PDE-based engineering applications.

Mentor(s):
Tejas Ravindra Kulkarni (Engineering); Sadha Sivam Murugesan (Engineering); Xiaoyue Zhang (Engineering); Ganesh Subbarayan (Engineering)

Other Acknowledgement(s):
Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1443
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Dexterous Manipulation Benchmark

STEM
SURF

Authors(s):
Khoa Duc Khoa Nguyen†

Abstract:
In the rapidly developing field of robotics, new policies and simulation approaches are constantly emerging to perform more efficiently on broader and increasingly complex dexterous manipulation tasks. However, due to the inherent unpredictability and subtle variations of the real world, a model that performs well in simulation does not necessarily perform equally well in real-world environments. To bridge this sim-to-real performance gap, we introduce the Dexterous Manipulation Benchmark, an end-to-end pipeline spanning data collection, policy learning, and Sim2Real deployment.

Using a catalog of six dexterous manipulation tasks, each designed to evaluate contact-rich manipulation as well as single-arm and bimanual manipulation, the benchmark provides a comprehensive evaluation of reinforcement learning performance across a diverse range of dexterous skills. In addition, through large-scale simulation experiments, the policies are trained to generalize across variations in object geometry, size, mass, friction, and initial pose, improving their robustness for real-world deployment.

Finally, through Sim2Real deployment, we evaluate how these policies perform in real-world settings, providing insights into the capabilities and limitations of current reinforcement learning models. We expect the Dexterous Manipulation Benchmark to produce policies that exhibit greater robustness and more consistent performance between simulation and reality. Ultimately, this benchmark aims to improve the efficiency of reinforcement learning by reducing the need for extensive task-specific fine-tuning while enabling robots to tackle increasingly challenging dexterous manipulation tasks using a training pipeline that spans from simulated to real environments.

Mentor(s):
Yu She (Engineering); Zhengtong Xu (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1444
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Loss-of-function Mutations in the SCN2A Gene Cause Structural and Functional Deficiencies in Human Cortico-striatal Circuitry

STEM
SURF

Authors(s):
Jannah M Noshi† (Science|JMHC)

Abstract:
Autism Spectrum Disorder (ASD) is a lifelong neurodevelopmental disorder affecting social communication and behavior. Mutations in the SCN2A gene, which encodes the Nav1.2 sodium channel essential for neural signaling, are a leading cause of severe monogenic autism.

Though the SCN2A gene is important in neuronal signaling, its role in human cortico-striatal circuitry (a brain network strongly associated with ASD) is largely unknown. This study seeks to determine how the protein-truncating SCN2A-C959X mutation affects the development, connectivity, and function of human neural circuitry.

To answer this question, researchers cultured cortical and striatal organoids derived from human induced pluripotent stem cells (hiPSCs) and fused them to create cortico-striatal assembloids. Researchers integrated the mutation into the hiPSCs using CRISPR-Cas9 technology and compared wild-type (WT) and mutant assembloids using viral tracing, immunostaining, RNA sequencing, electrophysiology, and live-cell imaging.

The loss-of-function mutation in the SCN2A gene impaired long-range axon projections in the cortical region, decreased dendritic spine density, impaired excitatory synaptic transmission, and disrupted the expression of genes involved in synaptic function and axon growth. Despite these structural and functional impairments, mutant neurons displayed increased network hyperexcitability.

This study found that the SCN2A-C959X mutation impairs the development and function of human cortico-striatal circuits, shedding light on the cellular mechanisms underlying SCN2A-associated autism. The increased network hyperexcitability contradicts the expected result of less-excitable mutant neurons, suggesting a compensatory response specific to human neural circuitry that is not observed in comparable

mouse models. This suggests that human brain assembloids may offer valuable advantages for studying neurodevelopmental disorders.

Mentor(s):
Xiaoling Chen (Pharmacy)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1445

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Two-Dimensional Acoustic Spectroscopy: Exploration of Quantum Phenomena in Macroscopic Nonlinear Dynamics

STEM

SURF

Authors(s):

Zoe Noznesky† (Science)

Abstract:

Vibrational spectroscopy is an essential technique for investigating molecular structure and interactions, with applications ranging from chemistry to materials science. However, methods such as two-dimensional infrared (2D IR) spectroscopy rely on specialized instrumentation and can be difficult to study directly, creating a need for accessible models that reproduce the same underlying vibrational behavior. In this project, Acoustic Spectroscopy investigates vibrations as a macroscopic complement to nonlinear molecular spectroscopy by exciting a guitar string with defined acoustic pulses and recording its response with microphones to generate absorption spectra. Multiple excitation pulses induce nonlinear vibrational interactions, enabling the construction of two-dimensional (2D) acoustic spectra and the identification of nonlinear normal modes. The resulting 2D spectra demonstrates measurable vibrational coupling and nonlinear response patterns within the guitar string, showing that a macroscopic system can capture key events associated with multidimensional molecular spectroscopy. These findings establish Acoustic Spectroscopy as an accessible platform for studying nonlinear vibrational dynamics and provide a simplified experimental model that can improve understanding and interpretation of established techniques such as 2D IR spectroscopy while supporting the development of future vibrational spectroscopy methods.

Mentor(s):

Brandon Delos Parker (Science); Michael Earl Reppert (Science)

Other Acknowledgement(s):

Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1446
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Spatial Optimization of Intracortical Ultramicroelectrode Stimulation

STEM
SURF

Authors(s):
Evelynn Marie Papez† (Engineering|JMHC)

Abstract:
A major limitation of current prosthetic limbs is a lack of large-scale tactile feedback necessary to perform regular day-to-day tasks. Intracortical microstimulation utilizes microelectrodes placed in key areas of the somatosensory and visual cortices to stimulate the subject's natural sensory pathways and mimic natural sensory feedback. These implantations have limited efficacy due to the Foreign Body Response, which occurs when the immune system forms glial scarring around chronic implantations. This reduces the effectiveness of the device, as the scar tissue both decreases the number of neurons stimulated by the implants and requires a greater amount of stimulation to maintain sensory detection. Ultramicroelectrodes are a potential solution to these issues.

A four-pronged implant with planar electrode sizes of 5 μm and 10 μm was placed in the somatosensory cortex of rat subjects. One prong of the electrode, and thus one size, was selected per trial along with a particular stimulation amplitude, with charge density maintained across sizes and trials. Conditioned avoidance was used to determine the efficacy of this ultramicroelectrode stimulation, with six water-deprived rats receiving constant stimulation at a baseline threshold while drinking from a spout and ceasing drinking when they sensed the randomly timed changes in stimulation location on the implant.

Preliminary results indicated that the rats were able to discriminate between these spatial stimuli in this behavioral paradigm. The spatial thresholds obtained at 5 μm compared to 10 μm electrodes also seem to follow previous findings with lower threshold values on smaller electrodes.

Mentor(s):
Elizabeth Tarami Su (Engineering); Kevin John Otto (Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1447

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Converting Martian Soil to Rocket Fuel

STEM

SURF

Authors(s):

Isaac Parks† (Engineering); Sahda Mohammadu Haroon* (Engineering); Princess Gloria Onyinyechi Okoli* (Engineering); Tejas Pandit*

Abstract:

Space travel offers both the advent of vast scientific advancement and discovery, as well as the potential for substantial economic development. However, space travel is extremely expensive due to the energy needed to break Earth's gravitational field. One factor that could reduce costs and advance space travel is In Situ-Resource utilization (ISRU). ISRU is the process of utilizing existing materials on extraterrestrial bodies as opposed to bringing the required resources from Earth. This research paper specializes in the application of ISRU towards fuel independency on Mars via separating perchlorate ions from Martian regolith (soil) for use in production of energetic materials. Existent literature was analyzed to determine the wet chemistry of Martian regolith. From this, an experimental setup for procuring perchlorate was developed. Namely, this included mixing the regolith into water to isolate soluble ions. The water is then filtered of any sediment providing an aqueous solution. The perchlorate is then separated from any other present anions through a selective nanofiltration (NF) membrane. This NF membrane presents a major step in modeling as the ion concentrations of Martian regolith require unique membrane properties due to the nature of their specific ion radii and charge neutrality constraints. Thus, a large focus of this paper is on modeling using Donnan steric pore model and dielectric exclusion (DSPM&DE) paired with extended Nernst–Planck (ENP) equations. The perchlorate is then recovered by desorbing the present ions into a salt compound for further processing for use as energetic materials, and the water is recovered for future use in this system. In lieu of Martian experimentation, a least work model was developed to capture the energy requirements of critical elements. From this model, a conclusion will be drawn on the energy effectiveness of perchlorate separation for use in energetic materials for rocket fuel over shipping fuel from Earth.

Mentor(s):

Xavier I Morgan-Lange (Engineering); David Warsinger (Engineering)

Other Acknowledgement(s):
Clark Lay (Engineering)

Poster Presentation Abstract Number: 1448
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

A Custom Capacitive Liquid-Level Sensor for an R&D TPC in Dark Matter Detection

STEM
SURF

Authors(s):
Kavyaa Parmar† (Engineering|Science); Atiksh Bhattacharya† (Science)

Abstract:
Dual-phase noble gas time projection chambers (TPCs) are used in the world's most sensitive dark matter searches. Energy depositions in the liquid phase produce prompt scintillation (S1) and ionization electrons, which drift to the liquid surface and are extracted into the gas phase to generate secondary scintillation (S2). The S2/S1 ratio discriminates dark matter interactions from background events. Precise positioning of the liquid-gas interface between the electrodes that generate the extraction field is critical, as overfilling or underfilling can eliminate the S2 signal.

This work focuses on the design optimization of a custom capacitive liquid-level sensor for an R&D dual-phase noble gas TPC. The sensor is engineered with mounting features and precisely positioned screw holes to ensure alignment within the TPC structure. Electrostatic simulations are performed to model capacitance variations as a function of the liquid level, and a capacitive-to-digital converter is tested to evaluate its sensitivity to these variations. The sensor cables underwent testing in liquid nitrogen to evaluate the structural and electrical stability of its capacitance readout. The eventual integration of this sensor will provide real-time liquid-level monitoring, ensuring the operational stability and reproducibility of the experiment. Furthermore, this design can be adapted for use in a future solid/gas dual-phase TPC.

Mentor(s):
Shilo Xia (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1449

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Automation Methods for Gamma Ray Spectroscopy and Data Analysis

STEM

SURF

Authors(s):

Truman Carl Parrish† (Science); Ananya Molugu† (Science)

Abstract:

Gamma-ray spectroscopy is a key tool for studying nuclear structure, offering insight into the excited states and decay pathways of atomic nuclei that give rise to nuclear isomers. These transitions are organized into nuclear level schemes, typically reconstructed from two-dimensional gamma-gamma coincidence matrices through non-ML analysis. This process is slow, and are difficult to scale when matrices contain detector background, Compton scattering, finite energy resolution, and overlapping or ambiguous peak structures. As datasets grow larger, these challenges motivate automated methods leveraging AI/ML that can distinguish true transition relationships from background and scattering artifacts. This project explores machine learning methods for data analysis using simulated matrices generated from toy Monte Carlo models, providing large training datasets with known ground truth for comparison against model predictions. The approach frames level scheme reconstruction as an image-to-graph problem. A convolutional neural network (CNN) baseline first identifies local features in the coincidence matrices, and a Graph Attention Network (GAT) then represents candidate peaks as nodes and candidate coincidences as edges, encoding relationships such as coincidence strength, matrix symmetry, and detector count intensity. The attention mechanism learns which relationships most strongly reflect real nuclear transitions rather than background or scattering, letting the model prioritize the most physically meaningful connections when reconstructing a level scheme. By combining simulation, preprocessing, and graph attention based machine learning, this work contributes to a scalable pipeline for gamma-ray spectroscopy analysis. The long-term goal is to reduce reliance on manual interpretation, improve reproducibility, and accelerate nuclear isomer discovery and level scheme reconstruction.

Mentor(s):

Andy Jung (Science); Ace Rounds (Science)

Other Acknowledgement(s):
Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1450

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Two-Way Coupled Particle-Air Flow Simulation for Improved Erosion Prediction in Aircraft Engine Compressors

STEM

SURF

Authors(s):

Daniel J V Pike† (Engineering); Sai Kasturi Kamila* (Engineering|JMHC)

Abstract:

Aircraft engines operating in dusty environments ingest submillimeter particles that erode compressor surfaces and degrade engine performance and service life. Current erosion models, including those in commercial solvers such as Ansys CFX, apply particle tracking as a post-processing step on a fluid-only air simulation. This one-way coupled approach fails to capture how particles alter the airflow itself, limiting the physical accuracy of erosion predictions. To address this limitation, this project implements a two-way coupled, two-phase particle-air flow simulation in OpenFOAM, an open-source computational fluid dynamics platform, in which the particles and airflow influence each other simultaneously. Particle behavior is modeled stochastically, sampling properties such as size and density from realistic distributions, with impact and breakup behavior informed by laboratory testing of high-speed particle impacts against samples of materials found in standard commercial aircraft engines. Simulations are run on the Purdue Gautschi high-performance computing cluster, first for simplified test cases such as flat and curved surfaces, and then for a full compressor blade. Results are compared against one-way coupled Ansys CFX simulations, published OpenFOAM studies, and experimental data. This validated framework is expected to reveal trends relating particle size, density, and size variation to erosion severity, supporting the development of improved erosion models for aircraft engine compressors.

Mentor(s):

Zherui Martinez-Guo (Engineering); Adithya Kolisetty (Engineering)

Other Acknowledgement(s):

Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1451

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Computer Vision for Fencing Video Analysis

STEM

SURF

Authors(s):

Jacob Lee Prior† (Engineering); Andrew Thomas Choung* (Engineering)

Abstract:

Fencing, a high-speed action sport, proves difficult for new learners and spectators to understand due to its quick pace. While modern computing has been implemented in fencing for refereeing purposes, there is little work on automated fencer action recognition and strategic analysis for fencer training. We seek to design a system that utilizes modern computer vision techniques to analyze fencers' movements and provide insightful feedback given a fencing video recorded by an unstable camera. We believe that modeling the position, velocity, and acceleration of a fencer's skeletal joints with respect to their environment over time is sufficient to infer their actions. In the proposed system, we extract the fencers' skeletal joint features utilizing open-source pose estimation software and motion estimation algorithms. The skeletal features are then filtered and analyzed to determine what the individual fencers are doing throughout the video. Given an input set of fencing videos, the system's analysis is then compared with predetermined ground truth labels for each video to determine the degree to which the fencers' actions can be distinguished. In future work, we plan to extend the system's ability to confidently detect more precise actions.

Mentor(s):

Amy R Reibman (Engineering)

Other Acknowledgement(s):

Lipi Roy (Engineering); Haochuan Hu (Engineering)

Poster Presentation Abstract Number: 1452
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

The Emerging Role of Agentic AI in Transportation and Logistics

STEM
SURF

Authors(s):
Reyam Roumeih† (Engineering)

Abstract:
Agentic AI refers to systems that plan, decide, and act toward a goal over multiple steps with limited human oversight, rather than responding to a single prompt or running a fixed sequence of tasks. Unlike traditional AI that performs a set task on command, an agentic system controls its own workflow: it decides what to do next and adapts across systems as conditions change. Transportation and logistics are natural places to apply it, because these fields run on decisions made under time pressure, and much of that coordination still waits on people. It is also rich with data, which is the key to successfully adopting agentic workflows. This paper looks at the decisions that make up transportation and warehousing operations, and asks where agentic AI can help. We review the functions where agentic AI has been applied, in research and in practice, and identify functions that remain untouched or only partly addressed, where the structure of the decision points to strong potential. Building on this, we set out a framework for adopting agentic AI in these settings, covering how to scope the problem, design and integrate the model, prepare the data, and support continuous learning. We discuss the organizational barriers that have held adoption back, including the mismatch between capable agents and coordination systems still built for human decision-making.

Mentor(s):
Reem Khir (Engineering)

Other Acknowledgement(s):
Denver John Lobo (Engineering); Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1453

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Bistable Auxetic Patterns and their use in non-cooperative space object detumbling

STEM

SURF

Authors(s):

William James Rowe† (Engineering)

Abstract:

The methods and recovery of non-cooperative space objects remain complex, expensive or have a high cost of energy consumption. Objects in space typically have an unknown mass and angular velocity and require detumbling that is both fast and minimizes damage to the capturing craft and the detumbled object. This project seeks to use auxetic patterns (patterns that expand in multiple directions when stretched) to conform to the shape of a hypothetical space object. The goal is to develop a process that is low-cost, has a low energy budget, and minimizes damage to the object. 3D patterns are processed in Grasshopper into flat sheets that when stretched, “pop out” into 3d curvature surfaces. Multiple parameters in the pattern allow for the optimization of energy usage, minimizing the barrier required to switch the sheet between its “Flat” and “Popped out” states. Sheets are then 3D printed via TPU to be tested on a simulation probe in a zero-drag environment.

Mentor(s):

Yuto Tanaka (Engineering)

Other Acknowledgement(s):

Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1454

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Evaluation of SpeedBox Connection Strength

STEM

SURF

Authors(s):

Chris Schoenherr† (Polytechnic)

Abstract:

The coupled composite plate shear walls/concrete filled (CC-PSW/CFs) system, also known as the coupled SpeedCore system, accelerates high rise construction while providing satisfactory seismic performance. A planar SpeedCore wall consists of two exterior steel plates, flange closure plates, steel ties or steel ties and shear studs, and concrete infill. For a coupled SpeedCore system, the coupling beam consists of a steel tube that is shop welded to two SpeedCore walls. The three connected components are then transported to the field and cast with concrete on-site. A newly proposed steel coupling beam-to-wall (SpeedBox) connection aims to accelerate erection time and applicability of the coupled SpeedCore system through the use of a bolted connection. This connection also allows for the use of a wide flange steel coupling beam alternative. Experimental testing is currently ongoing to evaluate the strength of the SpeedBox connection. The test setup consists of one C-PSW/CF with a W-beam that is half the full length, allowing the replication of the full behavior without constructing a full coupled SpeedCore system. Two MTS actuators are attached to the top end of the W-beam, at a height corresponding to the mid-span of the full-length beam, to apply the load. An initial experiment demonstrates good agreement between the calculated and experimental bolt rupture capacity. Calculations performed using the elastic method found that bolt rupture should occur at a load of 79.3 kips. Experimental results show that bolt rupture occurred at 77.1 kips, a 2.81% difference. The low percent difference reasonably validates the capacity design and testing procedures, allowing for continued testing using different bolt configurations. The eventual results of this research will help determine whether the SpeedBox connection satisfies code required seismic behavior and can provide an alternative to a conventionally welded concrete filled steel tube in the coupled SpeedCore system.

Mentor(s):

Kaitlyn Amber Kondos (Engineering); Amit Varma (Engineering); Shivam Sharma (Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1455
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Developing a Human Astrocyte Model to Study the Role of VPS35 in Alzheimer's Disease

STEM
SURF

Authors(s):
Leonel Baskin Sesuraj Baskin† (Science)

Abstract:
Alzheimer's disease (AD) is the most common cause of dementia and affects millions of people worldwide. Although its exact cause remains unclear, growing evidence suggests that disrupted protein transport and recycling within brain cells may contribute to disease progression. VPS35 is a key protein in the cell's protein recycling system, which helps maintain proper protein localization and cellular function within astrocytes.

Reduced VPS35 levels have been linked to Alzheimer's disease, but the exact effects of its loss remain poorly understood because of the limited laboratory models available to study this process.

The goal of this project was to develop a human astrocyte model with reduced VPS35 expression to better understand how impaired protein recycling could contribute to AD. Stem cells were genetically modified using CRISPR interference to decrease VPS35 expression. The successfully modified cells were then selected using antibiotic treatment and differentiated into astrocytes. Cell growth and morphology were monitored throughout the differentiation process, and RNA was isolated for future gene expression analysis to verify successful VPS35 knockdown.

The modified cells remained viable throughout the experiment and successfully differentiated into astrocytes with healthy morphology. RNA was successfully isolated from the cells, although the yield was lower than expected, indicating that cell culture conditions can be further optimized before downstream analyses, such as cell painting, are performed.

This work establishes a human astrocyte model that will be used to confirm VPS35 knockdown and investigate how impaired protein recycling influences astrocyte function. By providing a platform to study this pathway, this model will advance our understanding of Alzheimer's

disease mechanisms and support the development of future therapeutic strategies aimed at accelerating the discovery of new treatments for AD.

Mentor(s):
Matthew Thomas Tegtmeyer (Science)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1456
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Joint Registration and Pathology Detection in CT via Diffeomorphic Neural Optimal Transport

STEM
SURF

Authors(s):
Ziqi Shen† (Engineering)

Abstract:
Accurate analysis of computed tomography (CT) data requires aligning and warping each scan to a standardized healthy atlas, followed by identifying the anatomical regions. This process is known as joint registration and segmentation. Existing machine learning workflows provide no useful guidance when the source and target have minimal overlap. We approach this spatial problem using optimal transport (OT), a mathematical framework that measures the minimum-cost transport between probability distributions. This registration method guarantees smooth, invertible warping—known as diffeomorphic deformations—by parameterizing a neural-network-approximated velocity field. To obtain the velocity field, the method optimizes for minimum transport cost (OT loss) between the source image and target atlas, yielding a globally informative signal even when the two distributions are disjoint, thereby guaranteeing topology-preserving, invertible deformations. Voxels absent from the prior atlas, such as lesions, tumors, and hemorrhages, are identified as extra-class structures in a fully unsupervised manner, enabling registration and segmentation without manual annotation. Embedded in a governed agentic harness, the full CT-to-decision workflow runs autonomously, reducing expert intervention from hours to minutes and allowing reproducible analysis at scale. Validation on an in vivo human brain hemorrhage CT dataset, CQ-500, demonstrates annotation-free, consistent identification of hemorrhage locations. These results establish diffeomorphic neural optimal transport as a principled and scalable foundation for automated, agent-driven quantitative neuroimaging.

Mentor(s):
Anubhav Dey (Engineering); Ilias Bilionis (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Poster Presentation Abstract Number: 1457

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Resolution restoration and segmentation of two-photon dendritic spine images using deep learning-based algorithms

STEM

SURF

Authors(s):

Leonor Antunes Sinogas† (Science)

Abstract:

Dendritic spines are small protrusions on neuronal dendrites and major sites of excitatory synaptic transmission. Their morphology, including spine head volume and area, neck length, and neck width, is closely linked to synaptic strength, plasticity, learning, and memory. However, their nanometer-to-submicron size makes them difficult to visualize and measure accurately. Although two-photon microscopy enables in vivo imaging in thick, scattering tissue, low signal-to-noise ratio, motion artifacts, blur, and limited axial resolution can obscure fine structures.

This project develops a deep learning-based pipeline to restore and segment three-dimensional two-photon microscopy image stacks of dendritic spines. The workflow loads TIFF stacks, applies preprocessing, and trains a Content-Aware Image Restoration (CARE) model using paired low-quality and higher-quality images. The model aims to reduce noise, improve axial and lateral resolution, and recover structural detail before automated segmentation.

Fluorescent bead stacks provide controlled reference data for evaluating resolution restoration through full width at half maximum measurements and object-based comparisons. Restored spine images will also be assessed using signal-to-noise ratio and preservation of biologically relevant structures. Expected results include clearer in vivo and ex vivo images with more easily identifiable dendrites, spine heads, and spine necks. Automated segmentation will separate these structures and extract measurements such as head volume, head area, neck length, and neck width.

These measurements will allow researchers to track changes in individual spines over time and examine how structural changes relate to synaptic plasticity, learning, and memory. By improving image quality and automated analysis, this pipeline aims to support more accurate, efficient, and reproducible studies of neuronal structure and function.

Mentor(s):
Shulan Xiao (Engineering); Linlin Li (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1458

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Analysis of Fast Tuning Methods for Cross Coupled Resonator Cavity Filters

STEM

SURF

Authors(s):

Peter Robertson Skrdla† (Engineering); Joseph Timothy Kritenbrink* (Engineering)

Abstract:

Microwave cavity filters are critical components in modern communication and RF systems. Cascading multiple resonant cavities are essential to maximize energy efficiency and frequency selectivity while minimizing insertion loss which is critical in communications, medical devices, scientific technology, and defense systems. To function correctly, each cavity's physical dimensions must be precisely tuned to align with the desired center frequency and bandwidth. In practice, manufacturing tolerances, material variations, and external coupling effects often degrade the ideal resonator characteristics resulting in dysfunctional devices. While mechanical tuning elements, such as actuator-controlled tuning disks, can compensate for these deviations, the filter becomes highly non-linear when more than two resonators are coupled. Traditional manual or iterative actuator tuning for higher-order filters is time-consuming and computationally expensive. This work evaluates automated tuning approaches for three mechanisms which could potentially expedite fine tuning in real-time while alleviating expense: Algorithmic Tuning (AT), Coupling Matrix Extraction (CME), and Constrained Bayesian Optimization (CBO). The experimental setup utilizes a MATLAB® controller which interfaces directly with a PNA-L Network Analyzer to instantaneously capture S-parameters. In tandem, a Raspberry Pi Pico 2 microcontroller is dynamically controlled which adjusts the physical actuator positions of the device under test (DUT). The output of this work will evaluate each of the methodologies in order to assess the viability and performance. The results from this study can be used to advance systems relying on higher order resonant cavities across a multitude of disciplines.

Mentor(s):

Alex Santiago-Vargas (Engineering)

Other Acknowledgement(s):

Dimitrios Peroulis (PWL); Jia Lin Cheoh (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1459
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Automating 2D material exfoliation

STEM
SURF

Authors(s):
Aditya Srinivasan† (Science)

Abstract:
In condensed matter physics, moiré materials are created by stacking two or more two-dimensional (2D) materials with a controlled twist angle between the layers, giving rise to a moiré superlattice with electronic properties that differ significantly from those of the individual materials. The first step in fabricating these devices is the mechanical exfoliation of bulk crystals to obtain thin, high-quality 2D flakes. This process is traditionally carried out by hand using scotch tape, making it highly dependent on user experience and difficult to reproduce consistently. Furthermore, different classes of 2D materials require different exfoliation procedures and operating conditions to maximize the yield of usable flakes, making the process both time-consuming and challenging to standardize. I am developing an automated exfoliation system using two computer numerical control (CNC) machines, each equipped with independently controlled x-, y-, and z-axis motors that provide precise and repeatable motion throughout the exfoliation process. By controlling parameters such as the position, speed, and force of the CNC systems, I aim to establish standardized exfoliation protocols that improve reproducibility while optimizing the yield of high-quality 2D material flakes. The resulting flakes can then be used in the subsequent fabrication and investigation of moiré heterostructures with novel electronic and quantum properties.

Mentor(s):
Shuaiqing Zhang (Science); Yihang Zeng (Science)

Other Acknowledgement(s):
Varun Aggarwal (Engineering); Nemanja Ninkovic (Science)

Poster Presentation Abstract Number: 1460

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Methods to control zeolite framework atom removal and insertion in varying environments within the MFI topology

STEM

SURF

Authors(s):

Kaylani Le'mae Tomlin† (Engineering)

Abstract:

Heterogeneous catalysis is essential for converting carbon feedstocks into fuels and chemicals. Zeolites are one of these catalysts, widely used because of their high stability and shape-selective microporous frameworks. MFI, a type of zeolite framework, contains two distinct pore environments: smaller channels (~0.55 nm diameter) and larger channel intersections (~0.70 nm diameter), which can influence catalytic behavior via van der Waals interactions. Trivalent heteroatoms (+3) such as Al, Ga, Fe, or B are inserted into MFI to generate Brønsted acid sites that serve as the active site for catalyzed reactions. These active sites can be biased towards channels, towards intersections, or randomly distributed in both environments. Our current work aims to understand not only how these atoms are placed, but also how they can be selectively removed without collapsing the framework. In particular, it is unknown whether boron located in different MFI environments can be completely removed from the framework without zeolite degradation. This project investigates framework boron removal from B-MFI samples with expected channel-biased, intersection-biased, and intermediate boron distributions. B-MFI samples are synthesized using different structure-directing agents and boron sources, then characterized by powder X-ray diffraction to confirm MFI crystallinity. Literature-based deboronation methods using deionized water and nitric acid will be tested, and post-treatment characterization will be used to evaluate boron removal and framework retention. Initial synthesis efforts produced crystalline B-MFI samples with varying yields depending on the structure-directing agent, silica source, and boron source. This work will identify framework-preserving deboronation methods for B-MFI and help determine whether boron removal depends on local siting within the MFI topology.

Mentor(s):

Sarah Gustafson Wagers (Engineering); Rajamani P Gounder (Engineering)

Other Acknowledgement(s):
Waire Olawolu (Engineering)

Poster Presentation Abstract Number: 1461

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Investigating the Integration of Dense Vision and Non-Traditional Sensing Modalities for Robust Robotic Perception

STEM

SURF

Authors(s):

Gabriel Torres† (Engineering)

Abstract:

Robotic perception systems that rely on a single sensor modality face fundamental limitations in adverse operating conditions. For example, RGB cameras provide dense scene representations but degrade significantly under fog, rain, and low illumination. Multi-modal sensor fusion addresses this limitation by combining modalities with complementary failure characteristics; however, practical deployment is constrained by two persistent challenges: aligning sensors into a shared spatial reference frame and synchronizing data across sensors with differing acquisition rates and latencies. This research presents a calibration architecture designed to address both challenges for robotic platforms operating in degraded visual environments. Spatial alignment is achieved by establishing a common coordinate frame across all sensing modalities using a target-based correspondence method, from which extrinsic parameters are recovered through nonlinear optimization. Temporal alignment is achieved by indexing hardware-level acquisition timestamps from each sensor and applying a statistical association method to group cross-modal observations into temporally consistent sets. Preliminary data collection using the calibration setup characterizes correspondence quality across a range of target positions and orientations, providing an initial basis for assessing the reliability of the proposed pipeline. This work is intended to inform the design of sensor fusion systems that maintain perception reliability in adverse environments where individual sensing modalities are unreliable, with implications for autonomous robotic operation in low-visibility field conditions.

Mentor(s):

Saru Bharti (Agriculture); Upinder Kaur (Agriculture|Engineering)

Other Acknowledgement(s):

Varun Aggarwal (Engineering); Ian Noronha (Agriculture)

Poster Presentation Abstract Number: 1462

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Multimode Entanglement in Attosecond Controlled Squeezed Light

STEM

SURF

Authors(s):

Sreeram Vengalloor Madhavan† (Science)

Abstract:

Light at a quantum level carries an irreducible amount of noise that limits how precisely it can be measured. Squeezed light is a special quantum state that redistributes this noise by quieting one property of the light (such as its amplitude or phase) below the quantum limit, at the cost of making the conjugate property noisier. This reduction in quantum noise allows measurements with sensitivities beyond standard limits and is utilized in LIGO to detect gravitational waves by measuring extremely small spacetime distortions. When squeezed light is generated from an ultrashort laser pulse, it spans many colors (frequencies), and its quantum correlations become distributed across them. Here, we develop a method to identify and quantify quantum entanglement among these frequency modes using squeezed light data obtained from experiments in a 100 micron MgO crystal. In our experiment, we control the degree of squeezing by tuning the crystal's nonlinear optical response on the attosecond timescale. We record the full bandwidth of an 808 nm femtosecond pulse in a single laser shot and construct a covariance matrix that captures the correlations between frequency components, from which we test for entanglement and measure how strongly each frequency is entangled with the rest. We expect this approach to confirm entanglement between frequency modes and to reveal how the entanglement evolves as the degree of squeezing is varied. These results would demonstrate the potential of attosecond-controlled squeezed light as a dynamically reconfigurable resource for quantum information processing and sub-shot-noise quantum metrology.

Mentor(s):

Niranjan Hirisave Shivaram (Science); Russell Lee Zimmerman (Science)

Other Acknowledgement(s):

Shashank Kumar (Science); Md Ehsanuzzaman (Science); Lipi Roy (Engineering)

Poster Presentation Abstract Number: 1463

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Binding Frequency Mapping: A Broadly Applicable Structure for Comprehending Antibody Reactions in Various Viral Pathogens

STEM

SURF

Authors(s):

Clayton Walden† (Science)

Abstract:

Most people believe that antibodies that regularly target viral epitopes are the most efficient at preventing infection, although this relationship is far more complicated than previously thought. According to recent research, frequently targeted epitopes may not always result in the best protective responses against influenza, Zika, SARS-CoV-2, and related viruses. To close this gap, we created a framework for binding frequency mapping, which measures the number of infected people or antibodies that recognize epitope sites. We then applied this approach consistently to various viral systems. Using complementary techniques such as cryo-electron microscopy, polyclonal antibody mapping, peptide microarray analysis, and ELISA, we synthesized peer-reviewed studies on various viral families, including influenza which is the HA head domain hierarchy, Zika virus which has quaternary EDII epitopes, SARS-CoV-2 which has RBD and NTD domains, MERS-related coronavirus, Lassa mammarenavirus, and Severe Fever with Thrombocytopenia Syndrome virus. Using patient cohorts stratified by illness severity and prior immunity, we retrieved standardized data on antibody sources, target immunogens, techniques, and binding frequency distributions. According to our data, binding frequency consistently decouples from neutralizing efficacy while remaining constant across technical approaches and clinical settings. The locations that are often recognized are determined by conformational dynamics and epitope accessibility rather than antibody concentration or functional efficacy. According to these results, effective vaccinations should focus on conserved, structurally accessible epitopes rather than just the most well-known ones. This binding frequency framework offers a methodologically sound, broadly applicable way for determining the best vaccination targets for any viral infection and ranking epitopes according to biological accessibility rather than just immunodominance.

Mentor(s):
Qixin He (Science); Bianca Shaunessy Broyles (PWL)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Poster Presentation Abstract Number: 1464
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Experimental Design and Prototyping for TPMS Condensers in Data Centers

STEM
SURF

Authors(s):
Serena Yuanyuan Wei† (Engineering|Science)

Abstract:
With advances in manufacturing, highly complex geometries that could not be produced via traditional methods are being investigated to improve heat exchanger efficiency. In particular, triply periodic minimal surfaces (TPMS) offer unique advantages due to their compatibility with additive manufacturing and ease of geometric manipulation. However, few studies examine the behavior of TPMS heat exchangers under two-phase flow, especially in data center applications. Therefore, this study aims to generate practical TPMS condenser prototypes, design a condenser test stand, and establish the representative operating conditions for data center thermal management. Current progress includes refining TPMS generation methods and pressure-testing samples for leak-free operation. While the current prototypes are generated with traditional 3D printing methods for rapid testing, the final heat exchanger design will be printed using metal additive manufacturing. The dedicated test stand is being constructed to characterize these TPMS condensers. Future testing and validation will utilize these results, aiding the implementation of energy-efficient TPMS condensers in data centers.

Mentor(s):
Jaewon Park (Engineering); Justin Weibel (Engineering)

Other Acknowledgement(s):
Jia Lin Cheoh (Engineering)

Poster Presentation Abstract Number: 1465

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

The Role of ARHGAP21 in the Egg-to-Embryo Transition of Mammalian Metaphase II Oocytes

STEM

SURF

Authors(s):

Sophie J Wilcox† (Pharmacy)

Abstract:

Mammalian eggs must undergo a process of maturation and reorganization to allow them to undergo embryogenesis and be successfully fertilized, known as the egg-to-embryo transition. Actin is a protein that is important to the rearranging of the cortex during this transition and is required to produce a viable embryo. ARHGAP21 is a RhoGTPase-activating protein that has yet to be studied in egg cells. However, since RhoGTPases regulate actin in cells, ARHGAP21 may be a key protein in the egg-to-embryo transition. Here we investigate the role of ARHGAP21 mouse eggs during the metaphase II phase of their transition via immunoblotting and immunofluorescence to confirm its presence in eggs and locate its precise location in eggs. This will allow us to form a clearer hypothesis regarding the function of ARHGAP21 in the egg-to-embryo transition by comparing its location to the locations of other known proteins. We found that ARHGAP21 is localized to the cortex of metaphase II mouse eggs in a semicircle that excludes the actin-rich area of the egg surrounding the DNA spindle, indicating that its presence may be involved in cortex rearrangement to progress mammalian egg cells through the transition to an embryo. These results indicate that ARHGAP21 is involved in understanding fertility and infertility in mammalian eggs and may play an important role in producing a successful embryo.

Mentor(s):

Christina Marie Boody (Science)

Other Acknowledgement(s):

Andres Catalino Castillo Jimenez (Engineering)

Poster Presentation Abstract Number: 1466
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Optimization of solvent based direct recycling for electrode delamination

STEM
SURF

Authors(s):
Ty Richard Yaguchi† (Engineering)

Abstract:
The increasing demand for lithium-ion batteries has created an urgent need for recycling methodologies that recover valuable electrode materials while minimizing waste and environmental impact. This research investigates a solvent-based direct recycling approach for recovering cathode active material, specifically NMC532, from electrodes using green organic solvents, including propylene carbonate (PC) and triethyl phosphate (TEP).

The electrodes, composed of a slurry of active material, carbon black and polyvinylidene fluoride (PVDF) coated onto aluminum foil, were submerged in the solvents. This process dissolved the PVDF binder, enabling recovery of the cathode active material. The study evaluated solid-to-liquid ratios of 1:10 and 1:20 to reduce solvent consumption while maintaining high recovery efficiency. Although solid-to-liquid ratios ranging from 1:10 to 1:40 have traditionally been used for electrode delamination, optimizing this ratio may decrease solvent usage without sacrificing material recovery.

Experiments compared the recovery percentage of cathode active material, solvent recovery efficiency, and processing time for each trial. The results showed that the 1:20 solid-to-liquid ratio recovered active material up to 87%, achieving recovery comparable to the previously reported 1:30 ratio while reducing solvent usage by approximately one-third. Current work is also exploring solvent recycling through thermally induced and nonsolvent-induced phase separation methods, including TIPS and NIPS. Overall, solvent-based direct recycling has the potential to significantly decrease waste generation during lithium-ion battery recycling, thereby providing economic and environmental benefits.

Mentor(s):
Hosop Shin (PWL); Mahmudul Hoq (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1467
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

PFOA and PFOS exposure induce endothelial cell barrier disruption

STEM
SURF

Authors(s):
Eric Y Yang† (Engineering); Bingrui Luke Wang* (Engineering)

Abstract:
Per- and polyfluoroalkyl substances (PFAS) are a class of highly persistent environmental pollutants that

accumulate in organic systems. PFAS exposure has been associated with neurodevelopmental and

neurodegenerative diseases, prompting investigation into their neurotoxic mechanisms. For a toxicant to

enter the central nervous system (CNS), it must first penetrate or disrupt the blood-brain barrier. PFAS'

ability to do so, however, is not well understood. To investigate these permeation mechanisms, this study

focuses on two major PFAS contaminants, PFOA and PFOS, and their effects on a human brain

endothelial cell line model, HBEC-5i. In addition to traditional 2D cultures, we utilized a Transwell insert

system to model the "blood" and "brain" compartments across the BBB and measure permeability and

transendothelial electrical resistance (TEER), which are markers of cell monolayer integrity. Using

relevant exposure concentrations of 0.4 and 4 ppb for both PFOA and PFOS, we assessed direct

cytotoxicity using MTT and LDH assays, effects on endothelial tight junctions using immunostaining for

tight junction proteins, endothelial cell tightness with TEER measurements, paracellular permeability

using dextran, and measured the permeability of PFOA and PFOS themselves. Results from MTT and

LDH assays suggested that PFOA and PFOS do not have direct cytotoxic effects but still impacted the

cells' barrier integrity. These findings suggest that PFAS exposure has a large role in damaging the integrity of the BBB via tight junction disruption, which increases CNS vulnerability to exposure and resulting neurotoxicity.

Mentor(s):
chongli Yuan (Engineering)

Other Acknowledgement(s):
Xihui Zhao (Engineering); Junkai Xie (Engineering); David Matthew Czerwonky (Engineering)

Poster Presentation Abstract Number: 1468
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Cas12a-Assisted Precise Targeted Cloning and Characterization of Nonomuraea candida NRRL B-24552 Biosynthetic Gene Cluster

STEM
SURF

Authors(s):
Eloise Zambrano† (Science)

Abstract:
Natural products (NPs) from living organisms have played a critical role in therapeutic discovery due to their diverse bioactivities, including antibacterial and anticancer. Actinomycetota, a phylum of soil-dwelling bacteria, are significant contributors to NP discovery because they contain biosynthetic gene clusters (BGCs) that encode for these bioactive secondary metabolites. Nonomuraea candida NRRL B-24552 is an Actinomycetota of interest based on genome sequencing and bioinformatic analysis. It is predicted to contain a BGC capable of producing novel, bioactive cyclic tetrapeptide NPs. Historically, a challenge has been activating transcription of silent and/or cryptic BGCs under standard laboratory conditions, preventing detection and characterization of NP metabolites. Direct cloning is a strategy for accessing these uncharacterized BGCs, but large-scale traditional cloning remains difficult because BGCs are often repetitive, large, and have high GC content. To combat this challenge, Cas12a-assisted precise targeted cloning using in vivo Cre-lox recombination (CAPTURE) can be used to clone these BGCs. CAPTURE is an established method that combines CRISPR-Cas12a DNA digestion to release the target BGC, T4 polymerase exo + fill-in DNA assembly to join the BGC with DNA receiver fragments, and Cre-lox-mediated in vivo circularization to generate a cloned BGC bacmid. The cloned BGC can then be introduced into a heterologous host for expression, generating previously inaccessible NPs of interest. Applying CAPTURE to N. candida NRRL B-24552 may enable direct cloning and heterologous expression of its BGC, supporting further characterization of its BGC and the predicted NPs. This project aims to characterize N. candida NRRL B-24552 BGC to access these novel, potentially bioactive NPs. Long-term goals of this project are to bioinformatically predict other bioactive cyclic peptides and leverage heterologous expression to discover novel bioactive NPs from Actinomycetota.

Mentor(s):
Elizabeth I Parkinson (Pharmacy|Science); Carson Bailey Roberts (Science)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Poster Presentation Abstract Number: 1469
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Implement BiLSTM on FPGA for Anticipating Decoherence

STEM
SURF

Authors(s):
Caleb Enos Zhang† (Engineering|JMHC); Sarthak Tandon‡ (Engineering)

Abstract:
The purpose of this research project was to better understand how to implement the BiLSTM architecture on an FPGA for the purpose of accelerating machine learning inference for predicting decoherence. The goals of this project are to have low latency predictions, high accuracy predictions, and low hardware usage. Low latency in particular is necessary for the ultimate goal of controlling the decoherence of a quantum system.

The implementation choices of individual modules will be examined in detail, especially as these goals are often tradeoffs. Three main comparisons are of concern: approximating sigmoid and tangent functions using piecewise linear approximation with different numbers of divisions yields different precisions, floating point and fixed point are also compared with different numbers of bits, and vector-matrix multiplication with varying number of rows exchange hardware usage for reduced latency.

Mentor(s):
Alexander V Kildishev (Engineering); Pranshu Maan (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1470

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Investigation of the Photochemical Degradation of 6PPD Using UV-Vis Spectroscopy and Liquid Chromatography

STEM

SURF-SCALE

Authors(s):

Sana Azat† (Science)

Abstract:

Tire-derived chemicals such as N-(1,3-dimethylbutyl)-N′-phenyl-p-phenylenediamine (6PPD) have become emerging environmental contaminants due to their widespread use and the formation of toxic transformation products in aquatic systems. This project investigates the photochemical behavior of 6PPD to better understand its environmental fate under simulated light exposure. UV-Vis spectroscopy is used to monitor changes in absorbance of 6PPD solutions prepared in a variety of solvents over time by collecting measurements at selected wavelengths following different irradiation intervals. The resulting absorbance data are used to evaluate changes in 6PPD during photolysis and generate reaction profiles. Following the UV-Vis experiments, liquid chromatography (LC) will be used to separate and mass spectrometry will be used to analyze the reaction products, providing additional information about the chemical transformations that occur during photodegradation. Additionally, 6-PPD was extracted directly from tires and the resulting solutions were analyzed with the same methods. Together, these techniques will help characterize the degradation of 6PPD and contribute to a better understanding of the persistence and transformation of tire-derived contaminants in aquatic environments.

Mentor(s):

Austin Jacob Pronk (Science)

Other Acknowledgement(s):

Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1471

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Source Differentiation of RP2040 and ESP32 Development Boards Using Non-Destructive Chemical and Surface Analysis

STEM

SURF-SCALE

Authors(s):

Owen Chen† (Engineering); James Arthur Spezzano* (Engineering); Sean Ross Klein* (Engineering|Libraries); Brandon Anthony Farber* (Engineering)

Abstract:

Microelectronics are foundational to modern electronics, with applications ranging from consumer devices to critical national-defense systems. As a result, counterfeit integrated circuits (ICs) and development boards pose growing risks to device reliability, functionality, and hardware security. Although modern standards like SAE AS6171 exist to detect counterfeit ICs, most detection methods included remain qualitative or destructive to the IC. This study evaluates non-destructive methods for distinguishing potentially counterfeit RP2040 and ESP32-DevKitC-32E-based devices obtained from one authorized distributor, DigiKey, and four foreign unattenuated sources. Using one-dimensional gas chromatography (GC) and laser profilometry (LP), we identified statistically significant differences in the chemical and surface-profile distributions among the five sources. These findings support the potential use of 1D-GC and laser profilometry as complementary, non-destructive tools for screening microelectronic components and development boards. This work may help guide future development of scalable counterfeit-detection protocols that strengthen hardware supply chain assurance.

Mentor(s):

Peter Bermel (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1472

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Educational Gap Analysis of SCALE HIAP Course Content Using Educational Mapping

STEM

SURF-SCALE

Authors(s):

Nathan Grant Clark† (Engineering); Junyi Xiu* (Vanderbilt University); Olyver Fierro* (Engineering); Eileen Koh* (Engineering)

Abstract:

The rapid growth of the semiconductor industry has increased the demand for a workforce with knowledge and skills that align with current industry needs. Educational programs play an important role in preparing students for these workforce expectations. This project evaluates the alignment between Heterogeneous Integration and Advanced Packaging (HIAP) course content and the knowledge required for semiconductor related careers. Educational mapping results generated from HIAP course materials and the SCALE HIAP educational standards are compared with workforce requirements identified from semiconductor job descriptions to identify areas of alignment and potential gaps in curriculum coverage. The project uses educational mapping and gap analysis to evaluate how well current course content supports the expectations of the semiconductor workforce. This analysis will identify strengths in the current curriculum and highlight areas where additional content could improve student preparation for the semiconductor workforce. The findings are expected to provide recommendations for strengthening curriculum alignment with industry needs and supporting future semiconductor workforce development.

Mentor(s):

Shauna Nicole Adams (Engineering); Kerrie Douglas (Engineering); Jill Anne Folkerts (Engineering)

Other Acknowledgement(s):

CJ Holdeman (Engineering); Gabriella Coloyan Fleming (Purdue University)

Poster Presentation Abstract Number: 1473

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Characterization of a Well-Type NaI(Tl) Detector for In-Vivo Neutron Activation Analysis Application

STEM

SURF-SCALE

Authors(s):

John W Fabian†

Abstract:

In-vivo neutron activation analysis (IVNAA) is a non-invasive technique used to quantify elemental analysis in biological tissue by detecting characteristic gamma-ray emissions from these elements after neutron irradiation. The accuracy of IVNAA measurements is strongly dependent on the performance and proper characterization of the gamma-ray detection system. In this project, a unique large-volume well-type NaI(Tl) scintillation detector specifically designed and constructed for IVNAA applications was characterized. After energy calibration, key detector parameters such as energy resolution, full-energy peak efficiency, total efficiency, and peak to total ratio were determined over a range of gamma-ray energies. Gamma-ray spectra were collected using standard gamma-ray sources including Am-241, Cs-137, and Co-60 placed at different positions along the detector well axis. The collected spectra were then analyzed to determine net peak area, energy calibration, energy resolution, and absolute full-energy peak efficiency. The resulting efficiency and energy resolution curves provide a comprehensive characterization of the detector response across the investigated energy range. The energy resolution of the detector ranges from 24% at 59.5 keV to 6.3% at 1332.5 keV at 25 cm away from the bottom of the well. This detector characterization establishes the performance baseline required for accurate gamma-ray quantification and supports the future implementation of the NaI(Tl) detector to be used for IVNAA measurements.

Mentor(s):

Majid Khorsandi (HHS); Linda Nie (HHS)

Other Acknowledgement(s):

CJ Holdeman (Engineering)

Poster Presentation Abstract Number: 1474

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Curriculum Gap Analysis of SCALE Educational Resources for System-on-Chip Workforce Development

STEM

SURF-SCALE

Authors(s):

Olyver Fierro† (Engineering); Eileen Koh‡ (Engineering); Junyi Xiu* (Vanderbilt University); Nathan Grant Clark* (Engineering)

Abstract:

Preparing students for careers in the semiconductor industry requires educational resources that reflect current industry expectations. As part of the SCALE initiative, this project conducts a curriculum gap analysis of educational resources within the System-on-Chip (SoC) technical vertical to evaluate how well they align with the SoC Educational Standards and substandards. More than 100 learning resources were reviewed and mapped to determine where educational standards are fully addressed, partially addressed, or missing, with research notes documenting the evidence for each evaluation. The analysis identified strengths and gaps across the curriculum, including areas where standards are well supported and others where additional instructional content could improve coverage. These findings will help guide future curriculum development and support current and future SCALE faculty, program leaders, and students as they continue strengthening SoC education and workforce preparation for the semiconductor industry.

Mentor(s):

Shauna Nicole Adams (Engineering); Kerrie Douglas (Engineering); Jill Anne Folkerts (Engineering)

Other Acknowledgement(s):

CJ Holdeman (Engineering); Gabriella Coloyan Fleming (Purdue University)

Poster Presentation Abstract Number: 1475
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Measuring degradation of Thermal Interface Materials

STEM
SURF-SCALE

Authors(s):
Richard Zhixiong Li† (Engineering)

Abstract:
Thermal Interface Materials (TIMs), including pads, pastes, and liquid metals, are ubiquitous in computing systems. Because of a TIM's role in transferring heat between a chip and a heat sink, the lifetime of a TIM (specifically those that come in the form of a paste) is very important. With continued use, pastes can undergo two major forms of degradation. The first is due to warpage of the chip's heat spreader due to thermal expansion. These cycles of expansion and contraction cause the TIM to drift away, known as pump-out. The second is due to the composition of TIMs, which tend to be mixtures of conductive particles and polymer grease. Mechanical and thermal stress results in phase separation of the TIM, which can cause voids. TIM degradation was examined in situ, where thermal and mechanical conditions were altered. TIM degradation was measured on a test bench composed of a metal plate with a heater and thermocouple attached to simulate the chip's heat spreader. The TIM was applied to this plate, and above the TIM was a secured glass plate. Fans were used to cool the setup. The metal plate was heated to varying temperatures ranging from 60-90 degrees C, with a cycle time of seven minutes on and seven minutes off. Images were taken through the glass plate, and warpage of the metal plate was measured with a laser rangefinder.

Mentor(s):
Yingru Song (Engineering); Jungmin Lee (Engineering); Amy M Marconnet (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Poster Presentation Abstract Number: 1476

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Radiation Shield Adaptable to Complex Geometries for Microelectronics Testing

STEM

SURF-SCALE

Authors(s):

Nadine Yifei Poon† (Engineering)

Abstract:

Facilities that are in accordance with military radiation testing standards are difficult to access for the purposes of research on a relatively small scale, as they are not only cost-intensive but also limited in accessibility. It is consequently important to consider employing underutilized university facilities that can provide early-stage qualification. This is an extension of work funded by the Defense Threat Reduction Agency that studies the neutron-induced gamma reaction in shielding material. The approach explores the development of a pliable non-toxic shield that can be utilized to attenuate gamma rays and neutrons; a potential application of the flexible material includes covering specific electronic components as opposed to entire systems. The testing process, fully hosted by Purdue University, involves the irradiation of samples with the use of Purdue University Reactor Number One (PUR-1), the subcritical pile, and the cobalt-60 irradiator. The environment is characterized using a Harshaw Thermoluminescent Dosimeter (TLD) System 4000, metal-oxide-semiconductor field-effect transistors (MOSFETs) are measured using a Cascade Manual Probe Station (MPS) 150, and the radiation spectroscopy of the samples is conducted via the utilization of a High-Purity Germanium (HPGe) detector. The experimental process is complimented with Monte Carlo N-Particle (MCNP6) modeling for the purpose of making comparisons between the trial results and the simulated results. It has been observed that the shield is highly effective against low energy gamma rays as well as neutrons spanning twelve decades of energy; however, the shield is relatively ineffective against high energy-photon gamma rays, a problem that can be solved with the addition of another high-density metal powder with properties similar to that of bismuth or tungsten.

Mentor(s):

Matthew M Niichel (Engineering)

Other Acknowledgement(s):

Stylianos Chatzidakis (Engineering); Peter Bermel (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1477
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Machine Learning for Intermetallic Compound Growth Prediction in Flip-Chip Solder Joints

STEM
SURF-SCALE

Authors(s):
Nikhil K Raman†

Abstract:
Flip chips, an important component in compact technologies such as smartphones, utilize Sn solders to bond chip dies to a substrate. In this study, we focus specifically on Sn bonding with Cu substrates. This reaction causes Cu6Sn5, an intermetallic compound (IMC), to form between the Sn and Cu. Though Cu6Sn5 is necessary for bonding, it is brittle and its growth can lead to reliability issues in flip-chip packages. Multiphase simulations are run using FEM (Finite Element Method) to investigate IMC growth based on factors such as Sn grain orientation, grain boundaries, and current density. Due to the complexity of these simulations, they can take days to run, even with CPUs. We seek to investigate whether a Convolutional LSTM (ConvLSTM) machine learning model can be used as a surrogate to decrease computation time and expense. We utilize data from FEM simulations to train the machine learning model to predict Cu6Sn5 growth for various grain orientations. The FEM training data consists of 10 simulations with one Sn grain at an angle ranging from 0 to 90 degrees with respect to the c-axis. During prediction, simulations with multiple grains and grain boundaries are used to test the generalization capabilities of the model. We find that the ConvLSTM can successfully generalize to geometrically complex test cases with two and three Sn phases. With generalization abilities, this model allows for faster exploration of a variety of geometries without needing extensive training. These findings reveal the potential for machine learning models to accelerate and improve chip design by decreasing simulation runtime.

Mentor(s):
Fariha Haq (Engineering); Marisol Koslowski (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Poster Presentation Abstract Number: 1478

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Curriculum Gap Analysis for SCALE Radiation-Hardening Technical Vertical

STEM

SURF-SCALE

Authors(s):

Junyi Xiu† (Vanderbilt University); Olyver Fierro* (Engineering); Nathan Grant Clark* (Engineering); Eileen Koh* (Engineering)

Abstract:

For engineering programs, curriculum gap analysis is commonly used to figure out if educational content can match the expected knowledge, skills, and abilities (KSAs) of students, to prevent underpreparing them for industry jobs. For the Scalable Asymmetric Lifecycle Engagement (SCALE) program, which focuses on creating a microelectronics defense workforce, a gap analysis of the Radiation Hardening (RH) technical vertical is essential for validating correct alignment between SCALE educational standards, created from the KSAs, and industry practices for all the stakeholders. This research will assist SCALE in understanding the coverage of the current resources offered to students on SCALE's online resource database and what additions are necessary to match the educational standards and microelectronics defense industry requirements. Three major gaps were analyzed: benchmarking, perception, and learning gaps. The benchmarking gap analysis mapped RH teaching resources to current SCALE educational standards. The perception gap analysis compared these standards to the required skills from industry job listings. Finally, the learning gap analysis documented the researcher's learning experiences while going through the course content to identify differences in content perceptions. This revealed that the researcher's curricular expectations were mostly met through SCALE content. Despite finding that the curriculum has coverage for most standards and job skills, there are still areas for improvement for certain gaps. This acknowledgement will help benefit the SCALE curriculum through insight and recommended future content. Overall, the RH technical vertical leads will have a starting basis to work on improving the now-known content gaps, while students will be impacted through a better learning experience.

Mentor(s):

Shauna Nicole Adams (Engineering); Kerrie Douglas (Engineering); Jill Anne Folkerts (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering); Gabriella Coloyan Fleming (Purdue University)

Poster Presentation Abstract Number: 1479

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Use of Digital Image Correlation in Calibration Chamber Tests to Study the Response of Soil in Geotechnical Engineering

STEM

UREP-C or UREP-LA

Authors(s):

Harol Esteban Botero Soto† (Engineering)

Abstract:

Calibration chamber testing is widely used in geotechnical engineering to simulate field stress and boundary conditions and to study soil–foundation interaction under controlled laboratory conditions. These tests are particularly useful for investigating pile jacking and shallow foundation behavior; however, interpreting soil deformation remains challenging because much of the response develops within the soil mass and may involve large displacements, strain localization, and spatially variable deformation that cannot be fully captured using conventional point-based instrumentation. This study presents a review of calibration chamber tests performed on different pile configurations and shallow footing systems, with emphasis on the interpretation of soil response using Digital Image Correlation (DIC).

The study focuses on full-field displacement and strain measurements within the soil domain to characterize deformation patterns that develop during testing. Vertical, radial, and horizontal displacement and strain fields are examined to identify soil movement, deformation mechanisms, and localized strain zones around the tested element. Preliminary observations indicate that DIC provides a clearer visualization of soil deformation than conventional instrumentation, which is limited to discrete measurement points. The results demonstrate that DIC is a valuable complementary tool for calibration chamber testing and for improving the interpretation of soil response under controlled experimental conditions.

Mentor(s):

Satish Kumar Adari (Engineering); Rodrigo Salgado (Engineering); Monica Prezzi (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1480
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Guardrail information model: A traceable AI agent methodology for reducing information loss in 2D infrastructure plans.

STEM
UREP-C or UREP-LA

Authors(s):
Luis Felipe Pardo Diaz† (Polytechnic)

Abstract:
[Abstract Redacted]

Mentor(s):
Soowon Chang (Polytechnic); Heung Jin Oh (Polytechnic); Daniel Francisco Castro (Polytechnic)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1481

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Dissolution Behavior of the γ′-phase in the HAYNES® 233® alloy Ni-Base Superalloy

STEM

UREP-C or UREP-LA

Authors(s):

Maria Alejandra Saavedra Mogotocoro† (PWL); Ian Edward Bowley‡ (Engineering)

Abstract:

HAYNES 233 alloy is a γ′-strengthened, alumina-forming nickel-base superalloy designed for high-temperature aerospace and power-generation applications. The mechanical performance of this alloy strongly depends on the stability of the γ′ precipitates. The objective of this study was to investigate the effect of thermal exposure temperature and holding time on the dissolution behavior of the γ′ phase and its influence on hardness. Samples were solution annealed at 1177 °C for 30 minutes followed by water quenching and subsequently subjected to a double-step age-hardening treatment consisting of 899 °C for 4 hours and 788 °C for 8 hours.Thermal exposure experiments were performed at temperatures between 850 °C and 1000 °C for holding times ranging from 1 to 120 minutes. Microstructural evolution was evaluated through metallographic analysis, while Vickers hardness testing was used to evaluate the overaging and dissolution response. The aged condition exhibited a hardness of approximately 387 HV. Hardness remained relatively stable at 850–871 °C, indicating γ′ stability, but progressively decreased as the temperature approached the γ′ solvus (964 °C) due to precipitate coarsening and dissolution. Above the solvus temperature, hardness dropped to approximately 225–235 HV, reflecting a significant loss of γ′ strengthening. These results provide insight into the thermal stability of 233 alloy and potential degradation mechanisms occurring during high-temperature service.

Mentor(s):

Michael Titus (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1482

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Regulation of bone remodeling through co-delivery of STING antagonist and phenamil nanocarriers.

STEM

Authors(s):

Abigail Catherine Alexander† (Vet Med)

Abstract:

Rheumatoid arthritis (RA) is a systemic autoimmune disease distinguished by severe bone erosion and inflammation of the synovial joints. In healthy individuals, bone strength is maintained by the process known as bone remodeling, which is balanced by osteoblasts and osteoclasts. Osteoblasts form new bone while osteoclasts resorb old bone, and dysregulation of this balance causes severe bone and joint degradation. Currently, no therapeutics are capable of attenuating inflammation and restoring bone homeostasis; however, one strategy for reducing RA-associated bone degradation and inflammation is to combine the effects of a cGAS-STING pathway antagonist and the pro-osteogenic agent, phenamil. We will assess osteoblast differentiation using MC3T3-E1 murine pre-osteoblasts and co-deliver nanocarriers (NCs) containing phenamil and STING antagonist. We hypothesize that delivery of co-loaded nanocarriers can simultaneously enhance osteoblast differentiation and decrease osteoclastogenesis. We will assay for improvements in osteoblast differentiation by quantifying pro-osteogenic gene expression and performing alizarin red staining at days 10 and 21, respectively. Preliminary results suggest that nanocarrier treatments under pro-inflammatory conditions upregulate genes BSP, OCN, and OPG. Interestingly, preliminary data indicates some NC combinations are sufficient to upregulate pro-osteogenic genes in the absence of differentiation supplements, suggesting an autonomous therapeutic effect. Future directions will focus on investigating how these nanocarriers affect osteoclastogenesis through TRAP staining, as well as preventing the disruption of osteoblast differentiation from pro-inflammatory factors using M1 macrophage conditioned media. This study seeks to improve RA treatment options by investigating strategies that can rebalance bone homeostasis and reduce inflammation, ultimately increasing quality of life.

Mentor(s):

Marxa Figueiredo (Vet Med)

Other Acknowledgement(s):
Gabriel Steven Harris (Vet Med); Kurt Ristroph (Agriculture|Engineering); Herman O Sintim (Science)

Poster Presentation Abstract Number: 1483
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Reinforcement Learning for fixed-wing path planning with feasibility evaluation

STEM

Authors(s):
Kaya Aypek† (Engineering); Adam Zhang‡ (Science)

Abstract:
Autonomous fixed-wing aerial vehicles require fast, physics-informed, and resilient path planning that dynamically adapts to varying and uncertain flight conditions. Although there have been many approaches to fixed-wing path planning, reinforcement learning (RL) implementations remain underexplored. This research proposes three RL implementations--Q-Learning, State-Action-Reward-State-Action (SARSA) and a Dynamic Programming (DP) baseline--for fixed-wing path planning and compares their speed and accuracy across varying and uncertain environments. These implementations include a pre-planner for defining high-level trajectories, and a dynamic planner for low-level guidance. Additionally, Signal Temporal Logic (STL) is integrated to compare robustness among the three implementations along with a Mixed-Integer Convex Programming (MICP) baseline. This work establishes a concrete analysis and relevant metrics for the feasibility of RL in the navigation of autonomous fixed-wing aerial vehicles in real environments.

Mentor(s):
Sabine Brunswicker (Polytechnic)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1484

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Targeting Pro-Inflammatory Macrophages via Sialylated Nanocarriers for Treatment of Rheumatoid Arthritis

STEM

CTSI R25

Authors(s):

Gabrielle Marie Barrido† (PWL)

Abstract:

Rheumatoid arthritis (RA) is a systemic autoimmune disease characterized by synovial inflammation and polyarthritis. Severe polyarthritis demands the delivery of relatively high drug concentrations to lesions on multiple joints across the body, necessitating targeted treatments to minimize toxicity. Some patients fail to respond to existing treatments due to the clinical heterogeneity of RA and the lack of targeted delivery systems capable of directing therapeutics to afflicted joints. One promising target is the sialic acid-binding immunoglobulin-like lectin (SIGLEC) receptor family. SIGLECs are predominantly expressed on immune cells like macrophages, and pro-inflammatory or “M1-like” macrophages play a direct role in the pathogenesis of RA. We hypothesize that sialylating the surface of nanocarriers (NCs) with N-acetylneuraminic acid (Neu5Ac) will facilitate selective association with M1-like macrophages via SIGLEC-mediated targeting. To test targeting efficacy, we formulate fluorescent NCs, entrapping Hostasol Yellow dye in either a PCL-b-PEG or PCL-b-PEG-Neu5Ac shell. We induce M1-like polarization in RAW 264.7 macrophages with pro-inflammatory stimuli (LPS & IFNγ), and we treat the cells with NCs. We quantify cell association by measuring fluorescence by flow cytometry. Moreover, to optimize formulation stability, we will formulate mixed shell NCs with varying ratios of PCL-b-PEG and PCL-b-PEG-Neu5Ac. We will measure the size and polydispersity of the NCs over 14 days by dynamic light scattering and test targeting efficacy as described above. Optimally sialylated NCs will exhibit minimal size change with comparable targeting efficacy to the uniform shell PCL-b-PEG-Neu5Ac NCs. Future work will investigate if increased uptake of sialylated NCs in vitro translates to an in vivo model. Ultimately, we aim to develop a targeted treatment capable of systemic delivery that maximizes therapeutic effects and minimizes off-target effects, improving RA treatment options.

Mentor(s):
Marxa Figueiredo (Vet Med); Gabriel Steven Harris (Vet Med); Kurt Ristroph (Agriculture|Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1485

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Reproducibility and accuracy of thigh musculature volumetric data analysis derived from axial MRI scans: 3D Slicer vs. Horos

STEM

Authors(s):
Jacob Bastian† (PWL)

Abstract:
MRI is the primary imaging modality for assessing musculoskeletal structure in both clinical and preclinical settings. Previously, our laboratory used Horos software and manual planimetry to assess quadriceps muscle volume. This method relies on simple geometric calculations from individual manual area traces of muscle dimensions. With advances in image analysis, 3D renderings of tissue are now possible and can be used to assess tissue volume with higher resolution. My project used open-source software (3D Slicer) to generate 3D renderings and muscle volume data for the quadriceps muscle group and compared them with the previously used manual planimetry method in Horos to validate reliability. Five de-identified MRI studies were randomly selected from our lab archives for validation analysis. Fifty proximal-to-distal axial slices of the thigh, with no interslice gap, were collected using a Siemens 3T Magnetom system. The quadriceps muscle group was then traced individually, from the gluteal fold to the point where the rectus femoris was no longer visible. Using a custom MATLAB script and the known in-plane pixel dimensions, muscle volume was calculated for each quadriceps muscle and summed to obtain the total muscle volume, the rectus femoris muscle volume, and the total vasti complex muscle volume. For validation analysis, the mean, standard deviation, and coefficient of variation (CV) for each specified muscle volume were calculated, and the mean difference between the methods for CV calculations was computed. Quadriceps muscle volume was analyzed using 3D rendering (vasti: 894 ± 257, rectus: 123 ± 41, quads: 1016 ± 296 cm3) and Horos (vasti: 904 ± 256, rectus: 106 ± 39, quads: 1010 ± 292 cm3). The within-subject CV showed high agreement between the two traces (vast: 4.0%, rectus: 11.94%, and quads: 3.0%). The presented work showed high agreement between Horos and 3D Slicer tracing, supporting the utilization of 3D renderings for muscle volume assessment.

Mentor(s):
Chad C Carroll (HHS); Gordon Carl Smilanich (HHS)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1486
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Evaluating Wi-Fi Signal Strength in Residential Environments: The effects of building materials and appliance interference

STEM

Authors(s):
Akshita Bhavanishankar† (Engineering)

Abstract:
Reliable Wi-Fi connectivity is essential to the performance of smart home appliances, yet signal strength can vary significantly depending on appliance location, antenna placement, interference from nearby electronics, and the construction materials of the home itself. Poor connectivity due to any of these aspects can undermine appliance functionality and consumer satisfaction. This research investigates how these factors influence Wi-Fi signal quality within a residential setting.

The initial phase of this research will involve using a 3D mapping tool and a network analyzer tool to create a map of the baseline RSSI (Received Signal Strength Indicator) and noise floor of the home. This baseline will be followed by additional test cases to isolate the effects of electromagnetic interference by other common household appliances – microwave/cooktop operation – which can generate noise that disrupts WiFi performance.

A reference IoT device (Google Chromecast) will be power-mapped throughout the house to serve as a control group and provide a realistic benchmark for acceptable Wi-Fi performance.

An internal Whirlpool wireless communication module known as ZCore will be used and testing will compare the module's onboard PCB antenna performance when attached to the appliance versus standalone in an equivalent location to isolate the effects of appliance material on signal degradation.

Additionally, we will also explore stretch goals including evaluating the influence of the ZCore antenna location and evaluating other antenna models and their polarization against the ZCore.

We anticipate that signal quality will vary based on building materials, appliance and antenna location and placement, and electromagnetic interference from nearby devices. Results from this research study will

inform us on the impact of these critical factors on the signal, assisting in reducing connectivity issues and improving reliability of smart-home appliances in residential environments.

Mentor(s):
Grace Ulmer (Engineering); Marcelo Invitti (Whirlpool)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1487
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Seismic survey of the Kentland Impact Structure

STEM

Authors(s):
Ivana Naomi Bilic† (Science)

Abstract:
This project is a geophysical survey to understand the structure and physical properties of the Kentland Impact Structure, a complex crater with an exposed central peak in an active quarry in NW Indiana. First break seismic refraction methods and MATLAB were used to find an average refracted velocity of 2821.92m/s. The average refraction depth in the geological layer where the refraction occurred was 5.5m. The data was used to generate tomography and wave concentration images using WET tomography processing. The graphs illustrate that the velocity structure of Kentland crater at the point of surveying is clustered around 2065-3065m/s at 10-15m below the surface with pockets of above 4000m/s. While the calculated velocities do match what is being seen in the tomography, the calculated depths put those values at about 3-5 meters above where they are taking place. Using well-log data from the Kentland area (directly east of the site), comparisons are currently being done with velocities of rocks that are out of range of the crater. The data includes the same types of rock formations that are exposed at the central peak (where the refraction was done). This will allow more sure conclusions to be drawn about whether the rocks in the central peak were affected significantly by the crater-forming impact.

Mentor(s):
Douglas R Schmitt (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1488
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Investigating the biocatalytic activity of SavA/B homologs in S. pristinaespiralis via heterologous expression in E. coli

STEM

Authors(s):
Phoebe Burrell† (Liberal Arts|Science)

Abstract:
Streptomyces avermitilis produces avermectin, a natural product with well-known antiparasitic properties that is used in agriculture and medicine. AvaR1 is a TetR-like repressor in S. avermitilis, which along with its ligand avenolide, control regulation of production of avermectin. Avenolide is biosynthesized by the genes SavA and SavB. Streptomyces pristinaespiralis, the producer of the antibiotic pristinamycin, utilizes a similar strategy, with the TetR-like repressor SpbR regulating pristinamycin production. It has been established that SpbR can be derepressed by avenolide; however, its natural regulatory molecule encoded by SavA and SavB homologs is unknown. The purpose of this project is to perform heterologous expression of the SavA/B homologs in E. coli to inform future efforts in determining the regulatory molecule produced in S. pristinaespiralis. We hypothesize this molecule is structurally similar to avenolide and expect it will be useful in inducing natural product production.

Mentor(s):
Elizabeth I Parkinson (Pharmacy|Science); Manuela Frias Gomez (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1489
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Transcribing the Audio-Visual Materials within the Neil A. Armstrong papers

Humanities

Authors(s):
Hannah Marie Cano† (Liberal Arts|Libraries)

Abstract:
The purpose of preserving and making available these audio visual material is to enhance access to the Neil A. Armstrong papers collection within the Purdue Archives, a project that began in 2008 and is recently experiencing a larger digitization initiative. This research consists of using an open sourced and locally hosted general-purpose speech recognition model to generate a transcript that is time stamped to the material being processed and then corrected and edited by a student assistant to relay the audio visual material accurately through text captions. This processing project is currently being done for over 200 separate files donated to the Purdue University Archives and Special Collections by Neil Armstrong, consisting of audio he collected and received, detailing multiple reports of the Apollo missions and celebrations, fellow Apollo 11 astronauts, and songs and plays sent to the donor from around the world. The results of this processing of material will be a database online of accurately transcribed and described audio visual material within the Neil A. Armstrong papers made available through the Purdue Archives. The implications of this research will influence the processing of other audio-visual material collected by the archives. It will also provide an increase of easily accessible material to researchers all over the world with internet connection to these audio-visual material which may have never been accessed or researched before, providing more material for the field of space exploration research. Finally, the digitization of these materials lends to answer important questions that will be asked by researchers, aiming to answer important questions such as what are the previously undiscovered facts available through these newly digitized materials and what can be done with them?

Mentor(s):
Jo Otremba (Libraries)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1490
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Monitoring Small-Scale Gas Activity Using Electrochemiluminescence Microscopy

STEM

Authors(s):
Daniel Michael Carrel† (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Brady Layman (Science); Jeffrey Edward Dick (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1491

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Addition of pentanol enhance aqueous zinc metal battery lifetime and performance

STEM

Authors(s):

Kaleb Caudle† (Science)

Abstract:

Aqueous zinc metal batteries (AZMBs) are a promising energy storage technology that has advantages including being environmentally friendly, having low material cost, and intrinsic safety. Despite these advantages, these batteries still suffer drawbacks such as parasitic reactions such as the hydrogen evolution reaction (HER), dendrite formation, and passivation of the anode surface, all of which contribute to lowering the lifetime and performance of the batteries. To address these drawbacks, we investigated the addition of pentanol (PeOH), methanol (MeOH), and pentaerythritol (PER) as additives to the zinc sulfate ($ZnSO_4$) electrolyte. We hypothesize that these additives may tune the solvation environment surrounding the Zn^{2+} cations in the supporting electrolyte as well as influence the structure of the solid electrolyte interphase (SEI) to suppress parasitic reactions and passivation. Using ultramicroelectrodes (UMEs, $r \leq 25$ μm), we performed cyclic voltammetry to elucidate key kinetic information including the exchange current and the diffusion coefficient of the supporting electrolyte. Moreover, other electrochemical techniques were performed including electrochemical impedance spectroscopy, linear sweep voltammetry, and chronoamperometry to evaluate important parameters such as charge-transfer resistance and nucleation overpotential. From Aurbach tests as well as symmetric and asymmetric coin cell data, we demonstrate that upon the addition of 75 mM PeOH to a 2 M $ZnSO_4$ supporting electrolyte, both the Coulombic efficiency (a performance metric) and the lifetime (number of cycles) is enhanced. From this work, we present a promising strategy to improve the design and ultimate commercialization of AZMBs.

Mentor(s):

Megan Leigh Hill (Science); Jeremy Hugh Lawrence (Science); Md Arif Faisal (Science); James Hoang Nguyen (Science); Jeffrey Edward Dick (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1492

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Coronary Cyclical Cardiac-based Lesion Location and Cardiovascular Risk Factors vs Severity of Right Coronary Artery Stenosis

STEM

Authors(s):
Nha Chau† (Unknown); Quang Vo‡ (Unknown); Pham Phan‡ (Unknown); Ngoc Nguyen‡ (Unknown); Quang Hoang‡ (Unknown)

Abstract:
Background: Coronary plaque formation is influenced by local hemodynamic forces with different properties across the cardiac cycle. Then, the right coronary artery (RCA) acoustic map, a promising framework, is created to assign each arterial segment to a distinct hemodynamic phase of the cycle. This study examined the impact of cyclical cardiac-based lesion location and cardiovascular risk factors on stenosis severity.

Methods: This cross-sectional study involved 47 patients with unstable angina who underwent invasive coronary angiography. Patients without RCA lesions were excluded; 29 patients with RCA stenosis were classified as non-severe (<70%) or severe (≥70%). Lesion sites were assigned to 1R-4R using the coronary acoustic map. Fisher's exact tests and multivariable logistic regression were used to evaluate association between stenosis severity and either lesion location or cardiovascular risk factors.

Results: Eight (27.6%) patients had severe stenosis. Location 1R was predominant in all patients (p=1), whereas location 4R was observed only in non severe cases. Severe stenosis was not significantly associated with cyclical cardiac-based lesion location or cardiovascular risk factors (p>0.05), despite nonsignificant trends toward higher rates of hypertension, diabetes, smoking, high BMI, and elevated LDL C.

Conclusion: Neither cyclical cardiac-based lesion location nor cardiovascular risk factors predict severe RCA stenosis. Lesions in 4R appeared exclusively in non-severe cases, consistent with laminar diastolic flow being less conducive to plaque progression than transitional-phase flow. Larger populations are needed to clarify whether flow-phase environments and risk factors influence stenosis severity.

Mentor(s):
Ernest Francis Talarico, Jr. (PNW); Thach Nguyen (Tan Tao University)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1493
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Cover crop-based No-till Strategies for Organic Garlic Production

STEM

Authors(s):
Hannah Everette† (Agriculture); Mia Constance Schecter‡ (Agriculture); Keirstyn Amponsah‡ (Agriculture)

Abstract:
Despite its challenges, cover crop based no-till (NT) vegetable production is of continued interest among farmers for soil improvement and input reduction. Cereal rye is most frequently evaluated. However, other cover crops may also have potential. Garlic is a high value crop with potential to succeed in no-till systems. Sunn hemp (Crotelaria juncea L.) is a high biomass producing legume that suppresses weeds. Sunn hemp growth is well matched for terminating before fall garlic planting.

A series of studies are being conducted at the Purdue Student Farm in West Lafayette, IN. In the 2024-2025 garlic season, we compared two sunn hemp termination treatments, mowing and rolling. In the 2025-2026 garlic season we are evaluating three rolling dates for terminating sunn hemp.

The objectives of these studies are to assess the feasibility of cover crop-based organic NT for garlic production through evaluation of sunn hemp and weed growth and garlic yield and quality. We measured sunn hemp and weed weight before and after termination. We measured the size and weight of green garlic and garlic bulbs.

In the 2024-2025 season, sunn hemp biomass was greater in the rolled treatment compared to the mow treatment when measured in the spring following termination 2.7 v 1.7 t ha-1 and consequently weed weight measured in June was more than double in the mow treatment. The critical weed free period for garlic is 3-6 weeks after emergence. Our preliminary results show cover crop based organic NT garlic using sunn hemp may provide adequate weed suppression during the critical weed free period.

Individual dry bulb weight ranged from 28.3g – 164.4g/bulb. There was no difference in yield between mow and roll. Yields before drying with

tops ranged from 19-40k kg/ha. Commercial garlic yields of 20,700 kg/ha have been reported.

Cover crop based no-till garlic production may be a viable option for keeping weeds down and reducing tillage in organic NT vegetable production systems.

Mentor(s):
Moriah Tzivia Bilenky (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1494
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Behavioral and Neuroinflammatory Effects of Chlorpyrifos Exposure in Pon1(-/-) and Wild-Type Rats.

STEM

Authors(s):
Karis Ge Fu† (HHS|JMHC)

Abstract:
Abstract:

Chlorpyrifos (CPF) is an organophosphate used in agriculture that disrupts the nervous system by inhibiting acetylcholinesterase. Research has linked CPF to Parkinson's disease (PD). However, it remains unclear how genetic variation impacts Parkinson 's-related genes, specifically dopaminergic toxicity. Paraoxonase 1 (Pon1) plays a key role in detoxifying neurons that produce CPF. Genetic changes in Pon1 may also increase the likelihood of PD from CPF exposure. We tested the hypothesis that Pon1 Knockout with CPF exposure would represent a PD- relevant gene- environment interaction.

Methods:

We tested this hypothesis on male and female rats with Pon1-knockout (KO) and wild-type (WT) genotypes, aged three months. They were then divided on treatment. CPF was administered at 2 mg/kg or a control treatment (corn oil) for 8 weeks, after which they were euthanized. During the 8 weeks, their body weight alterations and behaviors– cylinder testing, posture, stability, and VEBT. We then collected, sliced, and stained their brains to analyze the striatum and substantia nigra. We examined microglia, neurons, dopamine, dopamine transport, and oxidative stress within the brain using IBA1, MAP2, TH, VMAT2, and nitrotyrosine, respectively.

Analysis:

We used a FIJI, a computer imaging program, to analyze the fluorescence. We measured fluorescence in the dorsal striatum, ventral striatum, and total striatum.

Results:

Behavioral results showed that Pon1 KO rats had a decrease in neurobehavioral assessments. Analysis of inflammatory markers showed

increased inflammation in the substantia nigra than in the striatum. We plan to look for more TH and oxidative stress.

Mentor(s):
Reeya Tanwar (HHS)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1495
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

AI Aversion in Students' Perceptions of Code Quality

STEM

Authors(s):
Matthew Tomasz Galej† (PWL)

Abstract:
Within the realm of software engineering, the increasing impact that generative AI (GenAI) tools have had on code production cannot be ignored. As adoption of these tools increases, many individuals may find themselves in a position where they must work with and review code that was, in part or in full, created with the use of GenAI. Among the first to be at the front of these changes are undergraduate students. Given this unique position, understanding how students view AI-generated code can provide valuable insights into perceptions of GenAI tools in the educational space. In this study, we evaluated multiple parameters of perceived code quality from 36 undergraduate students via an online survey. Participants were asked to evaluate a C-based code snippet written with AI assistance, with some participants being shown a disclosure stating the snippet as being AI-generated. Ultimately, we find that students evaluate the provided code more critically when it is disclosed as having been written with AI assistance, highlighting an aversion to AI-assisted code. Notably, we find that students perceive AI-generated code to be of lower quality in categories such as structure, testability, adaptability, security, etc. We discuss how these findings could be significant for computer science education and potential implications.

Mentor(s):
Mary Anne Smart (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1496

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

The Relative Roles of Genetic Distance and Chromosomal Rearrangements on Reproductive Isolation

STEM

Authors(s):

Michael David Gardner† (Science)

Abstract:

A question yet to be solved by evolutionary biologists is how different evolutionary mechanisms contribute to reproductive isolation. In multicellular organisms, different species typically cannot form viable progeny, often due to genetic barriers that prevent successful meiosis. It is hypothesized that genetic distance between species and/or chromosomal rearrangements contribute to these genetic barriers, but their relative contributions are unknown. Thankfully, Saccharomyces yeast lets us test these relative contributions. Saccharomyces eubayanus and its most closely related species, Saccharomyces uvarum, are as distantly related as humans and mice, yet are capable of forming hybrids. However, these hybrids do not produce viable meiotic progeny. It is hypothesized that reproductive isolation between these species is caused by some combination of a reciprocal translocation between chromosomes VI and X and the large number of sequence differences between them that prevents faithful recombination. To test the role of the translocation in reproductive isolation, I will use CRISPR-Cas9 editing with two guide RNAs to reverse the translocation in a scarless manner. To determine the effects of sequence differences on reproductive isolation, I will use CRISPR to edit two yeast promoters, reducing the expression of genes involved in mismatch repair. After each change, I will estimate hybrid spore viability to identify what effect each had on the reproductive isolation, which will provide further insight into the causes and mechanisms of reproductive isolation broadly speaking.

Mentor(s):

Brian Metzger (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1497
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Evaluating the Antimicrobial Potential and Safety Landscapes within a Customized Chemical Library

STEM

Authors(s):
Huda Touqeer Hussain† (HHS|JMHC); Mahmoud Adel Mohamed Sayed Ahmed‡ (Vet Med)

Abstract:
Antibiotic-resistant bacteria pose an escalating global public health threat as conventional antimicrobial therapies become increasingly ineffective. Among the pathogens responsible for healthcare-associated infections (HAIs), vancomycin-resistant Enterococcus faecium (VREfm) is a critical priority pathogen due to its multidrug resistance, persistence in healthcare settings, and limited treatment options. Current therapies, including linezolid and daptomycin, are hindered by drawbacks such as emerging resistance, toxicity, bacteriostatic activity, and treatment failure, underscoring the urgent need for novel antimicrobial agents. During an initial screen of a library of thirty-six novel synthetic compounds against clinically relevant bacterial pathogens, RSC-4 emerged as the sole compound demonstrating potent antibacterial activity and was selected for further investigation. The antimicrobial activity of RSC-4 was

evaluated against VRE E. faecium using minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) assays. Additional in vitro characterization included biofilm inhibition and eradication assays, as well as checkerboard analysis to evaluate interactions between RSC-4 and vancomycin. RSC-4 exhibited potent antibacterial activity against VRE E. faecium, demonstrating MIC and MBC values of 4 and 16 μg/mL, respectively. The compound also demonstrated substantial antibiofilm activity while maintaining

antibacterial efficacy comparable to or exceeding the current standard-of-care antibiotic linezolid in several in vitro assays. Checkerboard analysis revealed an additive interaction between RSC-4 and vancomycin, supporting the potential use of combination therapy. Collectively, these findings identify RSC-4 as a

promising lead compound for the treatment of multidrug-resistant enterococcal infections. Future studies will investigate its mechanism of

action and optimize its antimicrobial properties through medicinal chemistry.

Mentor(s):
Ahmed Abdelkhale Hassan (Vet Med)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1498

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Protein-protein interactions among pollen tube reception regulators

STEM

Authors(s):

Andrea Carmen Jacobson† (Agriculture|Science)

Abstract:

Pollen tube reception is the step in the fertilization process of flowering plants in which the pollen tube enters the female gametophyte and is triggered to rupture, releasing its sperm cells. This key event is dependent on intercellular signaling between the pollen tube and synergid cells within the ovule. Failure in cell communication prevents the pollen tube from rupturing, instead overgrowing within the ovule. THALNA (THAL) and ZAPNA (ZPA) have been identified for their role in pollen tube reception, as loss of function in either protein results in pollen tube overgrowth. THAL and ZPA are predicted to be homologs of Vacuolar ATPase (V-ATPase) accessory proteins. V-ATPase protein complexes are proton pumps that regulate lumen acidity, a crucial factor for the functional endomembrane trafficking required in cell signaling events. V-ATPases are highly conserved across eukaryotes, but their component proteins have not yet been fully characterized in plants. The aim of this project is to determine interactions between THAL and ZPA in plant cells via split luciferase complementation assay. Plasmid constructs of THAL and ZPA tagged with firefly luciferase fragments were transformed into Agrobacterium tumefaciens. Nicotiana benthamiana leaves will be infiltrated with A. tumefaciens constructs and imaged to quantify the intensity of reconstructed luciferase fluorescence. If THAL and ZPA are demonstrated to interact, this will serve as a key signal towards their identity and the influence of V-ATPases on pollen tube reception.

Mentor(s):

Sharon A Kessler (Agriculture); Sowmiya Devi Venkatesan (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1499
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Uncovering Structural Determinants of Substrate Scope in a Peptide Cyclase Enzyme Family

STEM

Authors(s):
Lucas O Johnson† (Science)

Abstract:
Cyclic tetrapeptides (CTPs) are a class of macromolecules that have received increasing interest due to their therapeutic potential. Compared to linear tetrapeptides, CTPs have increased proteolytic stability, enhanced membrane permeability, and more defined structural conformations. However, traditional chemical methods to access CTPs often have restrictions that limit the scope of CTPs that can be produced, necessitating the development of an alternative route for accessing a broad range of CTPs. Previous work has identified a class of enzymes, penicillin-binding protein-type thioesterases (PBP-TEs), that can efficiently catalyze the macrocyclization of tetrapeptides in vitro, but the structural features of these enzymes that determine their substrate scopes are largely unknown. This project is focused on further investigating this family and using mutagenesis techniques to pinpoint structural features that guide their substrate specificities. Through this work, we have identified a residue of the PBP-TE Ulm16 that plays a key role in determining substrate tolerance. Overall, this work aims to guide future engineering efforts to make a broadly useful biocatalyst for accessing a diverse range of CTPs.

Mentor(s):
Elizabeth I Parkinson (Pharmacy|Science); Paisley Lilliana Jeannette (Science); Zachary Logan Budimir (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1500

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Optimizing Air-Annealing Parameters for Single-Step Surface Morphology on C- and A-Plane Sapphire

STEM

Authors(s):

Aditya H Joshi† (Engineering); Brayden Kauffmann* (Science)

Abstract:

A substrate's surface morphology is critical when it comes to epitaxially growing high-quality thin films. Atomic terraces act as templates for film nucleation, domain orientation and defect density, all of which are established within the first few monolayers, where the quality of the film is largely determined.

Sapphire (α-Al_2O_3) is a popular substrate choice for epitaxial growth due to its cost-effectiveness, chemical stability at high temperatures, and optical transparency. Preparing these atomic steps by ambient-air annealing is well established in principle, but the requisite temperature and duration vary with both crystallographic orientation and the specific annealing apparatus. These parameters must therefore be calibrated empirically for each setup and substrate. In this study, we systematically determine the muffle furnace air annealing conditions that produce atomically stepped c-plane (0001) and a-plane (11-20) sapphire. Substrates of both orientations were annealed in air with temperatures ranging from 800 to 1200 °C for 5 hours and characterized by atomic force microscopy. Preliminary results of this ongoing study indicate that A-plane sapphire develops clean single steps with step heights matching its known 0.238 nm interplanar spacing by 1200 °C, establishing a reproducible recipe for stepped a-plane substrates. Characterization of the c-plane series across the same range is ongoing, with early results indicating a distinct, orientation-dependent reconstruction behavior.

This methodology provides a transferable framework for calibrating substrate preparation to a given furnace, a practical prerequisite for reproducible and high-quality epitaxial growth.

Mentor(s):

Tiancong Zhu (Science); Daniel Johannes Jung (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1501

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Automated Image Correlation Analysis of Particle Impact for Solid Particle Erosion

STEM

Authors(s):

Sai Kasturi Kamila† (Engineering|JMHC); Melody Christine Yang† (Engineering); Daniel J V Pike* (Engineering)

Abstract:

High-speed ballistic impact experiments generate large volumes of image data in which particle fragmentation and subsequent motion are difficult to analyze manually. Accurate characterization of fragment trajectories is essential for understanding the mechanisms governing solid particle erosion and impact dynamics. In this work, an automated image-processing workflow is developed to segment, track, and quantify particle fragments captured during high-speed impact experiments. Image sequences are processed using Fiji (ImageJ) and the TrackMate plugin, where optimized detection parameters identify individual particle fragments across sequential frames while minimizing false detections and maintaining tracking accuracy. Particle trajectory data are exported to MATLAB for post-processing, including track organization, noise filtering, trajectory visualization, and computation of displacement and velocity. The automated workflow transforms raw high-speed imaging data into quantitative kinematic measurements while significantly reducing the time and manual effort required for analysis. The resulting methodology provides a working repeatable and scalable approach for characterizing particle fragmentation and motion following impact, enabling more consistent analysis of large experimental datasets. This framework supports ongoing investigations of solid particle erosion by facilitating quantitative comparisons of fragment behavior under varying experimental conditions and establishes a foundation for future improvements in particle image segmentation and fragmentation analysis.

Mentor(s):

Zherui Martinez-Guo (Engineering); Adithya Kolisetty (Engineering); Tyler Dillard (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1502
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Uncovering the Role of the scs Pilus Within the Complex Surface Architecture of Stenotrophomonas maltophilia

STEM

Authors(s):
Ian Kim† (DSB|JMHC)

Abstract:
Stenotrophomonas maltophilia is an emerging multidrug-resistant, Gram-negative opportunistic pathogen with direct association to numerous types of healthcare related infections (e.g., blood stream infections, urinary tract infections, pneumonia) as well as chronic respiratory infections in people who suffer from cystic fibrosis. A major factor contributing to its persistence and pathogenicity is its ability to attach to surfaces and establish biofilms, which protect bacterial communities from antibiotics and the host immune response. Surface associated pili play important roles in S. maltophilia biofilm formation. S. maltophilia makes several types of pili. We previously showed that two types of pili, encoded by the smf1 and cblA loci are important for biofilm formation. Here, we investigate another type of pili, encoded by the scs locus. We deleted the scs gene and tested phenotypes of biofilm formation, motility and infection. We show that the scs locus plays a minor role in these processes, potentially enhancing the effects of smf1 and cblA encoded pili.

Mentor(s):
Seema Mattoo (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1503

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Left Ventricular Ejection Fraction, Right Coronary Artery Reverse Flow, and Lesion Distribution in Coronary Angiography

STEM

Authors(s):
Khanh Le† (Unknown); Thy Le‡ (Unknown); Van Hoang‡ (Unknown); Thi Chau‡ (Unknown); Khanh Le‡ (Methodist Hospitals)

Abstract:
Background: Retrograde coronary pressure waves have been proposed to contribute to plaque localization. Left ventricular ejection fraction (LVEF), as a marker of systolic function, may influence coronary hemodynamics and lesion distribution. This study examined associations between LVEF, RCA reverse flow, and lesion location.

Methods: We retrospectively analyzed 48 patients undergoing coronary angiography with documented LVEF, categorized as >40% or ≤40%. The primary outcome was RCA reverse flow. Lesions were classified by segment (RCA1–RCA4). Associations were assessed using Fisher's exact tests and multivariable logistic regression adjusted for age, sex, systolic blood pressure, and heart rate.

Results: Forty-two (87.5%) had LVEF >40%, and 6 (12.5%) had LVEF ≤40%. RCA reverse flow was observed in 32 patients (66.7%) and did not differ significantly between groups (69.0% vs. 50.0%, p=0.386). After adjustment, LVEF was not significantly associated with RCA reverse flow (adjusted OR 0.31, 95% CI 0.045–2.279). LVEF was also not significantly associated with lesion distribution across RCA segments (RCA1–RCA4; p=0.188, 1.000, 0.237, and 0.503, respectively). However, RCA1 lesions were more prevalent in patients with LVEF ≤40% than in those with LVEF >40% (83.3% vs. 45.2%).

Conclusions: LVEF was not significantly associated with RCA reverse flow or RCA lesion distribution. A trend toward increased RCA1 lesions in patients with reduced LVEF warrants further investigation. Larger prospective studies are needed to evaluate the relationship between ventricular function, coronary hemodynamics, and lesion localization predicted by the water-hammer shock hypothesis.

Mentor(s):
Ernest Francis Talarico, Jr. (PNW); Thach Nguyen (Tan Tao University)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1504
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Determining the reduced matrix elements of electron-dipole transitions in atomic cesium

STEM
Physics REU

Authors(s):
Belinda Xintian Li† (University of Illinois)

Abstract:
We aim to measure the absorption strength of an electronic transition in an atomic cesium gas. To do this, we use a laser that is tuned to the exact frequency that will be absorbed by cesium's valence electron as it makes a transition from the ground state to an excited state. By shining the laser through a vapor cell while scanning through a small range of frequencies and measuring the power of the transmitted light, we can extract the absorption coefficient. An 894 nm-wavelength (infrared) laser is used for the 6s2S1/2 → 6p2P1/2 transition, and a 456 nm-wavelength (blue) laser is used for the 6s2S1/2 → 7p2P3/2 transition. The 894 nm transition has been studied extensively already, and its corresponding matrix element ⟨6s1/2||r||6p1/2⟩ has already been determined precisely. Using the ratio of the absorption coefficients from these two transitions, and the previously determined ⟨6s1/2||r||6p1/2⟩, we can calculate the reduced matrix element ⟨6s1/2||r||7p3/2⟩ corresponding to the 456 nm transition. Precise determinations of these matrix elements are important for calculating the weak charge of the cesium nucleus (to see if experimental results match theoretical predictions based on the standard model). In pursuit of results with lower uncertainty and thus higher precision, we are measuring the 456 nm transition from both the F=3 and F=4 hyperfine levels of the ground state. In similar past experiments, this transition was measured from only one hyperfine level. We have also implemented several other improvements to the experiment over the earlier work, and we therefore expect to observe a lower uncertainty.

Mentor(s):
Daniel S Elliott (Engineering|Science); Diego Esteban Garcia (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1505

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Understanding Coronary Artery Disease and Atherosclerosis Through the Language of Fluid Dynamics

STEM

Authors(s):
Dhruva Magesh† (Unknown); Mateusz Wlodarczyk†

Abstract:
Purpose: The initiation of plaque formation within atherosclerotic disorders remains widely unknown within today's paradigm of cardiovascular pathophysiology. Recent works reframe coronary artery disease within the language of fluid dynamics, conceptualizing the cardiovascular system as a pulsatile fluid dynamic network. This poster attempts to explain the Water Hammer Effect (WHE) and extends this framework to acoustic models.

Methods: A review of fluid mechanical principles and theories was applied to coronary blood flow patterns using novel dynamic coronary angiography. Acoustic experimentation to model hydraulic pressure-wave behaviors and AI-assisted acoustic mapping was used to identify pressure compression and rarefaction zones within the coronary arterial network. Blood flow dynamics and AI-assisted acoustic mapping were applied to evaluate whether observations in coronary angiograms were consistent with WHE.

Results: Analysis of coronary angiograms and acoustic analysis of pressure wave patterns demonstrated a correlation of arterial contrast concentrations with spatial zones of pressure compression and rarefaction consistent with changing patterns of blood flow. Compression zones were associated with turbulent flow and severe stenotic lesions, in regions characterized by abrupt diastole-systole transitions. These findings are consistent with localized pressure amplification as a result of the WHE, leading to increased intimal stress and thus creating the predisposition that leads to atherosclerotic plaque formation and plaque rupture. Rarefaction zones were associated with local environment that favored laminar flow and low intimal stress.

Conclusion: Angiographic compression and rarefaction zone identification may be used clinically to predict regions of compression antinodes that favor stenotic lesions. These observations align with the wave propagation proposed by WHE.

Mentor(s):
Ernest Francis Talarico, Jr. (PNW); Thach Nguyen (Tan Tao University)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1506

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

A Low-Cost Readout Circuit for Real-Time Protein Sensing Using Electrochemical Impedance Spectroscopy

STEM

Authors(s):

Aditi Magesh† (Engineering|JMHC)

Abstract:

Label-free electrochemical sensing offers a route towards continuous and accessible biomolecular detection, but its translation into portable diagnostics is constrained by the cost and complexity of conventional impedance instrumentation. Here we report a low-cost electrical impedance spectroscopy platform comprising a Digilent Analog Discovery 2 and an LM324-based potentiostat and transimpedance amplifier, developed as an analogue front end for real-time protein sensing. Benchmarking against resistive standards spanning 33 Ω-100Ω (for test resistances between the working electrode and reference electrode) and 4.7 kΩ (for test resistance between the counter and working electrode) revealed impedance recovery within 5% of the nominal resistance over load-dependent frequency ranges. For 33–100 Ω standards, the real component of impedance remained within this threshold from 1 Hz to 2 kHz, whereas a 4.7 kΩ standard was accurately recovered up to approximately 300 Hz. At higher frequencies, systematic phase shifts and capacitive roll-off exposed limitations in the breadboarded analogue measurement chain. These findings establish the feasibility of inexpensive impedance acquisition while defining the bandwidth constraints that must be addressed for electrochemical sensing. Integration onto a printed circuit board, validation with electrochemical interfaces, and explorations into controlling the distortion of function generators for excitation current could provide a foundation for compact, label-free biosensing systems.

Mentor(s):

Laia Vancells Lopez (Engineering); Nan Kong (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1507

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Customs and courtesies: Preliminary qualitative analysis of an equine-assisted learning program for military veterans

Social Science

Authors(s):

Kelly Marie Makovic† (Vet Med)

Abstract:

The mental health of military veterans in the United States is a topic of concern for the veterans themselves, their families, and the organizations that serve them. PTSD, depression, and anxiety, among other conditions, are more prevalent in the veteran community than in civilian populations. While many veterans have taken part in traditional mental health-promoting activities or therapies, one frequently unexplored area is the role that equine-assisted learning (EAL) programs could play as a complementary and integrative health option. EAL involves professionally facilitated human-horse interaction sessions designed for participants to grow in problem solving, communication, and regulation skills that can be applied to their daily lives. This study analyzes veterans' own descriptions of their experiences from taking part in an EAL program at Horsemanship for Heroes (H4H) in Reno, Nevada. After taking part in the program, veterans described their experiences in semi-structured interviews (n=15). Data were analyzed using a constant-comparative approach. Results revealed two themes of military cultural integration and Self-Determination Theory. Findings suggest that integrating military culture and structure into a veteran-focused EAL program is perceived to be important for participant success. Programs should consider providing their participants with a step-by-step structure grounded in military ideals, while emphasizing continuous equine and human connection. Programs should additionally consider incorporating lessons targeting the three pillars of Self-Determination Theory: autonomy, competence, and relatedness. Furthermore, programs should be aligned with a structure that encourages continuous participation, so that participants can continue to experience life-changing outcomes. If programs are able to provide these elements, participants may be able to self-motivate themselves to achieve sustained improvement in functioning.

Mentor(s):

Leanne Nieforth (Vet Med); Sarah Jean Reega (Vet Med)

Other Acknowledgement(s):
John Maxwell Evans (Interdisciplinary and Special Programs)

Poster Presentation Abstract Number: 1508
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Exploring methods of Staghorn Coral (Acropora cervicornis) outplant monitoring off the coast of Utila, Honduras

STEM

Authors(s):
Ashlynn R McLaughlin† (Agriculture)

Abstract:
Effective coral reef restoration depends on consistent monitoring to evaluate coral survival, growth, and overall restoration success. This project assessed the efficiency of two commonly used monitoring techniques, 2D photomosaics and 3D photogrammetry, for monitoring Acropora cervicornis (staghorn coral) outplants off the coast of Utila, Honduras. Monitoring protocols from the Coral Restoration Foundation were reviewed and compared while considering environmental conditions unique to Utila, including strong currents, varying algal abundance, and the characteristics of local restoration sites.

The two methods were evaluated based on field procedures, data outputs, advantages, limitations, and overall practicality for long-term monitoring. Although 3D photogrammetry provides detailed measurements of colony volume, surface area, and structural complexity, it requires extensive image collection and processing, making it more suitable for small-scale research applications. In contrast, 2D photomosaics efficiently capture larger restoration sites, require less dive time, and are compatible with ReefCloud image analysis software while still providing valuable ecological metrics, including coral cover, mortality, bleaching, disease prevalence, and spatial distribution. Based on this comparison, 2D photomosaic monitoring was identified as the most efficient and practical method for routine monitoring of coral outplanting efforts in Utila, where large restoration sites and limited field resources require a balance between data quality and operational efficiency.

Mentor(s):
Maria Soledad Sepulveda (Agriculture)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1509

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Claudin-4 as a Target for Fluorescent Surgical Imaging of Metastatic Cancer

STEM

Authors(s):

Noah Miller† (PWL); Beatrice V Dyas‡ (Science); Laurel Frances Tayloe‡ (Science)

Abstract:

Complete surgical removal of metastatic tumors is often hindered by the inability to distinguish cancerous tissue from surrounding healthy tissue. Claudin-4 (CLDN4), a tight junction protein overexpressed in many epithelial-derived cancers, represents a promising target for fluorescence-guided surgery. This project evaluates fluorescent peptide-dye conjugates as imaging agents for CLDN4+ metastatic tumors. Peptides were synthesized using solid-phase peptide synthesis, purified by high-performance liquid chromatography (HPLC), and conjugated to fluorescent dyes. The resulting peptide-dye conjugates were evaluated for binding to CLDN4-expressing cells using flow cytometry and confocal fluorescence microscopy. Flow cytometry demonstrated a submicromolar binding affinity, while confocal imaging confirmed fluorescence associated with peptide-treated CLDN4-expressing cells. Building on these findings, near-infrared (NIR) dye-conjugated peptide probes have been synthesized and are being advanced toward in vivo evaluation. Collectively, this work advances the development of CLDN4-targeted fluorescent imaging agents for improving intraoperative visualization of metastatic disease.

Mentor(s):

Pranav Ballaney (Science); Madduri Srinivasarao (Centers & Institutes)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1510

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Association of Systolic BP and LDL Cholesterol with Retrograde Coronary Flow and Lesion Distribution in Coronary Angiography

STEM

Authors(s):
Ngoc Nguyen† (Unknown); Thuy Nguyen‡ (Unknown); Thi Chau‡ (Unknown); Nghia Nguyen‡ (Unknown); Quang Hoang‡ (Unknown)

Abstract:
Background: Systemic hypertension and elevated low-density lipoprotein cholesterol (LDL-C) are established risk factors for coronary artery disease, but their influence on lesion distribution remains incompletely understood. This study examined associations among systolic blood pressure (SBP), LDL-C, retrograde coronary flow, and coronary lesion distribution.

Methods: Consecutive adults with unstable angina without ST-elevation undergoing coronary angiography at two community hospitals (2012–2025) were prospectively evaluated. Patients with prior revascularization, chronic total occlusion, severe tortuosity, structural heart disease, or inadequate image quality were excluded. SBP was averaged from three pre-sedation measurements and categorized as <130 or ≥130 mmHg. Retrograde coronary flow was assessed frame-by-frame (15 frames/s) by two blinded cardiologists. Multivariable logistic regression adjusted for age, sex, diabetes, smoking, heart rate, beta-blocker use, and ejection fraction.

Results: Among 47 eligible patients (mean age 66.0±12.5 years; 44.7% female; 40.4% diabetic), retrograde coronary flow was observed in 31 (66.0%). SBP ≥130 mmHg showed a trend toward greater left coronary artery involvement (63.3% vs. 35.3%, p=0.064) but was not independently associated with retrograde flow (adjusted OR 0.98/mmHg, 95% CI 0.95–1.01, p=0.244). Higher LDL-C was independently associated with reduced retrograde flow (adjusted OR 0.978/mg/dL, 95% CI 0.958–0.999, p=0.040).

Conclusions: Retrograde coronary flow was common. Elevated SBP showed a trend toward greater left coronary involvement, whereas LDL-C was independently associated with retrograde flow. Larger prospective studies are warranted.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
Ernest Francis Talarico, Jr. (PNW); Thach Nguyen (Tan Tao University)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1511

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Wide Pulse Pressure and Reverse Flow in the Right Coronary Artery on Dynamic Coronary Angiography

STEM

Authors(s):

Thai Nguyen† (Unknown); Sanad Ahmad‡ (Unknown); Thy Le‡ (Unknown); Quang Vo‡ (Unknown); Van Hoang‡ (Unknown)

Abstract:

Background: Pulse pressure reflects pulsatile arterial load and pressure-wave transmission, potentially marking hemodynamic stress associated with right coronary artery reverse flow. This study evaluated whether wide pulse pressure is associated with RCA reverse flow and 1R lesion presence on dynamic coronary angiography.

Methods: A cross-sectional analysis was performed on 46-patient dynamic coronary angiography dataset from 2023 to 2025. Pulse pressure was calculated as SBP minus DBP and categorized as <60 or ≥60 mm Hg. Outcomes included RCA reverse flow and any 1R lesion presence. Patients with prior dynamic coronary angiography evaluation and without valid outcome data were excluded from the study. Associations were assessed using two-sided Fisher's exact test.

Results: 26 had pulse pressure ≥60 mm Hg and 20 had pulse pressure <60 mm Hg. RCA reverse flow was present in 15 of 26 patients with pulse pressure ≥60 mm Hg and 15 of 20 with pulse pressure <60 mm Hg (57.7% vs 75.0%; OR 0.45, 95% CI 0.127-1.629; p = 0.2261). Any 1R lesion was present in 13 of 26 versus 9 of 20 patients (50.0% vs 45.0%; OR 1.22, 95% CI 0.380-3.935; p = 0.7366).

Conclusion: Wide pulse pressure was not significantly associated with RCA reverse flow or any 1R lesion. The minimal association may suggest that pulse pressure alone does not explain reverse-flow physiology or focal 1R vulnerability. Studies with larger sample sizes are warranted to clarify whether subtle associations exist.

Mentor(s):

Ernest Francis Talarico, Jr. (PNW); Thach Nguyen (Tan Tao University)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1512
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Long-Term Neurocognitive Effects of Childhood Lead Exposure

STEM

Authors(s):
Ngoc Anh T Nguyen† (PNW); Nghia Nguyen‡ (Unknown)

Abstract:
Background: Childhood lead exposure is a major global health crisis, affecting an estimated 800 million children with blood lead levels $\ge$ 5 µg/dL. In 2019 alone, it caused a loss of 765 million IQ points in children under five. Because this potent neurotoxin causes irreversible cognitive and behavioral damage, this study examines its long-term impact on brain structure and function.

Methods: A literature review was conducted using PubMed and Google Scholar to identify studies published between 2008 and 2026 examining the neurological effects of lead exposure. Search terms included lead neurotoxicity, MRI, cognitive decline, brain aging, gray matter volume, white matter integrity, and executive function. Original studies, cohort analyses, clinical guidelines, and review articles evaluating neurobiological mechanisms, structural brain changes, and cognitive outcomes were included.

Results: Lead inflicts neurotoxic damage by disrupting calcium signaling and crippling antioxidant defenses, which triggers heightened oxidative stress, neuronal apoptosis, and myelin degradation. MRI shows that childhood BLLs are inversely correlated with adult brain volume accounting for a 1.2% reduction in total gray matter, with pronounced deficits occurring in the frontal and anterior cingulate cortices. Higher childhood BBLs predict diminished cortical surface area, reduced hippocampal volume, compromised white matter integrity, and accelerated brain aging. Structural damage manifests as a predictable 2.07-point deficit in adult IQ for every 5-µg/dL increase in childhood BLLs.

Conclusion: Childhood lead exposure inflicts permanent structural brain damage—driving neuronal loss, demyelination, and accelerated aging. Ultimately, these neurodegenerative changes cement long-term cognitive decline, making aggressive prevention and early screening non-negotiable.

Mentor(s):
Ernest Francis Talarico, Jr. (PNW)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1513
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Experiential Learning: Developing Custom Assistive Technology Through Participatory Design and 3D-Printing

STEM

Authors(s):
Muneera Shoaib Rasheed† (Engineering); Korphiena Kimona Stephen‡ (Engineering)

Abstract:
Commercial assistive technology (AT) is designed for a broad range of users with disabilities, so it often fails to meet an individual's specific needs. Many AT users therefore rely on custom solutions, and 3D printing makes these more practical through rapid, low-cost, personalized fabrication. Combined with participatory design (PD), where end users are actively involved throughout the process, this approach produces AT that better reflects individual needs and preferences.

Building on this approach, our team gathered customer needs and translated them into design specifications through user interviews. We then designed and 3D printed three custom devices for wheelchair users with limited upper limb mobility: an extendable phone mount, a personalized wheelchair joystick, and a key fob button enlarger. The phone mount improves on the user's existing holder, which stays fixed between the legs and is hard to see and reach; the new mount slides out to rest over one leg for better visibility, then collapses back when not in use. The joystick was sized to the user's wrist and range of motion while maintaining clearance from the driving controls. The key fob enlarger encases a car key fob to make its buttons easier to press accurately. Each device went through an iterative, user-centered process: after every prototype, the user tested it over several days and gave feedback that shaped the next revision. The phone mount reached four iterations, the joystick five, and the key fob enlarger three so far, with more planned.

This project taught us that participatory design, while time-intensive, produces solutions that fit user needs far better than a single round of feedback could. We also found that even small design changes, enabled by rapid low-cost prototyping, had an outsized impact on usability. Future work includes refining the designs, testing with more users, and releasing the 3D printable files as open-source to improve accessibility.

Mentor(s):
Shaiv Mehra (Engineering); Bradley S Duerstock (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1514
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Low pH Exposure Alters Mediator Response in Poly(o-phenylenediamine)-Based Molecularly Imprinted Polymer Sensors

STEM

Authors(s):
Amanda Rodriguez-Gonzalez† (Engineering); Keeley Vonne Farmer* (Science); Ali Jo Crouse* (Science)

Abstract:
Molecularly imprinted polymer-electrochemical sensors (MIP-ES) are a promising approach for detecting non-electrochemically active contaminants such as per- and polyfluoroalkyl substances. However, exposure of poly(o-phenylenediamine) [poly(o-PD)]-based MIP films to strongly acidic conditions can alter the polymer environment and complicate the interpretation of electron mediator-based electrochemical readout. In this study, we examined how low pH exposure influences the response of a PFOA-templated poly(o-PD) MIP-ES by comparing four commonly used electron mediators with different charge states: ferrocenemethanol, ferrocyanide, ferricyanide, and ruthenium(III) hexamine. Apparent binding affinity constants (K_a) derived from Langmuir isotherm models, together with ratiometric comparisons of normalized current decreases, showed that mediator-dependent trends changed after acidic pH exposure of the polymer. Charged mediators exhibited larger perturbations in apparent sensor response, whereas the neutral mediator, ferrocenemethanol, showed the most consistent performance across the conditions examined. These results are consistent with the interpretation that changes in the protonation state of the poly(o-PD) film influence mediator access and interactions within the sensing environment, thereby biasing the mediator-based current response. Overall, this work highlights that mediator choice can strongly affect the apparent performance of poly(o-PD)-based MIP-ES after exposure to low pH and should be considered carefully when interpreting sensor response under challenging conditions.

Mentor(s):
Mobina Masdari (Science)

Other Acknowledgement(s):
Jeffrey Edward Dick (Science); Dane Christophe Wagner (Science); Uttam Pal (Science)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1515

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Twisted Two-Dimensional Devices Yield Novel Quantum Phenomena

STEM

Authors(s):

Timothy A Schmiedl† (Science|JMHC); Diya Shivpuje† (PWL)

Abstract:

The search for novel material quantum behaviors is the aim of a great portion of condensed matter physics research. Often, though, these behaviors are locked behind the innate structure of a crystal lattice. Twisted 2-dimensional quantum nanomaterial devices show great promise in loosening those constraints via tunability. 2D materials show excellent tunability through their interlayer twist angle, doping, layer thickness, and materials used. This produces a wide range of unique material properties that can be adjusted, combined, and subtracted from one another to create the requisite conditions for fascinating phenomena to emerge, such as a strange metal phase, unconventional superconductivity, the quantum spin Hall effect, and the anomalous Hall effect. These phenomena occur largely due to correlated electron-electron interactions throughout the materials as the electron bands flatten. It is possible to attain such thin materials via exfoliation of thicker mother materials. The materials are then refined through laser lithography and atomic force microscope cleaning in order to be stacked on top of one another, forming a device. This device is then connected with electrodes to probe interesting quantum phenomena. Twisted tungsten diselenide (WSe2) is a particularly interesting material because it demonstrates the Pomenranchuk effect at 1/3 filling. We plan to study novel superconductivity and fractional correlated insulators in WSe2

Mentor(s):

Yihang Zeng (Science); Nemanja Ninkovic (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1516
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Visual Representations of Speech Decoding

STEM

Authors(s):
Muhammad F Shaaban† (Engineering)

Abstract:
Computational Neuroscience lies at the intersection of machine learning and neuroscience. Research in this field is often extremely technical, making it difficult for the layperson to follow along. To make this field more accessible to newcomers, I've developed a public-facing, interactive website focused on visualizations of recent work in brain-machine interfaces for speech. For example, the website has interactive tools to display which recording electrodes are important for decoding speech from neural activity. This poster presents the tools developed for this project, explores the efficacy of these methods, and discusses design choices for accessibility and scientific communication.

Mentor(s):
Joseph Gerard Makin (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1517

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Angiographic Factor Predicting Persistent Normalization of Ejection Fraction in Dilated Cardiomyopathy

STEM

Authors(s):
Jayden Shah† (Lake Central High School); Ngoc Anh T Nguyen† (PNW)

Abstract:
Background: Normal arterial phase (AP) measured via dynamic coronary angiography (DAG) accurately predicts long-term, sustained recovery of ejection fraction (EF) to over 50% in patients with newly diagnosed dilated cardiomyopathy (DilCM) treated with guideline-directed medical therapy (GDMT).

Methods: Four years ago, patients with newly diagnosed DilCM and an EF less than 35% were subject to DAG recorded at 15 images/sec while healthy patients served as controls and the AP, the length of time among blood flow entry and clearance of contrast from distal vessels, was recorded. All patients with Dil CM received GDMT, specifically betablockers and sacubitril/valsartan. In the Machine Learning analysis, the program had 2 models (built on Python). Model 1 was built based on U-net and Densenet-121 for vessel segmentation. Model 2 was used for classification of flow. The model 2 was trained based on the convolutional neural network. The data to be collected were the types of flow (laminar or turbulent), (antegrade or retrograde), duration of the AP in milliseconds (msec), the EF (%), and hospitalization because of HF before and 48 months after treatment.

Results: Study found that the AP of the control group was 1560 msec. All patients with low EF and normal AP of 1630 msec (p=NS compared to control), improved clinically (no hospitalization for HF) and their EF increased to > 50% after one year follow-up. They were treated with sacubitril/valsartan and/or beta blockers without implanted defibrillators (ICD) nor cardiac resynchronization therapy (CRT).

Conclusion: In DilCM, a normal AP predicted the patients whose EF improved to above 50% and stayed stable with GDMT across a four year follow up. New clinical trials are needed to confirm findings and begin a personalized approach.

Mentor(s):
Ernest Francis Talarico, Jr. (PNW); Thach Nguyen (Tan Tao University)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1518
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Designing Microfluidic Chips for Accurate Neutralizing-Antibody Capture Using Magnetophoresis

STEM

Authors(s):
Maia Stef-Praun† (Engineering)

Abstract:
In the immune system, antibodies are large proteins that specialize in identifying and neutralizing bacterial and viral antigens, especially those from disease-causing pathogens. Gene therapies based on AAV (adeno-associated virus) rely on nonpathogenic viral vectors to infect quiescent cells. However, AAV is often restricted by antibodies that recognize them as threats from prior natural infections, leading to AAV neutralization and reduced treatment efficacy.

This project aims to design a technology for the effective capture and removal of these neutralizing antibodies (NAbs) from a patient's bloodstream. Current methods for identifying and removing NAbs from a patient's system are nonspecific, which increases the risk of life-threatening infections and immunodeficiency. Work performed on this collaborative project between Colleges of Engineering, Science, and Agriculture, seeks to solve this problem by attaching customized NAb-binding peptides to streptavidin magnetic beads. Once synthesized, these functionalized beads are then added to NAb-rich serum and flow into a microfluidic device designed to selectively capture and remove harmful antibodies.

In Stanciu's group in the College of Engineering, a microfluidic chip was designed and fabricated, to combine the serum and customized beads and remove NAbs. The chip channels include zones for mixing, binding without aggregation, and separation. Due to the behavior of fluids in a microscale system, three different PDMS channel designs were developed to anticipate the potential behavior of paramagnetically attracted nanoparticles.

The results include prototype CAD models that established a foundation for the ongoing fabrication and validation of the microfluidic device. If successful, these devices will make high-specificity NAb targeting through magnetophoretic capture possible, which in turn could help

overcome a major immunological barrier to successful AAV-based gene therapy.

Mentor(s):
Lia A Stanciu-Gregory (Engineering); Zhijian Wang (Engineering); Amit Kumar Barui (Engineering)

Other Acknowledgement(s):
Majid Kazemian (Agriculture|Science); Matthew Olson (Science); Rahim Rahimi (Engineering); Devendra Nikhil Sarnaik (Engineering)

Poster Presentation Abstract Number: 1519
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

ADAPT-E: Adaptive Donning and Attachment Platform Technology for Eating Utensils

STEM

Authors(s):
Korphiena Kimona Stephen† (Engineering); Muneera Shoaib Rasheed‡ (Engineering)

Abstract:
Upper limb impairments caused by progressive multiple sclerosis, stroke, spinal cord injuries, and other neurological conditions can significantly reduce hand strength, dexterity, and motor control. These limitations often make activities of daily living, such as grasping and using utensils, difficult to perform independently. Although many individuals retain cognitive function, reduced manual ability can increase dependence on caregivers, negatively impacting quality of life. With stroke alone affecting approximately 93.8 million people worldwide, there is a clear need for accessible, user-centered solutions that support independent dining. Universal cuffs are commonly used to help individuals hold eating utensils; however, their donning and doffing process can be challenging for users with limited hand function. Additionally, many existing cuffs require extra dexterity to insert and remove utensils, limiting their effectiveness as independent assistive devices.

This project introduces ADAPT-E, a lightweight, comfortable, and modular wrist-based attachment system designed to allow eating utensils to be attached and detached from a functional wrist brace using one-handed or two-handed operation with reduced dexterity demands. Various 3D-printed attachment concepts were developed, including a spring-latch lever mechanism, a Geneva mechanism, a mechatronic prototypes, and others.

To determine the most suitable ADAPT-E solution, each concept was evaluated against the other prototypes and a standard universal cuff using objective measures including weight, material cost, attachment time, detachment time, load capacity, and connection reliability, as well as subjective measures of comfort, usability, and overall user feedback. These evaluations identified the best design and validated its performance relative to the standard universal cuff.

Mentor(s):
Shaiv Mehra (Engineering); Bradley S Duerstock (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1520
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Micro-CT Imaging and Segmentation of Chicxulub Impactite Samples

STEM

Authors(s):
Devikaa Prashant Thakker† (Engineering)

Abstract:
High-resolution digital core characterization provides critical insights into the cratering mechanics and structural properties of the Chicxulub impact structure. The purpose of this study is to construct a 3D digital model from core scan segments of a Chicxulub peak ring impactite samples to characterize its internal pore network and simulate fluid permeability. High-resolution 3D micro-computed tomography (micro-CT) imaging is utilized to capture the intricate, heterogeneous structures of the impactite. Processing multi-segment core scans introduces significant data artifacts such as simple grayscale thresholding failing across the full volume because grayscale values shift unpredictably between different scanned segments. To resolve these inter-segment intensity shifts and artifact boundaries, the methodology applies a data normalization pipeline that combines a localized center of rotation correction with a Gaussian filter. The ongoing phase of the project utilizes a machine learning segmentation pipeline to handle the remaining volume. By manually labeling specific voxels within each phase as training data, the model learns to identify distinct material boundaries based on localized texture and spatial context rather than relying solely on raw voxel brightness. To assess the accuracy of this digital pore-network model, the segmented volume will be physically validated against baseline laboratory measurements obtained via Helium Pycnometry and Mercury Porosimetry. These experimental benchmarks show a baseline sample grain density of 2.6359 g/cm³, a bulk density of 2.0239 g/cm³, a porosity of 23.2156%, and a fluid permeability of 22.3388 mD. Ultimately, comparing the digital segmentation directly against these physical metrics ensures a robust, validated, and transferable digital modeling workflow applicable to other complex, heterogeneous rock samples.

Mentor(s):
Douglas R Schmitt (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1521
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Acute Coronary Syndrome Comorbidity with Heart Failure in Elderly Patients

STEM

Authors(s):
Vo Uyen† (Tan Tao University)

Abstract:
Background: Acute Coronary Syndrome (ACS) and Heart Failure (HF) are severe, frequently coexisting conditions that elevate the risk of complications and mortality. This association is particularly critical in elderly patients with preexisting HF, as ACS significantly exacerbates their prognosis, presenting a major challenge for interventional cardiologists. Consequently, a well-defined management strategy is essential. This study analyzes the outcomes of percutaneous coronary intervention (PCI) in elderly HF patients presenting with ACS.

Methods: A prospective cohort study was conducted between September and December 2024 at a tertiary geriatric center in Vietnam. Consecutive ACS patients with a history of HF who underwent PCI were enrolled. Baseline assessments included electrocardiography (ECG), cardiac biomarkers (troponin, NT-proBNP), Killip classification, and GRACE score. Laboratory tests (complete blood count, lipid profile, hemoglobin A1c) were obtained within 8 hours. Frailty was evaluated using the Clinical Frailty Scale (CFS), and treatment decisions were guided by multidisciplinary consensus involving patients and families.

Results: Thirty-two patients met the inclusion criteria. Comorbidities included prior myocardial infarction (46.8%) and HTN (93.8%). Killip class distribution on admission: 1 (n=25), 2 (n=4), 3 (n=2), and 4 (n=1). ACS subtypes comprised non-ST-elevation MI (n=16), ST-elevation MI (n=11), and unstable angina (n=5). PCI revealed lesion locations: left main (n=4), right coronary artery (n=14), LAD (n=25), LCX (n=7), in-stent restenosis (n=2), and chronic total occlusion (n=3). Multivessel disease (3-vessel: n=14; LM + 3-vessel: n=6) was common. Non-frail patients (CFS ≤4) had significantly shorter hospital stays (10.2 ± 3.4 days) than frail patients (15 ± 10.9 days; $p<0.05$).

Conclusion: PCI is a safe and feasible intervention for elderly ACS patients with comorbid HF. However, post-ACS care must incorporate CFS to optimize outcomes.

Mentor(s):
Ernest Francis Talarico, Jr. (PNW); Thach Nguyen (Tan Tao University); Loc Vu (Tan Tao University)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1522
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Role of Delamination found in Microtrichia at the Elytral Interlocking Mechanism of the Diabolical Ironclad Beetle

STEM

Authors(s):
Tomas Vargas-Bernal† (Engineering|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Pablo D Zavattieri (Engineering); Marie Kate Palau Andrade (Engineering)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1523

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Tracing Independent Origins of Tyrosine Kinase Activity in the NEK Kinase Family

STEM

Authors(s):

Alexander Webb† (Science)

Abstract:

A central question in molecular evolution is whether biochemical functions arise through shared molecular routes or lineage-specific evolutionary histories. Addressing this requires multiple independent origins of the same functional outcome so reconstructed ancestors can be compared across independent origins. Tyrosine kinase activity provides a useful case because the ability to phosphorylate tyrosine has evolved multiple times across eukaryotes. Here, we examine two origins of this activity within the NIMA-related Expressed Kinase (NEK) family. NEKs are primarily serine/threonine kinases, but NEK1 and NEK10 both independently evolved tyrosine kinase activity in different clades of the NEK family, motivating ancestral sequence reconstructions for both lineages. To reconstruct these ancestors, NEK-related sequences and IKS1 (outgroup) sequences were collected across broad eukaryotic sampling. Sequences were reduced to kinase-domain regions, then an alignment was produced using MUSCLE5, CLOAK, and a condensation module. A maximum-likelihood phylogeny was then inferred from this alignment using RAxML-NG with the LG4X model. Future work will use RAxML-NG to reconstruct ancestral sequences across the phylogeny, from which ancestors before and after the appearance of tyrosine kinase activity in the NEK1 and NEK10 lineages will be analyzed for the mutations responsible for the functional shift. These mutations will then be compared to other independent origins of tyrosine kinase activity to evaluate whether the evolution reflects shared molecular constraints or lineage-specific evolutionary histories.

Mentor(s):

Brian Metzger (Science)

Other Acknowledgement(s):

Poster Presentation Abstract Number: 1524

Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Task Design Effects on Student Knowledge Prioritization in CRISPR Gene-Therapy Tasks

STEM

Authors(s):

Jennifer Hyerin Yang† (Pharmacy)

Abstract:

As undergraduate science education increasingly emphasizes interdisciplinary learning, educators aim to carefully design tasks that help students practice integrating knowledge across disciplines. Prior research has shown that task design and context features shape what students attend to and which knowledge pieces they activate and connect (Gysin & Brovelli, 2021). Students differ in how they connect and weigh ideas (Haudek et al., 2017), so there is a need to examine how task design affects knowledge prioritization in interdisciplinary thinking. To investigate how the difference in problem framing influences prioritization of knowledge, this study uses an open-ended, hypothetical CRISPR-Cas9 gene-therapy patient case study, designed to require students to draw knowledge across multiple scientific disciplines. Advanced science majors with prior coursework in biochemistry and exposure to sickle cell disease and hemoglobin were purposefully assigned to one of two versions of the task which were identical in background information but differed in the physical scale in question presentation. Participants completed semi-structured think-aloud interviews, which were then analyzed using a combination of deductive and inductive coding that is informed by our Cognitive Resource theoretical framework and previous analysis of student artifacts in an undergraduate bioanalytical chemistry course, and concept maps to visualize the prior knowledge each participant drew upon to answer their assigned task. Preliminary findings indicate that while students activate similar resources, their prioritization of knowledge differs depending on the version they were given. These results demonstrate that problem framing affects what knowledge students prioritize and select across disciplines. By intentionally altering a task framing, interdisciplinary science educators can guide students to focus and integrate specific disciplinary areas, though further study is needed to optimize designs.

Mentor(s):

Robyn Krystal De Dios (Science); Stephanie M Gardner (Science)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Poster Presentation Abstract Number: 1525
Presentation Time: Session 3: 1:30-2:30pm in PMU Ballrooms

Comparison of Correlation, Distribution, and Concentration of Metals and Trace Elements in AD and Healthy Human Brain Tissue

STEM

Authors(s):
Richard Z Zhang† (Engineering); Zonghan Lei‡ (Science|JMHC)

Abstract:
Introduction:

Exposure to heavy metals and dyshomeostasis of essential metals have been linked to neurodegenerative diseases such as Alzheimer's disease. However, the processes and mechanisms behind how these metals deposit and interact in the brain, ultimately leading to neuropathology, remain largely unknown.

Methods:

Synchrotron micro-X-ray fluorescence (μXRF) was used to map the concentrations of multiple metals and trace elements in the brain with microscale resolution. Region of interests (ROIs) with similar metal distribution patterns from AD and healthy brains were analyzed using software programs developed with C language. The two ROI groups were compared in terms of the mean elemental concentrations and the correlations among the elements.

Results:

Using a correlation comparison program, between multiple pairs of ROIs, with one of the pair being from an AD brain sample and the other being from an NCI brain sample, a list of the ten most major correlation changes among the elements that had a change greater than 0.1 when going from AD to NCI was made. Iron, calcium, lead, and nickel show the largest shifts in mean concentrations across the ROIs. Iron, calcium, lead, sulfur, zinc, and phosphorus are among the main drivers of the change in correlations among elements. Along with that, an overall, noticeable decrease in correlation strength among elements was observed when transitioning from AD brain samples to NCI brain samples. Overall, elemental concentration and correlation changes varied widely among sample pairs.

Conclusion:

Our findings show that iron, calcium, lead, and zinc exhibit the largest shifts in elemental concentrations as well as the most pronounced changes in elemental correlations between AD and healthy brains. Together, these patterns suggest that these elements may contribute to neuropathological processes in AD, consistent with observations reported in previous studies.

Mentor(s):
Linda Nie (HHS)

Other Acknowledgement(s):

RESEARCH TALKS

Only presenting authors (italicized) and mentors are listed. Contributing authors and acknowledgements are listed later in the abstract book.

RESEARCH TALK SESSION 1 | 10:00AM-11:00AM

ROOM: GRIS 103

10:00am **7000** Nanoscale Thermal Transport Mapping and Interfacial Constraints of Individual Layers for Titanium Carbide (Ti3C2Tx) MXene
Johanna Walther; Ram Eknath Munde; Raisul Islam

10:20am **7001** Atomization of Fuel in the Pre-vaporization Tube of a Small-Scale Annular Gas Turbine Combustor
Levi Hammerbeck; Amogh Natu; Daniel Robert Guildenbecher

10:40am **7002** Event and Passing Detection for Football (Soccer)
Boyang Zhang; Jan-Anders E Mansson; Daniel Castro Mesa

ROOM: GRIS 118

10:00am **7003** BioreactorMR: An AI-Augmented Mixed-Reality Tool for Collaborative Bioreactor Education
Azeem Ehtisham; Xinyu Zhang; Ehijie Ebewele

10:20am **7004** Finding the Story in the Sound: A Language-Model-Driven System for Synchronized Audio and Lyrical Narrative Visualization
William Andres Bayona Vergara; Rua Mae Williams

10:40am **7005** Graph-Theoretic Observability and Redundancy Analysis for Large-Scale Water Treatment and Distribution Systems
Mihir Samanyu Talamudipi; Kris Villez; David Warsinger

ROOM: GRIS 126

10:00am **7006** Acoustic Enhancement of Porous Filters in HVAC Systems for Submicron Bioaerosol Removal
Tyler Hughes; Sudharshan Anandan

10:20am **7007** Pixel-Wise Gamma-Ray Coincidence Detection Using U-Net Convolutional Networks
Samuel D Bryan; Erick Vazquez Torres; Andy Jung; Ace Rounds

10:40am **7008** Radar-Based Identification of Buried Lava Flows in the Moon's South Pole-Aitken Basin
Liliana Triscari; Ali Bramson

ROOM: GRIS 133

10:00am **7009** Vision-Based Runway Detection
Kabir Jain; Sabine Brunswicker; Jayanth Shreekumar

10:20am **7010** Beyond Diameter: Biomechanical Phenotyping of Pediatric Aortic Root Dilation Across Etiologies
Julian Vuong; Shubh Parag Mehta; Craig Goergen; Benjamin Landis

10:40am **7011** Pulse-Flow Reverse Osmosis
Taher Mustafa Mukadam; Ali Naderi Beni; David Warsinger

ROOM: GRIS 134

10:00am **7012** Determining Regulation of PACT via Phosphorylation in TNBC
Keeley Ann Rohrer; Kyle Aaron Cottrell

10:20am **7013** Investigating substitutions in Hypervariable Region 1 of Hepatitis C virus envelope protein E2 to improve antibody binding
Mei Qi Gordon-Washington; Ryan George Peters; Richard J Kuhn

10:40am **7014** High-Resolution Cellular STA using Ribosome Alignment
Anna Boeva; Kristy Rochon; Samuel Hartzler; Lauren Ann Metskas

RESEARCH TALK SESSION 2 | 11:00AM-12:00PM

ROOM: GRIS 103

11:00am **7015** Recovering Behaviorally-Relevant Neural Trajectories from Motor Cortex Using Dynamical and Probabilistic Models
Samridh Tiwari; Om Tejas Kolhe

11:20am **7016** Ice-Droplet Interaction with Supersonic Shock Waves
Alex Perry; Caleb Jonathan Radtke; Matthew Leight; Varun Aggarwal; Adam Carson Lay

11:40am **7017** Building Morphosyntactic Networks for Precision Assessment and Intervention in Preschool-aged Children
Ronald Liu Tsai; Mariel Schroeder; Arielle Borovsky

ROOM: GRIS 118

11:00am **7018** Force Generation and Contraction of the Actin Cytoskeleton
Vahin Pichairaj; Tae Yoon Kim; Jeffery Robert Coulter

11:20am **7019** Designing a Game-Based Learning Platform for Teaching Mathematical Optimization
Huy Bao Huynh; Danial Davarnia

11:40am **7020** ChemOperator: A Reproducible Simulation Library for Chemical Engineering Operator Learning
Rohan Patel; Sergey Gusev; Anja Hribljan; David Esteban Bernal Neira

ROOM: GRIS 126

11:00am **7021** Neural Network Predictors for Learning General Quantum Systems Environments
Chee Ying Tay; Pranshu Maan

11:20am **7022** Evaluating the Cardiotoxicity of Doxorubicin Using 4D Echocardiology
Helen Yee; Craig Goergen; Benjamin Zeidler

11:40am **7023** Impact of Varying Wall Temperature on Hypersonic Boundary-Layer Transition
Michael Oscar Greenlee; Brandon C Chynoweth

ROOM: GRIS 133

11:00am **7024** Digital Inline Holographic Particle Tracking Velocimetry for High-Image-Density Particle Erosion Characterization
Yi Yang Hsu; Daniel Robert Guildenbecher; Amy Chang

11:20am **7025** Enhancing the Mechanical Reliability of Free-Standing Laser-Induced Graphene through Process and Material Design
Elena Paias Ferreira; Wenzhuo Wu; Pedro Henrique de Souza Barbosa

11:40am **7026** Design and Noise Characterization of a Low-Noise Voltage Preamplifier for Nanovolt-Scale Measurements
Shashank Varamballi; Leonid P Rokhinson

ROOM: GRIS 134

11:00am **7027** Tau-Jet Matching and Tag-and-Probe Tau Tagging Efficiencies for HH→bbτ+τ- Searches Using Run 3 CMS Scouting Data
Annella Bellot; Jan-Frederik Schulte; Yao Yao

11:20am **7028** Inert-Atmosphere Assembly of Encapsulated Air-Sensitive vdW Heterostructures with Machine-Learning Layer Identification
Manaswini Singh; Tiancong Zhu

11:40am **7029** Molecular thresholds for activation and fratricide by anti-B7-H3 CAR T cells
Nicole Shashurin; Shalini T Low-Nam

RESEARCH TALK SESSION 3 | 12:00PM-1:00PM

ROOM: GRIS 103

12:00pm **7030** Semantic Processing and Early Language Learning (SPELL)
Changyeol Im; Paris Gappmayr

12:20pm **7031** A Market-Driven Framework for Neutron Detection: Aligning Detector Technologies with Emerging Nuclear Applications
Lucas K Philip; Joseph F Pekny; Parker Haven LaTour

12:40pm **7032** Compact Single-Shot Ranging, Locating and Multi-Scale Imaging Using Metasurfaces
Roy Liu; Qi Guo

ROOM: GRIS 118

12:00pm **7033** Sustainable Manufacturing of Aerospace Composite Structures using High-performing Bio-based Epoxy Systems
Luis Mariano Avalos Campa; Isabelle Schaekel; Jonathan J Wilker

12:20pm **7034** Machine Learning for Fast Decision Generation in Engineering Optimization
Samuel Kinstlinger; Shraman Pal; Can Li

12:40pm **7035** Cellulose Nanocrystals as a Biotemplate for Gold Nanomaterial Synthesis
Raina Wang; Chao-Hsiang Chang; Michael T Harris

ROOM: GRIS 126

12:00pm **7036** Review of Current Nursing Practice Regarding Phosphate Replacement Therapy Administration in an Intensive Care Environment
Caihla Timbang; Ellen M Schellhase; Monica Miller

12:20pm **7037** "Structural Characterization of N-terminally ubiquitinated BAP1 in complex with Ub-VME"
Donovan Dewitt; Abigail Marie Wight; Nipuni Maleesha Pannala; Chittaranjan Das

12:40pm **7038** Comparing B-Factors and Local Resolution as Metrics of Cryo-EM Protein Structure Quality
Jalynn Somerville; Ramaswamy Subramanian; Trung T. Thach

ROOM: GRIS 133

12:00pm **7039** Controlled Assembly of Amphiphilic Janus Particles in Polymer Matrix for Novel 3D Printing Applications In Space
Kevin Santiago Pineda Rojas; Carlos J Martinez

12:20pm **7040** Buildup, Instrumentation, and Optical Diagnostics for the Purdue High-speed Automated Sand Erosion Rig (PHASER)
Justin Babilino; Amy Chang; Daniel Robert Guildenbecher

12:40pm **7041** Photoelastic Gel Pad for Vision-Based Tactile Sensing
Samuel Timothy Bibeau; Yu She; Md Rakibul Islam Prince

ROOM: GRIS 134

12:00pm **7042** A Non-Invasive Acoustic Sensing System for Sleep Bruxism Screening
Aaruni Singh; Saeed Mohammadi; Babak Ziaie

12:20pm **7043** Evaluation of Control Strategies for Drone Path Tracking and Cooperative Multi-Agent Exploration of Indoor Environments
Ediz Guzey; Shreyas Sundaram; Younggil Chang

12:40pm **7044** Comparison of scanning electron microscopy and histological observations of human aorta tissue
Bea Olivia Cabot; Shubh Parag Mehta; Cortland Hannah Johns; Craig Goergen; Benjamin Landis

RESEARCH TALK SESSION 4 | 1:00PM-2:00PM

ROOM: GRIS 103

1:00pm **7045** Enhancing Tennis Racket Feel Through Multi-Material Additive Manufacturing of Handle Pallets
Drake R Augustine; Jan-Anders E Mansson; Adeline Nora Ripberger

1:20pm **7046** Risk Exposure of U.S. Industry Sectors to Oil Price Shocks
Santiago Melo Munoz; Stephan Robert Biller; Steven R Dunlop

1:40pm **7047** Computational Design and Optimization of Functionally Graded TPMS Heat Exchangers
Wyatt Soberg Catz; Jaewon Park; Justin Weibel

ROOM: GRIS 118

1:00pm **7048** Pressure-Triggered Contact Sensing for Fully Mechanical Soft Robotic Response
Juan Pablo Monge Mesen; Juan Camilo Osorio Pinzon; Jhonatan Steven Rincon Angarita; Andres Arrieta Diaz

1:20pm **7049** Socioeconomic Status as a Moderator of ACT Outcomes in Caregivers of Children with Neurogenetic Conditions
Chenrui Yin; Lyndsey Nicole Graham; Bridgette Kelleher; Daniel J Foti

1:40pm **7050** Fluid-Powered Autonomy: Embedded Fluidic Oscillators for Pneumatic and Hydraulic Soft Robots
Camila Uribe; Juan Camilo Osorio Pinzon; Jhonatan Steven Rincon Angarita; Andres Arrieta Diaz

ROOM: GRIS 126

1:00pm **7051** AI-Guided Engineering of Lipocalin Scaffolds for Programmable Small-Molecule Recognition
Atharva Bhatta; Kanaga Vijayan Dhanabalan

1:20pm **7052** Machine-Learning-Driven Nuclear Band Reconstruction from γ–γ Coincidence Data
Josiah W Beauchaine; Ace Rounds; Andy Jung

1:40pm **7053** Thermosensitive Histidine Dehydrogenase (HisD) Mutants in Salmonella typhimurium
Olivia Nicole Safranek; Nicholas Noinaj; Laszlo Csonka

ROOM: GRIS 133

1:00pm **7054** DNA Origami Nanocube Scaffold for Production of Multiple Therapeutic RNA Sequences
Logan M Murray; Leopold Noel Green

1:20pm **7055** NASA Hydrogen Drone Refueling Project
William Zheng; Holman Lau; Li Qiao

1:40pm **7056** Investigating Zinc Incorporation During Zn-MFI Synthesis for Fuel and Chemical Production
Alana N White; Rajamani P Gounder; Sarah Gustafson Wagers

ROOM: GRIS 134

1:00pm **7057** Engineering Technology: How Do Entry Pathways Relate to Preparation, Satisfaction, and Career Confidence?
Japteg Singh Bamrah; Charis Knoerr; Anne M Lucietto

1:20pm **7058** High-Resolution Thermal Warpage Measurement Using 3D Laser Vibrometry and Optical Profilometry
Ishaan Brar; Ujjawal Arya; Ganesh Subbarayan

1:40pm **7059** Developmental Neurotoxicity of Trifluoroacetic Acid (TFA): Oxidative Stress and Neurotransmitter Responses in Zebrafish
Maxwell J Gootee; Jennifer Freeman; Umamaheswari Sathisaran

RESEARCH TALK SESSION 5 | 2:00PM-3:00PM

ROOM: GRIS 103

2:00pm **7060** Characterizing Structural and Mechanical Femoral Outcomes in a Murine Model of Alcohol Use Disorder and Type 2 Diabetes
Isabelle Anne Hunt; Joseph Wallace; Dyann Marie Segvich; Olivia Nicole White

2:20pm **7061** A Looking Glass Into the Future of Disease in a Warmer World: Susceptibility to Metschnikowia bicuspidata Infection in Daphni
Ana Martinez; Jonathan Lopez; Catherine L Searle

2:40pm **7062** Synthesis of biotemplated palladium-coated nanorods on cellulose nanocrystals
Halaya Vann; Chao-Hsiang Chang; Michael T Harris

ROOM: GRIS 118

2:00pm **7063** Mapping the Stacking and Surface Chemistry Landscape of MXenes and Metal Carbides via DFT and Molecular Dynamics
Samiya Balu; Aidan Damian Pantoya

2:20pm **7064** Miniaturizing X-Ray Fluorescence Spectroscopy Through Simulation-Driven Vacuum Chamber Design
Ashwin Natarajan; Abu Sayed Mohammed Sayam; Aaron James Specht

2:40pm **7065** Comparison of Neutron Detectors and Evaluation of Shielding Materials for Space Microelectronics
Jack G Darby; Rusi P Taleyarkhan; Stepan Ozerov; Everett John Nally

ROOM: GRIS 126

2:00pm **7066** Supply chain regionalization and the viability of an AI server hub for Latin America: a system dynamics analysis of Panama
Natasha Catherine Farias Cisneros; Reem Khir

2:20pm **7067** An automated workflow for Multi-Omics Analysis using Solvent Touch Extraction.
Jesus Esteban Ladino Giraldo; Christina R Ferreira; Ryan T Hilger

2:40pm **7068** A Conductive Polymer-Based Approach to Soft Tactile Sensing for Robotic Manipulation
Jeronimo Contreras Castaneda; Ramses Martinez

ROOM: GRIS 133

2:00pm **7069** Bioinspired Continuum Robot
Eain Drae Oo; Denyse Isingizwe; Timothy M Whalen

2:20pm **7070** Collapse of the Human Thermal Body Plume: Modeling and Characterization of Gravity-Dependent Gas Exchange
Henry Ewald; D. Marshall Porterfield

2:40pm **7071** Beyond the Game: Exploring Sport, Culture, and Community Through Experiential Learning in Türkiye
Aarushi Gupta; Dwaine H Jengelley; Natasha Duncan

ROOM: GRIS 134

2:00pm **7072** City Sounds: How Increasing Noise Impacts the Host-Seeking Behavior of a Frog-Biting Mosquito
Nina Rose Hall; Ximena Bernal; Richa Singh

2:20pm **7073** Effects of Cancer-Associated Fibroblasts on Pancreatic Cancer Cell Migration Under Hypoxic Conditions
Ambhranee Yakkundi; Chi Zhang

2:40pm **7074** Optimization of a Folate Conjugated Fully Modified miR-34a for Enhanced Stability, Uptake, and Activity
Aindri Abhishek Singh; Shreyas Ganesan Iyer; Andrea L Kasinski

RESEARCH TALK SESSION 6 | 3:00PM-4:00PM

ROOM: GRIS 103

3:00pm **7075** Modeling Thin Membrane Response to Time-Varying Forces
Carman Stanton; Hatim Bamoumen; Farhan Ishraque Zahin; Kevin J Webb

3:20pm **7076** Movement Pattern Analysis in Football (Soccer)
Pranav Tallapaka; Jan-Anders E Mansson; Daniel Castro Mesa

3:40pm **7077** Soft Growing Robot Cap's Sensor Integration
Ana Clara de Medeiros Morais; Laura Helen Blumenschein; Priyanka Balkrishna Bhovad; Ethan Michael DeVries; Jack Rearden Ferlazzo

ROOM: GRIS 118

3:00pm **7078** BioSimulateAI: Turning Plain-Language Descriptions into Multi-Scale Biological Simulations
Aarush Agarwal; Linlin Li

3:20pm **7079** Investigating Performance of Nanosilica and Non-traditional and Natural Pozzolans in Type IL Cementitious systems
Aryan Daga; Anelya Zhussupbekova

3:40pm **7080** Beyond Task Completion: Training Computer-Use Agents to Evaluate Usability
Rishab Sai Vempati; Jason Wu

ROOM: GRIS 126

3:00pm **7081** The Impact of a Snack Inspired by the Dieta de la Milpa on Cardiovascular-Kidney-Metabolic Health in Hispanic Individuals
Kaylei Lank; Annabel Biruete

3:20pm **7082** Process-Level Digital Twin Guide for Flow Optimization and Interoperability in a Semiconductor Backend Manufacturing Plant
Ana Susana Deng Guan; Young-Jun Son

ROOM: GRIS 133

3:00pm **7083** Understanding Differences in Active Learning Classroom Typologies
Odalis Joana Campos Vasquez; Barbara Young

3:20pm **7084** Temperature Annealing Properties of a Commercial Optical Transceiver in the Subcritical Pile and Nuclear Reactor
Brandon Anthony Farber; Andrew Owen Fewell; Peter Bermel

ROOM: GRIS 134

3:00pm **7085** Bumblebee, a Foundation Model for Particle Physics Discovery
Cara Suh; Miaoyuan liu

3:20pm **7086** Couples Perceptions of Family Functioning in Military Families with a PTSD Service Dog: A Convergent Mixed Methods Analysis
Tatum Reese Ebbeskotte; Leanne Nieforth

3:40pm **7087** Structural and Electronic Investigation of ACIGS Chalcopyrites using Density Functional Theory
Yutika Vasudeo Sawant; Arun Kumar Mannodi Kanakkithodi

Talk Presentation Abstract Number: 7000
Presentation Time: GRIS 103 at 10:00-10:20

Nanoscale Thermal Transport Mapping and Interfacial Constraints of Individual Layers for Titanium Carbide (Ti3C2Tx) MXene

STEM
SURF

Authors(s):
Johanna Walther† (Engineering)

Abstract:
Two-dimensional materials such as titanium carbide (Ti3C2Tx) MXenes show promise for electronics, catalysis, and energy conversion devices. Engineering these materials for reliable applications requires understanding local heat transport at the layer scale. Thermoreflectance (TDTR/FDTR) cannot resolve nanoscale thermal transport due to diffraction limits. This study investigates thermal transport across the van der Waals gap between individual 2D layers to constrain the parameters governing interfacial heat flow. Scanning thermal microscopy (SThM) tests whether thermal conductivity changes as a MXene flake grows from one to a few layers, using a sub-100-nm voltage-sensitive probe whose resistance changes reflect local temperature variations. An algorithm extended from prior work converts the raw probe signal into thermal conductivity, characterizing k_eff as a function of h_BD, the thermal boundary conductance across the buried interface between the flake's bottom layer and the SiO2 substrate, across three mono/bilayer regions. This reveals a feasibility threshold near h_BD ~35-40 MW/m2K below which no solution exists; k_eff decreases monotonically above this threshold. Within the feasible range (~40-200 MW/m2K), k_eff spans ~20-300 W/mK. Tip radius uncertainty (b = 25-50 nm) adds ±116.3 W/mK. Raman spectroscopy independently confirms correlation between the SThM signal and local phonon spectral distribution, a signature of local thermal conductivity in MXenes. Prior DFT calculations report 10-108 W/mK for monolayer Ti3C2Tx depending on termination, overlapping the lower part of the measured range but not the upper values. A single per-layer k_eff therefore requires an independently measured h_BD, since extraction is highly sensitive to this value. This threshold approach bounds the admissible parameter space for layer-resolved thermal transport, identifying buried-interface calibration as the next step toward resolving monolayer-to-bilayer conductivity.

Mentor(s):
Ram Eknath Munde (Engineering); Raisul Islam (Engineering)

Other Acknowledgement(s):
Varun Aggarwal (Engineering); Krutarth Kiran Kamath (Engineering); Brian Cecil Wyatt (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7001
Presentation Time: GRIS 103 at 10:20-10:40

Atomization of Fuel in the Pre-vaporization Tube of a Small-Scale Annular Gas Turbine Combustor

STEM
SURF

Authors(s):
Levi Hammerbeck† (Engineering)

Abstract:
Although small-scale gas turbine engines have gained increasing interest, they face significant challenges in achieving the efficiency of their large-scale counterparts. These challenges lie in the ability to adapt specific components to accommodate the decrease in overall size in these engines, particularly in the combustor. This study investigates an improvement to the fuel injection and mixing processes that occur inside a small-scale gas turbine engine's combustor. Inside the combustor, an annulus of pre-vaporization tubes (PVTs) premixes fuel with high-speed incoming air. Previous testing of similar engines has shown that liquid fuel is not effectively atomized as it travels through a PVT, resulting in difficulty evaporating and mixing with the surrounding air. To improve the atomization of liquid fuel, an insert (pre-filmer) was added to the PVT to promote higher shear forces exerted by air onto the fuel stream. To compare the atomization of the control and pre-filmer designs, digital inline holography (DIH) was used to capture the size, total number of droplets, and droplet velocities in the spray. Holograms were acquired and processed using custom software designed for digital refocusing. The experiment was conducted in a rig with water and air nondimensionalized to the conditions in the combustor at ignition. Results show that incorporating a pre-filmer in the PVT substantially increases the droplet density while decreasing the average droplet diameter. A new design consisting of concentric tubes to produce a spray is tested and compared to existing designs. These effects are expected to increase combustion efficiency as they contribute to higher evaporation rates and more complete fuel-air mixing. In the future, testing is necessary to confirm the applicability and benefits of pre-filmers in a reacting flow with jet fuel as well as the consequences of neglecting conductive heat transfer in the PVT.

Mentor(s):
Amogh Natu (Engineering); Daniel Robert Guildenbecher (Engineering)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Talk Presentation Abstract Number: 7002
Presentation Time: GRIS 103 at 10:40-11:00

Event and Passing Detection for Football (Soccer)

STEM
SURF

Authors(s):
Boyang Zhang† (Engineering); Pranav Tallapaka‡ (Engineering)

Abstract:
Modern soccer matches generate vast amounts of positional tracking data that records the location of every player and the ball many times per second. However, this raw data does not directly indicate what is actually happening on the pitch. Coaches, analysts, and researchers care about events, but identifying them today usually relies on slow, expensive manual tagging, and the raw data itself comes with no labels. This project aims to build an automated detection pipeline for soccer that identifies key game events directly from player and ball positional tracking data. To do this, it needs to first recognize what is happening in the raw data at any given moment. A dead-ball event detector identifies when play has stopped and classifies what type of event occurred, such as a goal, free kick, corner, throw-in, or substitution. A separate passing detector identifies in-play passes and determines whether each pass succeeded, failed, or was intercepted. To accurately detect these events, we combine geometric rules based on ball position and velocity with machine learning models, specifically Random Forests and Gradient Boosting, trained on labeled match data. We evaluate both detectors against ground-truth annotations by measuring precision, recall, and F1 score to ensure the results are reliable. The ultimate goal is to produce accurate, timestamped event records from raw tracking data, providing a structured foundation that coaches, analysts, and researchers can use to better understand what is happening during a soccer match.

Mentor(s):
Jan-Anders E Mansson (Engineering); Daniel Castro Mesa (Engineering)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Talk Presentation Abstract Number: 7003
Presentation Time: GRIS 118 at 10:00-10:20

BioreactorMR: An AI-Augmented Mixed-Reality Tool for Collaborative Bioreactor Education

STEM
SURF

Authors(s):
Azeem Ehtisham† (Polytechnic)

Abstract:
Bioreactors are important in undergraduate education for fields such as biosciences, bioprocessing engineering, biomanufacturing, and more, but they are expensive to purchase, operate, and maintain, labor-intensive to use, and occupy limited laboratory space. Mixed reality (MR) can place a life-size interactive bioreactor in any setting through an immersive headset environment. However, many educational MR applications remain single-user, and collaborative multiplayer experiences in MR are still rarely explored. This project seeks to explore MR's strong potential for group instruction and learning with the development of BioreactorMR, an AI-augmented multiplayer MR application in which multiple users can view and explore the same virtual bioreactor together. The application is used by placing a scaled bioreactor model in the user's physical space, with 35 components configured as interactive components. Users can select a component to highlight it and open a side panel with a brief description, while an AI voice assistant provides on-demand guidance about the application, bioreactor components, and operating concepts. The application was built in Unity and tested on Meta Quest 3 hardware. Multiplayer functionality allows multiple users to join a shared session where every participant sees the same bioreactor in their physical space and all participants can interact with it simultaneously. The primary result of this application is a functional proof of concept, suggesting that consumer mixed-reality hardware can support shared bioreactor instruction. Future work includes aligning the model to the same real-world location for all users and classroom use to evaluate learning outcomes.

Mentor(s):
Xinyu Zhang (Engineering); Ehijie Ebewele (Polytechnic)

Other Acknowledgement(s):
Jia Lin Cheoh (Engineering)

Talk Presentation Abstract Number: 7004
Presentation Time: GRIS 118 at 10:20-10:40

Finding the Story in the Sound: A Language-Model-Driven System for Synchronized Audio and Lyrical Narrative Visualization

Creative
SURF

Authors(s):
William Andres Bayona Vergara† (Polytechnic)

Abstract:
Music is often experienced as pure emotion, yet most visualization tools reduce songs to flashing colors driven by volume or beat, ignoring the story they tell. This gap is clear in narrative rich music, such as musical theater or Conceptual Albums, where lyrics carry a full arc of character, conflict, and resolution that audio only visualizers miss. Prior work using Large Languages Models (LLMs) to translate music features into expressive output, such as dance movement, shows that LLMs can act as creative interpreters rather than mechanical mappers, an approach not yet applied to visual storytelling combining sound and lyrics. This work presents a real time visualization system combining audio feature extraction with natural language analysis of song lyrics to generate an integrated visual narrative. Audio features like tempo, beat timing, energy, spectral brightness, and harmonic content are extracted using Librosa, while lyrical emotion is derived through lyrics processing and aligned to precise timestamps. Both signals are passed to a language model acting as creative director, which generates a sequence of visual instructions, including shape, color, motion, and opacity, before playback begins. The system is tested on narrative rich songs chosen to maximize variation in energy and emotional tone. Results are expected to show that the generated visuals track both sound and story more coherently than audio only approaches. The project is expected to yield a working prototype and an early framework for using language models as interpretive creative agents, with applications in accessibility and live performance.

Mentor(s):
Rua Mae Williams (Polytechnic)

Other Acknowledgement(s):
Jorge Enrique Neira Garcia (Engineering)

Talk Presentation Abstract Number: 7005
Presentation Time: GRIS 118 at 10:40-11:00

Graph-Theoretic Observability and Redundancy Analysis for Large-Scale Water Treatment and Distribution Systems

STEM
SURF

Authors(s):
Mihir Samanyu Talamudipi† (Engineering)

Abstract:
Sensors in water treatment and distribution systems generate data used to monitor performance, detect faults, and optimize operations. However, placing sensors strategically is challenging - critical variables go undetected and costs become prohibitive. A graph-theoretic algorithm exists that systematically determines, for a given sensor layout, which variables are directly measured, which are observable (i.e., can be inferred from available measurements and process constraints), and which are redundantly measured. However, the algorithm has thus far been demonstrated only for small-scale systems containing fewer than ten components. This study extends the algorithm to two large-scale systems: a Piston Batch Reverse Osmosis desalination system with approximately 30 components, which converts saltwater into drinkable water through membrane-based separation enhanced by energy-recovering pistons, and the Anytown water distribution benchmark network with over 80 components, which models the water supply infrastructure and demand of a hypothetical town. Each system is modeled as a directed graph of physical components and pipe connections, enabling the algorithm to classify every flow, pressure, and concentration variable in the network. Both systems were successfully modeled and passed the algorithm's internal verification step, producing visualizations that label each sensor as measured, redundant, or soft-sensed (i.e., observable). The successful application of the algorithm to two large-scale water systems demonstrates its scalability beyond previously studied small-scale networks. Future work will address two remaining challenges: representing the different operating phases of Batch Reverse Osmosis and accurately modeling distributed pressure losses in the Anytown network. Addressing these challenges is expected to improve the algorithm's applicability to real-world water systems and further support cost-effective sensor placement.

Mentor(s):
Kris Villez (Oak Ridge National Laboratory); David Warsinger (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Talk Presentation Abstract Number: 7006
Presentation Time: GRIS 126 at 10:00-10:20

Acoustic Enhancement of Porous Filters in HVAC Systems for Submicron Bioaerosol Removal

STEM
DUIRI

Authors(s):
Tyler Hughes† (Centers & Institutes)

Abstract:
The average person spends 80-90% of their life indoors, making indoor air quality especially important. However, many heating, ventilation, and air conditioning (HVAC) systems struggle to remove common viruses from the air due to the small size of these particles. Acoustics have been shown to increase particle interaction with filters and channel walls through acoustic streaming, radiation forces, and the interaction force. We investigate how acoustically enhanced filtration systems can improve the capture efficiency of these small particles while also decreasing the power consumption of the system. Experimental testing was conducted using the Aerogen Solo Nebulizer to generate particles of varying sizes, which were then measured using an optical particle scanner (OPS) and a scanning mobility particle sizer (SMPS). A Belimo 22ADP-55q was also used to measure the pressure drop across our acoustic channel. Using these scanners, the capture efficiency and pressure drop can be accurately calculated, as well as other parameters, to determine if an acoustic channel will not only improve filtration efficiency but also power consumption. Our preliminary results show that the capture efficiency increases when the acoustics are implemented, which is expected. However, it was also seen that the pressure drop across a filter decreases, creating a less restrictive filter, allowing the fans in an HVAC system to run at a lower speed, saving power and money. The acoustic filtration systems provide a safer, more energy-efficient alternative to typical HVAC systems and high-voltage electrostatic precipitators, eliminating harmful ozone byproducts while maintaining high filtration standards.

Mentor(s):
Sudharshan Anandan (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7007
Presentation Time: GRIS 126 at 10:20-10:40

Pixel-Wise Gamma-Ray Coincidence Detection Using U-Net Convolutional Networks

STEM
Data Mine

Authors(s):
Samuel D Bryan† (Science); Erick Vazquez Torres† (Science)

Abstract:
Gamma-ray coincidence spectroscopy is widely used to analyze isotopes and reconstruct nuclear level schemes, but manually identifying coincidence peaks is time-consuming, subjective, and increasingly challenging as matrix complexity grows. This work investigates the implementation of machine learning to automate peak detection in synthetic gamma-ray coincidence matrices generated through Monte Carlo simulations. A U-Net convolutional neural network (CNN) was trained to produce pixel-wise probability heatmaps using binary cross-entropy loss with class weighting to address the large peak-to-background imbalance. Two post-processing methods were evaluated for converting heatmaps into peak coordinates: intensity-weighted centroid detection and local maxima filtering. While both methods were able to accurately detect peaks across a matrix, they shared a common limitation: when peaks are in close proximity, the model often merged them into a single probability cluster, producing false negatives regardless of post-processing method. By training the model to compare relationships between distant regions of the matrix, self-attention improved its ability to distinguish closely spaced and partially overlapping coincidence peaks while preserving fine structural details that any standard convolution alone can overlook. The output framework provides a scalable, reproducible approach for automated gamma-ray coincidence analysis, demonstrating how attention-based deep learning can improve peak localization while being able to support more reliable nuclear level-scheme reconstruction.

Mentor(s):
Andy Jung (Science); Ace Rounds (Science)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7008
Presentation Time: GRIS 126 at 10:40-11:00

Radar-Based Identification of Buried Lava Flows in the Moon's South Pole-Aitken Basin

STEM

Authors(s):
Liliana Triscari† (Science); Aaron Lee Perrault* (Science); Miah KeAnna Sinks* (Science)

Abstract:
The Moon preserves a long record of ancient impact craters, volcanic activity, and surface processes that provides insight into the early history of the Solar System. One of the most significant lunar features is the South Pole-Aitken (SPA) Basin, the largest and oldest recognized impact basin on the Moon. Spanning nearly a quarter of the Moon's circumference, SPA dominates the lunar farside and is an important exploration target because it provides a window into lunar bombardment history, interior structure, and surface evolution. Previous studies have identified sites of potential cryptomaria—ancient lava flows buried beneath the lunar surface. Their presence suggests volcanic deposits may be more widespread than surface observations alone indicate, making their identification important for constraining the Moon's thermal history and extent of ancient volcanism. Radar can probe beneath the surface, providing insight into the distribution and burial depth of cryptomare deposits. Here, we use radar data collected by NASA's Lunar Reconnaissance Orbiter (LRO) to investigate previously proposed cryptomaria in central SPA and place new constraints on the inventory of the Moon's oldest volcanism. We characterize known surface mare deposits using S-band radar products and map areas with similar radar signatures elsewhere in SPA as candidate cryptomaria. These candidate regions will be compared with elevation, slope, mineralogy, and iron abundance to evaluate whether they are consistent with shallowly buried volcanic materials. This analysis tests whether cryptomare-like radar signatures extend beyond central SPA, remain concentrated near previously identified deposits, or vary across the basin in response to burial depth, impact modification, and regolith mixing. Our results will place new constraints on early lunar geologic evolution and identify scientifically valuable SPA regions for future mission planning, including NASA's Endurance long-distance rover concept.

Mentor(s):
Ali Bramson (Science)

Other Acknowledgement(s):
Briony H Horgan (Science); Kelsey Prissel (Science)

Talk Presentation Abstract Number: 7009
Presentation Time: GRIS 133 at 10:00-10:20

Vision-Based Runway Detection

STEM

Authors(s):
Kabir Jain† (Science)

Abstract:
Automated detection of complex landing zones is well established for rotary-wing UAV systems, whose ability to hover and adjust approach angles allows for a greater margin of error. Despite this, robust runway detection for fixed-wing UAV systems remains underexplored, particularly under extreme weather conditions and complex landing areas. We propose a quantized deep learning framework designed for real-time inference on resource limited UAV hardware. The framework integrates a YOLOv26 model with SIFT/SURF feature matching to maintain consistent identification despite changes in atmospheric conditions, and CSRT tracking to preserve bounding box localization, reducing the need to rerun the YOLO model on a per-frame basis. We evaluate this framework through the use of c-mAP on real world flight imagery present in the LARD v2 dataset, with a focus on excluding simulated or satellite based imagery to ensure our results reflect in-flight conditions.

Mentor(s):
Sabine Brunswicker (Polytechnic); Jayanth Shreekumar (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7010
Presentation Time: GRIS 133 at 10:20-10:40

Beyond Diameter: Biomechanical Phenotyping of Pediatric Aortic Root Dilation Across Etiologies

STEM
DUIRI

Authors(s):
Julian Vuong† (Engineering); Julia Kang‡ (Engineering|Science)

Abstract:
In pediatric cardiology, progressive aortic root dilation is driven by various pathways. While Marfan syndrome (MFS) reduces structural tissue integrity and bicuspid aortic valve (BAV) alters hemodynamic flow, some idiopathic cases also present with unexplained dilation lacking genetic or valvular markers. Standard care tracks aortic root diameters at the annulus, sinus of Valsalva (SoV), and sinotubular junction (STJ) using transthoracic echocardiography (TTE) but misses dynamic mechanical differences.

We analyzed TTEs acquired from controls (n=18), MFS (n=38), BAV (n=38), and idiopathic cases (n=14) at IU Health for this study. A previously developed deep learning model segmented the aortic root on control TTEs, while a custom manual annotation tool was used for TTEs from diseased subjects. These masks were used to calculate diameters and Green-Lagrange circumferential strain (GLCS), a biomechanical metric that quantifies deformation of the aortic root wall throughout the cardiac cycle. Diameter Z-scores (Z) and GLCS were compared across 3 root locations (significance set at $p<0.05$).

Controls and diseased groups had significantly different Z at all 3 locations. While MFS and BAV showed significantly different Z at SoV, idiopathic Z at SoV differed from BAV but not MFS. Annular GLCS distinguished controls from all diseased groups, though SoV and STJ GLCS were similar in MFS, BAV, and idiopathic cases. Control-BAV Z varied significantly at the SoV, but GLCS did not, indicating BAV dilation did not result in severe stiffness commonly seen in MFS, where both metrics varied significantly. Idiopathic cases exhibited mixed profiles, aligning more closely with MFS (n=9) than BAV (n=5).

These findings suggest static and dynamic metrics provide complementary information that may improve characterization of etiology-specific mechanical profiles and distinguish genetic and non-genetic aortopathies, especially in low-resource settings.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
Shubh Parag Mehta (Engineering); Craig Goergen (Engineering);
Benjamin Landis (Indiana University)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7011
Presentation Time: GRIS 133 at 10:40-11:00

Pulse-Flow Reverse Osmosis

STEM
DUIRI

Authors(s):
Taher Mustafa Mukadam† (Engineering); Mackenzie Hathaway* (Engineering|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Ali Naderi Beni (Engineering); David Warsinger (Engineering)

Other Acknowledgement(s):
Sandra Patricia Cordoba Renteria (Engineering)

Talk Presentation Abstract Number: 7012
Presentation Time: GRIS 134 at 10:00-10:20

Determining Regulation of PACT via Phosphorylation in TNBC

STEM
PICR

Authors(s):
Keeley Ann Rohrer† (Agriculture|JMHC)

Abstract:
Triple-negative breast cancer (TNBC) is an aggressive type of breast cancer that lacks targets typical breast cancer therapies utilize. The Cottrell Lab identified PACT (protein activator of the interferon-induced protein kinase) as a potential therapeutic target for TNBC and suppressor of the dsRNA sensing protein, PKR (protein kinase R). In PACT-dependent cell lines, such as most TNBC cell lines, PACT depletion activates PKR. Activation of PKR in this context causes cell death and activation of the integrated stress response and NF-κB pathways. This study sought to understand how PACT is regulated to guide the development of therapies targeting PACT for TNBC. Two serine residues in PACT (S18 and S167) are phosphorylated more frequently than other residues in the protein. S18 is in the intrinsically disordered region (IDR), while S167 is in a dsRNA binding domain. We hypothesized that the phosphorylation of these residues inhibits PACT by disrupting the IDR or dsRNA binding, which is required for PACT to inhibit PKR, thus causing PKR activation and apoptosis. We performed a knockout-rescue experiment using an inducible CRISPR-Cas9 system to deplete endogenous PACT in HCC1806 cells engineered to express an exogenous copy of either a phosphor-null (S18A, S167A) or phosphomimetic (S18D, S167D) mutant of PACT. We performed immunoblot analysis to analyze PACT abundance and PKR activation and utilized CellTiter-Glo and foci formation assays to evaluate cell viability. Expression of each PACT mutant rescued PKR activation observed following endogenous PACT depletion; however, cell viability was not completely rescued in the PACT-S167 mutants. Our future work will include expressing the exogenous PACT mutants at a lower level closer to endogenous PACT, as well as investigating the discrepancy between rescued PKR regulation and reduced cell viability in the PACT-S167 mutant cell lines.

Mentor(s):
Kyle Aaron Cottrell (Agriculture)

Other Acknowledgement(s):
Addison Anton Young (Agriculture)

Talk Presentation Abstract Number: 7013
Presentation Time: GRIS 134 at 10:20-10:40

Investigating substitutions in Hypervariable Region 1 of Hepatitis C virus envelope protein E2 to improve antibody binding

STEM
REU-in-SCBB

Authors(s):
Mei Qi Gordon-Washington† (PWL)

Abstract:
Hepatitis C virus (HCV) is a blood-borne pathogen that is estimated to affect 47 million people worldwide and account for 240,000 deaths annually (World Health Organization). Direct acting antivirals (DAAs) have shown to be effective in treating over 95% of individuals diagnosed with chronic HCV (Center for Disease Control and Prevention). However, due to high rates of early asymptomatic infection, many with HCV develop chronic infections causing cirrhosis and cancer (hepatocellular carcinoma) of the liver. Delayed detection and varying access to treatment indicate that a prophylactic vaccine is essential for lowering rates of HCV infection. The virus' high genetic diversity and structural plasticity are significant obstacles to vaccine design. Broadly neutralizing antibodies (bNAbs) provide a promising solution, by preventing entry of a wide variety of HCV strains into host cells. Some such bNAbs of interest have been named the H200 series. The HCV envelope glycoprotein E2 possesses critical antibody binding sites (epitopes), one of which, Antigenic Region 4 (AR4), is obstructed by an intrinsically disordered domain called hypervariable region 1 (HVR1) located at the N-terminus of the E2 glycoprotein. Our sequence analysis has shown threonine is fully conserved at residue 385 of HVR1, which may facilitate binding of HVR1 with E2. We have designed amino acid substitutions to the conserved residue 385 that interrogate the potential influence of polarity and size in the binding of HVR1 to the bNAb epitope AR4. Through site directed mutagenesis and transfection of HEK293T cells to express envelope proteins E1E2, we experimentally investigate the effect of these substitutions on antibody binding of HCV in relation to the aforementioned H200 series antibodies. This work contributes to ongoing vaccine design efforts by proposing novel substitution designs intended to mitigate the obstructive binding of HVR1 to the AR4 epitope.

Mentor(s):
Ryan George Peters (Science); Richard J Kuhn (Science)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7014
Presentation Time: GRIS 134 at 10:40-11:00

High-Resolution Cellular STA using Ribosome Alignment

STEM
REU-in-SCBB

Authors(s):
Anna Boeva† (PWL)

Abstract:
Subtomogram averaging (STA) is an integral technique when determining high resolution structures of proteins in their native cellular context via cryo-electron tomography (cryo-ET). In situ cryo-ET constitutes taking images of a frozen sample at a series of tilt angles to gather multiple orientations of a particle. To generate a 3D volume or tomogram, these images must be aligned due to beam-induced motion and imperfections of the microscope. Typically, gold beads are introduced in the sample as their high contrast in ET images allows for easy tracking for alignment. After selecting the subvolumes which contain the particle of interest, STA aligns and averages these subvolumes to generate a higher resolution 3D model. However, one key limitation to cellular ET is that thick cells often require focused ion beam milling to get a thin slice of the cell where electrons can pass through and be detected. This results in images that must rely on markers within the cell for alignment, as gold beads do not permeate the cell membrane. We propose the use of ribosomes inside the cell to act as fiducials for aligning the tilt series due to their abundance and clarity in cellular images. Additionally, while there exists a workflow to process cryo-ET data into a final 3D structure, software programs Warp and M provide further capabilities for refinement and improving tilt series alignments upstream. These packages are usually used standalone whereas we want to integrate these capabilities into a workflow that is optimized to process custom cellular data. We present a pipeline to generate a high-resolution structure of a protein in situ. We first preprocess the cryo-ET data using custom MATLAB scripts, generate a 3D model of the ribosomes in the sample which is used to improve the tilt image alignments, then reiterate the workflow to target the protein of interest. This allows for more flexibility and higher resolution structures when processing cellular tomograms.

Mentor(s):
Kristy Rochon (PWL); Samuel Hartzler (Science); Lauren Ann Metskas (Science)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7015
Presentation Time: GRIS 103 at 11:00-11:20

Recovering Behaviorally-Relevant Neural Trajectories from Motor Cortex Using Dynamical and Probabilistic Models

STEM
SURF

Authors(s):
Samridh Tiwari† (Engineering)

Abstract:
When an animal moves, activity spread across many neurons follows a smooth path, called a neural trajectory, through a low-dimensional space. At each moment, this path is shaped by two things: the current internal state of the brain region and the input arriving from other regions or the outside world. Separating these influences matters because it reveals how activity passes from one state to the next, a first step toward a longer-term goal: designing stimulation that could gently push an unhealthy trajectory, such as one seen in a movement disorder, back toward a healthy one while an animal performs a task. We study this using spiking activity recorded from the motor cortex of mice performing an auditory-cued lever-press task across several sessions and subjects. We summarize the population activity as latent factors using two models: Gaussian Process Factor Analysis (GPFA), a linear method that assumes smooth factors, and Latent Factor Analysis via Dynamical Systems (LFADS), a non-linear method built from a recurrent neural network. We compare them on two fronts: how well their factors reconstruct held-out neurons' activity (co-smoothing), and how well they decode behavior (lever position). LFADS reconstructs held-out neural activity substantially better, roughly 2.6x more information per spike, indicating that its learned dynamics capture shared population structure that a smoothness prior misses. On decoding a slow, smooth behavioral variable, the two are comparable, as expected where GPFA's assumptions already fit well; the dynamical model's advantage is concentrated where within-trial temporal structure matters most. Ongoing work extends this across subjects and toward a real-time, hardware-based, causal implementation, a prerequisite for the closed-loop stimulation the approach is ultimately meant to enable.

Mentor(s):
Om Tejas Kolhe (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7016
Presentation Time: GRIS 103 at 11:20-11:40

Ice-Droplet Interaction with Supersonic Shock Waves

STEM
SURF

Authors(s):
Alex Perry† (Engineering); Caleb Jonathan Radtke† (Engineering)

Abstract:
Weather has been a major factor limiting aircraft capabilities. Current aircraft can traverse through a variety of weather conditions, but there is still limited understanding of how small weather particles interact with aircraft at high speeds. At supersonic and hypersonic flight speeds, shock waves form around a vehicle. These shock waves interact with small, high-altitude ice particles, causing particle deformation and breakup. The resultant particulate can then affect the aerodynamic flow, structural integrity, and control of high-speed flight vehicles. This study seeks to develop an understanding of ice breakup by conducting ground tests in the Purdue 3-Inch Shock Tube (P3IST). An acoustic levitation system was used to drop suspended ice particulates into the P3IST, and a Photron SA-Z high-speed camera was used to record the interactions between shock waves and ice particles. Shock arrival times were recorded using PCB fast-pressure fluctuation sensors flush-mounted in the shock tube walls. Pressure data and high-speed Schlieren videos were recorded to measure shock wave velocity and visualize ice particle breakup. At a pressure ratio of 1.2, the experimental Mach number was measured at 1.14, close to the theoretical value of 1.2. This difference was attributed to fluctuations in the pressure ratio across the shock during testing. At the tested conditions, the majority of the ice particle structure remained intact. Understanding this interaction provides useful experimental data to support future modeling of ice particle breakup behavior in supersonic and hypersonic flight environments.

Mentor(s):
Matthew Leight (Engineering); Varun Aggarwal (Engineering); Adam Carson Lay (Engineering)

Other Acknowledgement(s):
Abigayle Elaine Moser (Engineering); Zachary Allen McDaniel (Engineering); Brandon C Chynoweth (Engineering); Joseph S Jewell (Engineering); Siddharth Bhatnagar (Engineering); Chandler J Moy (Engineering)

Talk Presentation Abstract Number: 7017
Presentation Time: GRIS 103 at 11:40-12:00

Building Morphosyntactic Networks for Precision Assessment and Intervention in Preschool-aged Children

Social Science
SURF

Authors(s):
Ronald Liu Tsai† (Liberal Arts|Science)

Abstract:
Developmental language disorder (DLD) is a common yet overlooked condition resulting in difficulty acquiring, understanding, and using language. A key indicator of DLD in preschoolers is the omission of tense and agreement morphemes (TAM), the small word parts that mark when an action happens (e.g., past tense "-ed" as in "I walked") or that match a verb to its subject (e.g., third-person singular "-s" as in "she walks"). However, traditional TAM measures only count these omissions, neglecting potential patterns behind them that could inform more targeted treatment. Network science is a field that represents complex systems, such as social relationships, as interconnected nodes and edges to study their structure and dynamics. Applied to language, it offers a promising alternative to one-dimensional clinical scores by modeling children's mental grammar as an interconnected system of words linked by grammatical relationships. These networks model morphosyntax, the way words change form and position within a sentence, to capture TAM patterns across many sentences simultaneously. This project builds morphosyntactic networks using play-based language samples from 274 preschoolers (n=137 with DLD; n=137 without DLD) to characterize how network structure reflects differences in language ability. Language samples were annotated for grammatical omissions and processed with a linguistic analysis tool to map grammatical relations (edges) between words (nodes) into weighted, directed networks. At a granular level, the networks reveal TAM-linked vulnerabilities in DLD, such as a greater tendency to omit third-person singular "-s" with certain verbs. At a broader level, differences in network structure can help identify weak areas in grammar that may help clinicians decide where to focus treatment. Together, these findings offer a holistic, structure-based assessment of DLD beyond traditional accuracy scores, supporting more individualized clinical interventions.

Mentor(s):
Mariel Schroeder (HHS); Arielle Borovsky (HHS)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Talk Presentation Abstract Number: 7018
Presentation Time: GRIS 118 at 11:00-11:20

Force Generation and Contraction of the Actin Cytoskeleton

STEM
SURF

Authors(s):
Vahin Pichairaj† (Engineering)

Abstract:
Cells generate mechanical forces to move, divide, change shape, and respond to their surroundings during biological processes such as tissue development, wound healing, and disease progression. The forces are generated mainly by the actin cytoskeleton where actin filaments are pulled by myosin II motors and structurally organized by cross-linking proteins. Although interactions between actin filaments and myosin have been studied for recent decades, it still remains elusive how the shape and organization of myosin II motors affect force generation and contraction in the actin cytoskeleton. In this study, we employed an agent-based computational model to investigate how different forms of myosin II motors mediate the mechanical behaviors of actin networks. In the model, actin filaments, motors, and cross-linkers are treated as discrete elements that can bind, diffuse, and generate forces. Two types of networks are simulated: freely contracting networks and fixed-boundary networks. Under various conditions of motors, the contractile behavior of networks is evaluated by measuring strain, contraction velocity, network-level force, and motor energy consumption. These measurements show how strongly the network contracts, how much force it produces, and how effectively motor activity is converted into mechanical output. Our study can provide insights in understanding cell division, tissue repair, and diseases where cell mechanics are disrupted.

Mentor(s):
Tae Yoon Kim (Engineering); Jeffery Robert Coulter (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Talk Presentation Abstract Number: 7019
Presentation Time: GRIS 118 at 11:20-11:40

Designing a Game-Based Learning Platform for Teaching Mathematical Optimization

STEM
SURF

Authors(s):
Huy Bao Huynh† (Engineering)

Abstract:
Mathematical optimization is traditionally taught through formal mathematical models and symbolic notation, despite many of its underlying principles arising naturally in everyday decision-making involving trade-offs, uncertainty, and strategic reasoning. This project develops a web-based educational platform that teaches fundamental optimization concepts through interactive game-based learning. The platform features two instructional modules focused on strategic decision-making against adaptive computer opponents and resource planning under uncertain demand. Students engage in repeated decision-making tasks, receive immediate feedback, and refine their strategies while the system records gameplay metrics—including decisions, performance, progression, and time on task—for subsequent analysis. To support future comparative studies, the platform also includes a matched non-game version that presents the same instructional content through an interactive textbook interface. The platform is designed to support pre- and post-assessments that emphasize transfer by requiring learners to apply optimization concepts to unfamiliar real-world scenarios rather than recalling game-specific details. These capabilities will enable future research comparing learning outcomes between game-based and traditional instruction, as well as examining how students' decision-making strategies evolve during gameplay. The project contributes a deployable, extensible research platform for investigating whether interactive decision-making can improve students' intuition for optimization, trade-offs, uncertainty, and strategic reasoning.

Mentor(s):
Danial Davarnia (Engineering)

Other Acknowledgement(s):
Emily R Jakob (Engineering)

Talk Presentation Abstract Number: 7020
Presentation Time: GRIS 118 at 11:40-12:00

ChemOperator: A Reproducible Simulation Library for Chemical Engineering Operator Learning

STEM
SURF

Authors(s):
Rohan Patel† (Engineering)

Abstract:
Chemical engineering increasingly relies on repeated simulation of reacting systems to explore operating conditions, test control strategies, and quantify uncertainty, yet detailed models can be too expensive for rapid iteration. Machine learning surrogate models can make these predictions faster, but they require large, consistent, and well documented simulation datasets. This project develops ChemOperator, a Python library for generating reusable datasets for machine learning models of chemical systems. ChemOperator organizes each simulation in a structured record containing coordinates, time histories, physical constants, and metadata, making reactor datasets easier to reproduce and reuse. The library currently provides four examples: a continuously stirred tank reactor, a plug flow reactor, a one-dimensional packed-bed catalytic-membrane reactor, and a two-dimensional catalytic-membrane reactor, with additional chemical engineering systems under development. For each example, ChemOperator generates families of simulations with varied initial conditions, operating conditions, reactor parameters, and solver settings. Neural operator models were then trained and benchmarked on these datasets to evaluate how accurately they can predict reactor behavior compared with conventional simulation methods where the governing conservation equations are solved using numerical techniques for ordinary differential equations, differential-algebraic equations, and boundary-value problems. The results show that ChemOperator provides a practical workflow for moving from physics-based simulation to machine learning model training and evaluation across a diverse range of reactor models. This work provides a foundation for more reproducible surrogate-model studies in chemical engineering, with future extensions aimed at richer reactor geometries, physics-informed evaluation, and quantum neural network layers.

Mentor(s):
Sergey Gusev (Engineering); Anja Hribljan (Engineering); David Esteban Bernal Neira (Engineering)

Other Acknowledgement(s):
Waire Olawolu (Engineering)

Talk Presentation Abstract Number: 7021
Presentation Time: GRIS 126 at 11:00-11:20

Neural Network Predictors for Learning General Quantum Systems Environments

STEM

Authors(s):
Chee Ying Tay† (Engineering|Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Pranshu Maan (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7022
Presentation Time: GRIS 126 at 11:20-11:40

Evaluating the Cardiotoxicity of Doxorubicin Using 4D Echocardiology

STEM
PICR

Authors(s):
Helen Yee†

Abstract:
The purpose of this murine study is to utilize 4D echocardiology to measure doxorubicin (DOX) induced cardiotoxicity, a drug commonly used as a chemotherapeutic agent to treat solid tumors and hematologic malignancies. This agent, however, is known to cause heart failure in cancer patients. Our acute study was conducted over 7 days with an experimental group of 11 doxorubicin-treated mice and a control group of 6 saline- administered animals. Baseline images were taken before doxorubicin was administered, and again on days 2 and 7, one before a dobutamine (DB) stress test and then again after. The DB stress test measures how the heart reacts under stress as it causes the heart to contract harder and faster. 4D analysis was done on each ultrasound scan, followed by plotting and statistical analysis. The results showed a significant decrease in cardiac volume of the DOX mice in both the systolic and diastolic phase in addition to left ventricular mass. While there was no statistical significance in ejection fraction and only small differences in global longitudinal and circumferential strain, the heart may be overcompensating for volume loss. These findings can be applied to more clinical settings as these metrics could be used in early detection of myocardial damage before it becomes irreversible. Overall, these findings reveal that during the early stage of doxorubicin-induced cardiotoxicity, volume loss may be more apparent than cardiac function. The drug triggers muscle loss and apoptosis, leading to a measurable loss in ventricular mass.

Mentor(s):
Craig Goergen (Engineering); Benjamin Zeidler (Engineering)

Other Acknowledgement(s):
Ashlyn Marie Felton (Interdisciplinary and Special Programs)

Talk Presentation Abstract Number: 7023
Presentation Time: GRIS 126 at 11:40-12:00

Impact of Varying Wall Temperature on Hypersonic Boundary-Layer Transition

STEM

Authors(s):
Michael Oscar Greenlee† (Engineering)

Abstract:
Hypersonic boundary-layer transition occurs when the boundary layer shifts from laminar to turbulent flow, increasing the skin-friction drag, heating, and aerodynamic loads on the aircraft. This means vehicle performance is directly dependent on the state of the boundary layer.

Transition can be initiated from various instability mechanisms. This research investigates the impact of non-uniform wall temperature distributions on predicted transition location from the second-mode instability on a sharp 7° half-angle cone at Mach 6.5. Calculations were performed with STABL using the Parabolized Stability Equations to predict transition location with N-factor analysis. Historically, N-factor values of 8-11 in quiet tunnels and 4-5 in conventional tunnels can be correlated with the onset of transition [1].

A baseline case with a constant wall temperature of 300 K was used as reference for the study. Using the same grid and parameters, non-uniform wall temperature profiles were then applied, including linear gradients spanning 200-400 K and near-instantaneous jumps spanning 250-350 K. Lower wall temperatures consistently accelerated transition and higher temperatures delayed it, consistent with current literature on wall heating stabilizing second-mode acoustic instability waves. Cases with identical temperatures upstream displayed similar transition locations, independent of temperature gradients aft. Downstream, the temperature jumps produced large variation in N-factor behavior. An instantaneous jump in temperature decreased the maximum N-factor and a temperature drop increased the maximum N-factor.

To confirm the findings, the magnitude of the temperature differences was increased to 600-900 K for select cases. The previously observed trends persisted to a greater extent, supporting the sensitivity of predicted transition location to varying wall temperature profiles. These results will be valuable to calculations that guide future testing in the BAM6QT wind tunnel.

Mentor(s):
Brandon C Chynoweth (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7024
Presentation Time: GRIS 133 at 11:00-11:20

Digital Inline Holographic Particle Tracking Velocimetry for High-Image-Density Particle Erosion Characterization

STEM

Authors(s):
Yi Yang Hsu† (Engineering)

Abstract:
Gas turbine engines are frequently subjected to particle erosion as sand, dust, and other particulates are ingested and strike rapidly rotating aero-surfaces. Precise characterization of these particle flows is critical for effective aircraft maintenance, accurate prediction of engine performance degradation, and the development of advanced erosion-resistant materials and coatings. As compressor technologies evolve, current ground-based testing facilities have struggled to replicate the high temperatures, pressures, speeds, and sustained particle exposure conditions characteristic of modern compressor environments. The Purdue High-speed Automated Sand Erosion Rig (PHASER), currently under construction, is intended to be the first facility capable of acquiring sustained, compressor-relevant particle-flow data at modern compressor discharge temperatures. This study evaluates digital inline holographic particle tracking velocimetry (DIH-PTV), an optical technique that uses lasers to measure particle positions and velocities in three-dimensional space, for dense, high-speed microscopic particle flows such as those in the PHASER project. In contrast to prior research, this work investigates the performance of DIH-PTV in high-image-density particle fields, where interference, reconstruction noise, and particle-tracking ambiguity may limit diagnostic accuracy. Accordingly, small-scale, high-image-density DIH-PTV experiments are conducted in a controlled environment using 60 μm polyamide particles, demonstrating 60-95% agreement with expected particle concentration measurements up to 0.025 g/L. Evaluating these methods at a reduced scale will facilitate future implementation in larger-scale erosion testing facilities. In turn, these diagnostic capabilities will enable future measurements of particle position, velocity, and spatial distribution, support erosion modeling, and inform the design of erosion-resistant materials.

Mentor(s):
Daniel Robert Guildenbecher (Engineering); Amy Chang (Engineering)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7025
Presentation Time: GRIS 133 at 11:20-11:40

Enhancing the Mechanical Reliability of Free-Standing Laser-Induced Graphene through Process and Material Design

STEM

Authors(s):
Elena Paias Ferreira† (Engineering)

Abstract:
Wearable electronics based on Laser-Induced Graphene (LIG) require mechanically robust conductive networks capable of maintaining structural integrity during fabrication, handling, and subsequent integration into soft substrates. However, free-standing LIG remains highly susceptible to crack formation and fracture due to its brittle porous structure, limiting its mechanical reliability before device assembly. This work investigates fabrication strategies to enhance the structural integrity of free-standing LIG through substrate, process, and thickness control. LIG is laser-printed from lignin precursor films while systematically varying feature dimensions, precursor thickness, and processing methodology to evaluate their influence on crack formation and structural uniformity. In addition, a perimeter-cut fabrication approach is explored to alleviate residual stresses generated at the interface between the converted LIG and surrounding lignin film, which are hypothesized to contribute to crack initiation and out-of-plane deformation during laser processing. Optical microscopy is employed to qualitatively assess crack density and morphology, guiding the selection of optimized fabrication conditions. The resulting LIG structures will subsequently be integrated into stretchable substrates for electromechanical characterization, enabling correlations between fabrication parameters, structural integrity, and resistance variation under tensile loading. By establishing processing guidelines for mechanically reliable free-standing LIG, this work provides a foundation for improving the durability and performance of future skin-interfaced wearable electronic devices.

Mentor(s):
Wenzhuo Wu (Engineering); Pedro Henrique de Souza Barbosa (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7026
Presentation Time: GRIS 133 at 11:40-12:00

Design and Noise Characterization of a Low-Noise Voltage Preamplifier for Nanovolt-Scale Measurements

STEM
SURF

Authors(s):
Shashank Varamballi† (Engineering|Science)

Abstract:
Many experiments in condensed matter physics rely on detecting voltage signals only a few

nanovolts in size, roughly a billion times smaller than the voltage of a household battery. Signals

this small are easily buried by electrical noise generated within the measurement electronics

themselves, and commercial instruments often cannot reach the required noise floor. This project

addresses that limitation by designing, building, and testing a voltage amplifier quiet enough to

resolve nanovolt-scale signals, targeting an input-referred noise density of 1 to 1.5 nanovolts per

square root hertz. The amplifier uses a fully differential signal chain built around a matched dual

junction field-effect transistor (JFET) input stage, followed by a difference amplifier and an

output buffer. Precision potentiometers provide fine adjustment of offset and balance between

the two input channels, canceling errors that would otherwise mask the signal. The circuit is

realized on a four-layer printed circuit board with dedicated signal, ground, and power layers to

suppress interference, and guard rings surround the sensitive input nodes to block stray leakage

currents. The board will be assembled by reflow soldering in a controlled-temperature integrated

circuit oven to form reliable joints on the fine-pitch surface-mount components. The completed

amplifier will then be characterized with a spectrum analyzer, measuring its output noise across

frequency to extract the input-referred noise floor and verify gain. This study compares the

measured noise spectra against design targets to identify the dominant noise sources. The

resulting instrument provides a compact, low-drift platform for studying sub-microvolt signals in

noise-sensitive experiments.

Mentor(s):
Leonid P Rokhinson (Science)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Talk Presentation Abstract Number: 7027
Presentation Time: GRIS 134 at 11:00-11:20

Tau-Jet Matching and Tag-and-Probe Tau Tagging Efficiencies for HH→bbτ+τ- Searches Using Run 3 CMS Scouting Data

STEM
USCMS-PURSUE

Authors(s):
Annella Bellot† (PWL); Qianyue Chen* (PWL)

Abstract:
We are studying tau-jet matching efficiency and tau tagging efficiency for the search for Higgs boson pair production in the HH→bbτ+τ− decay channel using Run 3 CMS scouting data. Collision events in the CMS detector produce many particle candidates, so jets are clustered using the anti-kT algorithm to identify possible tau signatures. In Monte Carlo simulation, tau-jet matching efficiency can be measured by comparing generated taus to reconstructed jets. In actual collision data, however, generated taus are not available, so we use a tag-and-probe method with Z→τ+τ− candidate events. In this method, one tau candidate is used as the tag and the other as the probe. The invariant mass of the tau-pair candidates is plotted and fitted with signal and background functions to estimate the number of real tau events and determine the tagging efficiency. By comparing efficiencies in data and Monte Carlo simulation, this work helps evaluate the performance of scouting-based tau reconstruction and tau tagging for future HH→bbτ+τ− searches.

Mentor(s):
Jan-Frederik Schulte (Science); Yao Yao (Science)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7028
Presentation Time: GRIS 134 at 11:20-11:40

Inert-Atmosphere Assembly of Encapsulated Air-Sensitive vdW Heterostructures with Machine-Learning Layer Identification

STEM

Authors(s):
Manaswini Singh† (Science); Priya Mishra‡ (Science); Sagarika Menon‡ (Science)

Abstract:
Two-dimensional (2D) materials and their van der Waals (vdW) heterostructures host

diverse condensed matter phenomena, yet many of the most compelling systems,

particularly reactive transition-metal dichalcogenides and related 2D crystals, degrade

rapidly in air. Fully exploiting these materials requires that every fabrication step, from

exfoliation to characterization, be carried out in a controlled inert environment. In this

work, we present an integrated, machine-learning-enabled stacking platform that brings

the complete fabrication process inside the glovebox.

Our approach spans the full fabrication chain. Following mechanical exfoliation, a

motorized microscope automatically scans the wafer and captures optical images across

its surface, which a Gaussian mixture model then analyzes to locate flakes and classify

their thickness from optical contrast, replacing the slow and subjective manual search.

Selected flakes are assembled on a motorized, automated stacking stage integrated into

the glovebox using transfer methods such as a polyvinyl chloride (PVC) stamp. Each device

is built as a fully encapsulated stack, in which thick hexagonal boron nitride (hBN) layers

enclose the air-sensitive sample together with graphene and graphene local gates

patterned by local anodic oxidation (LAO), keeping it protected until the hBN is pulled to

access the sample for further measurements. Completed stacks are then characterized by

atomic force microscopy (AFM) inside the glovebox, without air exposure, to assess surface

topography, interfacial cleanliness, and step heights. A vacuum suitcase can transfer

samples and completed devices in and out of the glovebox without breaking the inert

environment, extending the workflow to external instruments.

By combining automated optical characterization with nanoscale fabrication under inert

conditions, this platform offers an efficient, scalable route to

heterostructures from air-sensitive 2D materials.

Mentor(s):
Tiancong Zhu (Science)

Other Acknowledgement(s):
Kyung Jun Lee (Science); Christopher Antonio Ulate (Science)

Talk Presentation Abstract Number: 7029
Presentation Time: GRIS 134 at 11:40-12:00

Molecular thresholds for activation and fratricide by anti-B7-H3 CAR T cells

STEM

Authors(s):
Nicole Shashurin† (Science)

Abstract:
Chimeric antigen receptor (CAR) T cells have emerged as a potent therapy for refractory blood cancers by redirecting native T cell cytotoxicity toward tumor destruction. Expression of exogenous engineered receptors enables targeting toward specific, typically overexpressed tumor markers. Upon CAR triggering and downstream activation, the release of toxic payloads damage target cancer cells and may induce apoptosis. Despite the potential for this therapy, its general application has been hampered by the lack of a mechanistic understanding about the parameters that control activation and killing outcomes. An emerging target for CAR T cells is B7-H3, an immune checkpoint biomarker that could expand CAR T cell therapies toward solid tumors, which have been elusive targets. Despite exciting preliminary potency, there is an unexpected obstacle given the inevitable expression of B7-H3 on activated CAR T cells. Thus, initial responses can result in diminished CAR T cell activity due to self-destruction via fratricide (‘brother killing brother’). Here, we test a panel of anti-B7-H3 CAR T cells to measure their thresholds for activation against pancreatic tumor cell lines and the development of fratricide over time. We use live cell microscopy-based approaches to observe in vitro CAR T cell:target cell interactions over time. These studies will build on our mechanistic, biophysical measurements that show killing outcomes are dominated by a subset of the CAR T cell population and that their activation occurs with only a small handful of CAR binding events. We expect to understand key mechanistic features of the most potent CAR T cells as a function of B7-H3 on both the tumor lines and CAR T cells.

Mentor(s):
Shalini T Low-Nam (Science)

Other Acknowledgement(s):
Sreetama Pal (Pharmacy|Science); Pradip Bajgain (Vet Med); Brendan Ball (Vet Med)

Talk Presentation Abstract Number: 7030
Presentation Time: GRIS 103 at 12:00-12:20

Semantic Processing and Early Language Learning (SPELL)

Humanities
SURF

Authors(s):
Changyeol Im† (Science)

Abstract:
During the first few years of life, children learn hundreds of words. One way to characterize this vocabulary growth is using semantic networks, which are networks linking words by shared meaning. However, children with Developmental Language Disorder (DLD) exhibit a sparser semantic network compared to typically developing children. This study aims to find the predominant pattern of how toddlers expand their semantic networks. Children aged 18-27 months are recruited into this longitudinal study. First, parents fill out a report of which words their child can already say. We merge that information with a database that contains semantic features for those words (e.g., for airplane: has_wings, used_for_travel). We then create a network graph and assign a score that evaluates how well each unknown word is connected across the entire set of known words. We build our metric for the evaluation based on two different sets of feature types: 1) perceptual features, which describe the word's sensory details (e.g., airplane: has_wings), and 2) functional features, which describe the word's practical use (e.g., airplane: used_for_travel). We generate a list of 8 top-scoring unknown words for each feature and randomly assign participants into the perceptual or functional group. We will provide the parents and children with individually tailored lists of words their child has yet to learn and aim to see whether children learn words from the perceptual or functional group faster over the course of a month. We anticipate the findings from the study will improve our understanding of language acquisition methods for toddlers with and without DLD.

Mentor(s):
Paris Gappmayr (HHS)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Talk Presentation Abstract Number: 7031
Presentation Time: GRIS 103 at 12:20-12:40

A Market-Driven Framework for Neutron Detection: Aligning Detector Technologies with Emerging Nuclear Applications

STEM
SURF

Authors(s):
Lucas K Philip† (Engineering); Samuel B Angus* (Engineering); Cory Berlin Stephenson* (Engineering)

Abstract:
Neutron detection is a foundational capability across fusion energy, fission, nuclear safeguards, national security, industrial imaging, medical therapy, and space exploration. Despite their importance, neutron detector technologies are often evaluated independently rather than within the context of their intended applications. This disconnect makes it difficult to identify which detector architectures are best suited for emerging nuclear technologies, particularly as commercial fusion, advanced fission, and national security applications increasingly demand capabilities beyond those of conventional neutron detectors. To address this challenge, this work develops a comprehensive market-driven framework that links detector physics to the operational demands of modern neutron measurement systems. An extensive review of historical and emerging neutron detector technologies—including gas-filled, scintillation, semiconductor, and diamond-based detectors—was performed alongside an analysis of the performance requirements across major application domains. Detector architectures were evaluated by their spatial resolution, temporal resolution, spectral response, gamma discrimination, environmental robustness, form factor, scalability, and cost. To complement the literature, the framework was further informed through discussions with stakeholders spanning commercial fusion companies, fission developers, national laboratories, defense organizations, and government agencies. Concurrently, our group is developing next-generation semiconductor neutron detectors to address many of the performance limitations identified through this analysis. The resulting framework demonstrates that detector selection is fundamentally dictated by the unique technical constraints of each market. This work provides a system-level roadmap for aligning future neutron detector development with the rapidly expanding demands of nuclear energy, national security, medicine, and scientific research.

Mentor(s):
Joseph F Pekny (Engineering); Parker Haven LaTour (Engineering)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Talk Presentation Abstract Number: 7032
Presentation Time: GRIS 103 at 12:40-1:00

Compact Single-Shot Ranging, Locating and Multi-Scale Imaging Using Metasurfaces

STEM
SURF

Authors(s):
Roy Liu† (Engineering)

Abstract:
Autonomous Underwater Vehicles (AUVs) are crucial for monitoring and analyzing the change in the ecosystem within the ocean, ranging from microscopic organisms to larger marine structures. Currently, many AUVs are equipped with cameras for these tasks. However, capturing both micro and macro scale targets require multiple cameras with different focal lengths or multiple working distances, leading to constraints such as power consumption, complexity, and size. Our research aims to address these limitations by developing a compact imaging system based on a hybrid metasurface–refractive optical architecture that allows simultaneous-capturing of both close-range and far-range scenes in a single snapshot by multiplexing multiple sub-images on a shared photosensor. The first stage is simulating how the position and distance between the captured point-spread functions (PSFs) change as we move the location of the point source. Using the data collected, we constructed a backward-warping pipeline based on the Brown-Conrady distortion model to characterize the relationship between the sensor and the PSF, creating a mapping between the geometric space and the photosensor plane. We achieved a working window of 2.5mm for lateral movement, and a working range from 11mm to 51mm with a mean-squared error of 0.23mm. Next, we will calibrate our Depth from Differential Defocus (DfDD) algorithm using images captured at known depths to reinforce the depth prediction made by our ML model. We expect an increase in the confidence of our depth predictions with the addition of the DfDD algorithm. The next phase of our research is to test our imaging system under simulated underwater environments to ensure our system works for its intended application. This research addresses the challenges in developing low-power and compact AUVs by proposing a compact imaging system that leverages a DfDD algorithm reinforced by geometric distortion model for real-time concurrent multi-scale observation.

Mentor(s):
Qi Guo (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Talk Presentation Abstract Number: 7033
Presentation Time: GRIS 118 at 12:00-12:20

Sustainable Manufacturing of Aerospace Composite Structures using High-performing Bio-based Epoxy Systems

STEM
SURF

Authors(s):
Luis Mariano Avalos Campa† (Science)

Abstract:
Abstract: Carbon fiber reinforced polymer (CFRP) composites, consisting of strong fibers embedded in a polymer matrix, are widely used in aerospace due to their exceptional strength-to-weight ratios. However, traditional CFRPs rely on petroleum-based epoxies, which contribute to microplastic pollution and resist natural degradation. While sustainable adhesives exist, most lack the strength and industrial scalability required for commercialization. Addressing this critical gap, this research evaluates a novel, fully bio-based thermosetting epoxy, inspired by the marine mussel and derived from naturally abundant feedstocks. This carbon-negative resin offers performance, cost, and scalability comparable to current commercial standards. To verify its performance in structural applications, the bio-based adhesive was utilized to fabricate a 6.8 kg carbon fiber unmanned aerial vehicle (UAV). Fuselage, wing, and empennage structures were aerodynamically optimized via computer-aided design (CAD) and computational fluid dynamics (CFD). Structural components were manufactured through the wet lay-up, vacuum bagging, and oven curing processes. Mechanical testing of experimental coupons, subjected to a curing cycle of 115°C for 18 hours, confirmed that the bio-based epoxy effectively impregnates the selected 3K twill-weave carbon fabric. Resulting laminates were tested for their tensile strength for direct comparison with standard epoxy composites. Furthermore, full-scale component manufacturing validated the resin's compatibility with advanced industrial manufacturing techniques, such as mold fabrication, debulking, and lightweight construction. Ultimately, the successful integration of this high-performance, sustainably sourced adhesive provides a scalable, industrial pathway toward environmentally responsible composite manufacturing for next-generation aerospace structures.

Mentor(s):
Isabelle Schaekel (Science); Jonathan J Wilker (Science)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Talk Presentation Abstract Number: 7034
Presentation Time: GRIS 118 at 12:20-12:40

Machine Learning for Fast Decision Generation in Engineering Optimization

STEM
SURF

Authors(s):
Samuel Kinstlinger† (Engineering)

Abstract:
Many engineering, logistics, energy, and scheduling problems can be modeled as decision problems with a linear objective and constraints, along with variables that may be continuous, like production levels, or discrete, like whole-number or on/off choices. These problems, known as mixed-integer linear programs (MILPs), are useful for encoding real engineering constraints but can be slow because standard optimization algorithms, called solvers, must search over many combinations of discrete decisions. Recent machine learning methods try to speed up this process by learning patterns from previously solved MILPs, such as which variables or solution regions are promising, but many still rely on a solver to repair, complete, or improve the learned prediction. This solver dependence can undermine the main advantages of learning-based methods by adding solver runtime and software requirements back into the pipeline, while also making the approach harder to use in gradient-based decision systems because the solver's discrete search steps are not easily differentiable. To address these issues, we propose a solver-free generator for MILP decision problems that learns a joint probability distribution over coordinated candidate solutions using the objective, constraints, variable types, and a fast approximation that allows discrete variables to take fractional values. Using solver-collected reference solutions, we train and evaluate the method on benchmark MILP families from packing items under capacity limits, matching resources to tasks, assigning workloads, and scheduling power generators. We compare feasibility rate, percent objective gap, and runtime. Early results show improved time-matched solution quality compared with solver-dependent learned methods, supporting fast, differentiable decision generation for large-scale engineering systems. Future work will focus on improving feasibility across harder MILP families and testing whether solver-free candidate generation can

Mentor(s):
Shraman Pal (Engineering); Can Li (Engineering)

Other Acknowledgement(s):
Waire Olawolu (Engineering)

Talk Presentation Abstract Number: 7035
Presentation Time: GRIS 118 at 12:40-1:00

Cellulose Nanocrystals as a Biotemplate for Gold Nanomaterial Synthesis

STEM
SURF

Authors(s):
Raina Wang† (Engineering); Halaya Vann‡ (Engineering)

Abstract:
Cellulose is a major component of products such as textiles, packaging, and other plant-based materials that contribute significantly to global landfill waste. This abundance of waste cellulose may be utilized to meet growing demands for gold nanorods in biomedicine and energy. Due to its rigid and linear shape, cellulose is a desirable biotemplate to increase the specific surface area of metallic nanoparticles, which improve their performance in catalysis and drug delivery applications. This project aims to repurpose cellulose as a template to synthesize gold nanorods, which can be applied towards catalysis and drug delivery. Cellulose nanocrystals (CNC), gold precursor (tetrachloroauric acid), and aqueous solution of various pH levels were prepared and reacted using hydrochloric acid, ammonium hydroxide, and deionized water. Dimethylamine borane (DMAB) was then used to reduce the gold ions in solution to metallic gold. Transmission Electron Microscope (TEM), Inductively Coupled Plasma (ICP), Ultraviolet–visible (UV-vis) spectroscopy and zeta potential characterization will be used to confirm reduction and identify CNC coating continuity, adsorption rates, and adsorption mechanisms. UV-vis spectroscopy of the nanorods after the addition of DMAB aligned with that of metallic gold, confirming reduction of gold ions to metallic gold. Preliminary TEM imaging indicates that synthesis at higher pH values optimized gold precursor adsorption and continuous coating on CNC. Overall, cellulose nanocrystals have been confirmed as a viable biotemplate, and the conditions derived provide a scalable method for improved continuous gold nanorod synthesis. Further improvements look to reduce the proportion of free nanoparticles to synthesized nanorods.

Mentor(s):
Chao-Hsiang Chang (Engineering); Michael T Harris (Engineering)

Other Acknowledgement(s):
Waire Olawolu (Engineering)

Talk Presentation Abstract Number: 7036
Presentation Time: GRIS 126 at 12:00-12:20

Review of Current Nursing Practice Regarding Phosphate Replacement Therapy Administration in an Intensive Care Environment

STEM

Authors(s):
Caihla Timbang† (Pharmacy|JMHC)

Abstract:
Introduction/Background

Hypophosphatemia is a common complication addressed by St. Bartholomew Hospital (SBH) Adult Critical Care Unit (ACCU) nursing staff. Despite being prescribed as an “as needed” medication, there is a lack of Trust-wide guidelines to direct administration of phosphate replacement.

Objective:

To identify current nursing practices regarding phosphate replacement therapy and support the development of an evidence-based treatment guideline.

Methods

An #-question MS Forms® survey was emailed to 200 SBH ACCU nurses from 1/6/2026 to 15/6/2026 to assess hypophosphatemia practices. Questions assessed definitions of mild, moderate, and severe hypophosphatemia, treatment approach, worrisome symptoms and barriers to administration. Descriptive statistics were used to assess current nursing practice.

Results/Outcomes

The survey response rate was 13.5% (n=27). On average, 30% of participants overestimated mild, moderate, and severe hypophosphatemia. 67% of participants (n=18) target a phosphate level of 1.0-1.19 mmol/L after administration, whereas 30% (n=8) target >0.8 mmol/L. Arrhythmias (n=24), altered mental status (n=16), and rhabdomyolysis (n=14) were the most worrisome symptoms identified. Participants unanimously identified use of IV therapy in symptomatic patients (mild, 85.6%; moderate, 96.3%; severe, 100%). Greater

variation was observed regarding oral phosphate use in asymptomatic patients (mild, 92.6%; moderate; 44.4%). The key barriers when administering oral phosphate were nausea/vomiting (n=22), unsafe swallow/no viable enteral route available (n=22), and lack of/little enteral absorption (n=22).

Conclusion/Discussion

ACCU nursing staff err on the side of caution regarding phosphate replacement therapy identifying higher treatment levels than neighbouring Trust guidelines. Results demonstrate an opportunity for education, given the lack of consistency regarding hypophosphatemia treatment practices.

Mentor(s):
Ellen M Schellhase (Pharmacy); Monica Miller (Pharmacy)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7037
Presentation Time: GRIS 126 at 12:20-12:40

"Structural Characterization of N-terminally ubiquitinated BAP1 in complex with Ub-VME"

STEM
REU-in-SCBB

Authors(s):
Donovan Dewitt† (PWL)

Abstract:
BRCA-associated protein 1 (BAP1) is a deubiquitinating enzyme (DUB) that cleaves the post-translational modification of ubiquitin (Ub) on histones during chromatin remodeling through binding to ASXL1. This process is essential in cell fate decisions and gene expression, implicating BAP1 in many cancers. An allosteric activation mechanism of BAP1 was recently described, where C-terminal ubiquitination of the ASXL1 DEUBAD enhances BAP1 activity. Our work suggests a convergent mechanism in UCHL5, a homolog of BAP1 with 44% sequence identity, in which catalytic activity is enhanced by an N-terminal Ub tag. Consistent with this model, a single-concentration Ub-rhodamine 110 assay demonstrated that tagged BAP1 (Ub-BAP1) exhibits approximately a threefold increase in catalytic efficiency compared to the unmodified enzyme. These findings collectively highlight the significance of regulatory mechanisms mediated by ubiquitin binding, suggesting that specific Ub tagging may serve as a mode of enzyme regulation. We seek to uncover the structural basis of Ub-BAP1 activation, providing insights into its allosteric mechanism of regulation for DUB activity. To capture the substrate-bound form of Ub-BAP1, we have leveraged a vinyl methyl ester (Ub-VME) activity probe covalently bonded to Ub-BAP1. In the present study, we have purified the catalytic domain of Ub-BAP1 in complex with Ub-VME for structure determination using x-ray crystallography. VME selection was guided by a clear preference over other inhibitors. Ub-BAP1 was purified by GST affinity chromatography, reacted with Ub-VME at a 1:2 molar ratio to generate the complex, and then isolated by size-exclusion chromatography (SEC). Crystallization attempts were set up using a hanging drop at a 1:1 drop ratio and will inform the optimization of future studies. This platform has provided proof of concept for using Ub probes in complex with Ub-BAP1 for obtaining a crystal structure.

Mentor(s):
Abigail Marie Wight (Science); Nipuni Maleesha Pannala (Science); Chittaranjan Das (Science)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7038
Presentation Time: GRIS 126 at 12:40-1:00

Comparing B-Factors and Local Resolution as Metrics of Cryo-EM Protein Structure Quality

STEM
REU-in-SCBB

Authors(s):
Jalynn Somerville† (PWL); Angel Ortiz‡ (PWL)

Abstract:
Protein structures are essential for understanding how biological molecules function, interact, and contribute to disease. Structural databases such as the Protein Data Bank and Electron Microscopy Data Bank provide access to protein models and cryo-EM density maps, but interpreting their quality requires careful use of validation metrics. B-factors commonly describe atomic displacement or uncertainty, while local resolution estimates describe how well cryo-EM map regions are resolved. The relationship between these two measures is not always clear, especially in cryo-EM structures where model quality may vary by region. This project examines the relationship between B-factors and local resolution in cryo-EM protein structures. The goal is to determine whether these quality metrics show consistent patterns across deposited protein models and associated cryo-EM maps. Computational methods were used to compare atomic B-factors from structures with local resolution values from corresponding cryo-EM density maps. Local resolution values were mapped onto atomic coordinates, averaged by residue, and compared with B-factors using correlation analysis. Preliminary results suggest a potential correlation between B-factors and local resolution, although the strength and consistency of the relationship may vary depending on protein region and deposited structure quality. These findings indicate that B-factors may provide useful information about structural reliability, but should not be used as a direct replacement for local resolution. Instead, the two metrics may be most informative when analyzed together. Overall, this work supports an integrated approach to evaluating cryo-EM protein structure quality. By comparing model- and map-based measures, this project may help improve how researchers interpret structural uncertainty in cryo-EM models. Future work will expand this analysis to additional structure quality metrics to determine whether the observed relationship holds.

Mentor(s):
Ramaswamy Subramanian (Engineering|Science); Trung T. Thach (Agriculture)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7039
Presentation Time: GRIS 133 at 12:00-12:20

Controlled Assembly of Amphiphilic Janus Particles in Polymer Matrix for Novel 3D Printing Applications In Space

STEM
UREP-C or UREP-LA

Authors(s):
Kevin Santiago Pineda Rojas† (PWL); Aryan Dayal‡ (Engineering); Nicholas Joseph Ostendorf‡ (Engineering)

Abstract:
Severe service conditions in space environments present significant materials design challenges, for which particle-reinforced polymers offer a promising mitigation strategy. This study investigates the directed assembly of metallodielectric (SiO2/Pt) Janus particles suspended in UV-crosslinkable monomer to fabricate structurally tailored composites. By exposing this suspension to an alternating current (AC) electric field, dielectrophoretic forces drive the spatial arrangement of the particles. We demonstrate that the resulting microstructures can be tuned, yielding distinct morphological assemblies ranging from isotropic dispersions to highly aligned, one-dimensional chains by modulating the applied frequency and voltage. These field-directed Janus particle assemblies provide a foundational framework for engineering advanced, anisotropic composites with highly specific localized properties for aerospace applications.

Mentor(s):
Carlos J Martinez (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7040
Presentation Time: GRIS 133 at 12:20-12:40

Buildup, Instrumentation, and Optical Diagnostics for the Purdue High-speed Automated Sand Erosion Rig (PHASER)

STEM
SURF

Authors(s):
Justin Babilino† (Engineering|JMHC)

Abstract:
Purdue University is constructing the High-speed Automated Sand Erosion Rig (PHASER) at Zucrow Labs to perform solid particle erosion (SPE) testing on aircraft engine compressor materials. SPE occurs when small particles like sand or dust are ingested into aircraft engines and impact internal solid surfaces, causing permanent damage. PHASER is a wind tunnel that suspends solid particles in the flow and provides optical diagnostic tools to characterize the flow and identify erosive damage. To prepare PHASER for full-scale testing, recent efforts have included buildup, instrumentation, and control of the fluid systems and sand feeder alongside preparation of optical diagnostic techniques to measure particle speed, concentration, and impact damage. A prototype stereo imaging setup was built to track single-particle erosive impacts in 3D space. A calibration procedure using MATLAB and LabVIEW was developed, which is designed to be scaled up to a high-speed camera setup. While high-speed single-particle impacts with stereo imaging will be used to study the fundamental erosion mechanics, the results from PHASER testing will be used to study the realistic high rate of particle impacts representative of aircraft engine SPE. Other tasks include setup of digital in-line holography (DIH) optical flow diagnostics and a LabVIEW control panel for the valves and actuators on the rig. The results of these tasks will help correlate the flow conditions of PHASER with the corresponding damage to raw materials and engine components, enabling accurate modeling of SPE. These results can be used to design and maintain safer, more resilient aircraft engines.

Mentor(s):
Amy Chang (Engineering); Daniel Robert Guildenbecher (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Talk Presentation Abstract Number: 7041
Presentation Time: GRIS 133 at 12:40-1:00

Photoelastic Gel Pad for Vision-Based Tactile Sensing

STEM
SURF

Authors(s):
Samuel Timothy Bibeau† (Engineering)

Abstract:
Dexterous manipulation, a subfield of robotics in which multiple coordinated fingers are used to interact with objects, relies heavily on tactile information. Existing tactile sensors are limited in their ability to extract task-relevant information as many rely on inferring data from only the surface deformation of flexible materials during contact, which often requires complex assembly procedures and limited spatial resolutions. This research presents PhoTac Wedge, a compact vision-based tactile sensor which overcomes these limitations by observing the internal mechanical stress of a deformable material directly. Initial research focused on prototyping a gel pad made from a transparent, photoelastic elastomer which refracts polarized light differently depending on the direction of applied stress. Subsequently, optical responses from this elastomer gel pad were integrated with an end-to-end robotic learning algorithm which eliminates the need for reconstructing forces or contact maps. Mounted to a parallel-jaw gripper on a robotic arm, the PhoTac Wedge sensor demonstrated its effectiveness across several manipulation tasks including precision gear assembly, tactile object sorting, snap-fit clip disassembly, and sustained valve twisting. Across these tasks, the average success rate improves from 60% when using only visual data to 83% when incorporating tactile observations. Additionally, PhoTac Wedge was evaluated alongside representative deformation based vision-based tactile sensors, with experimental results demonstrating its ability to provide robust tactile feedback while maintaining a simple, low cost design.

Mentor(s):
Yu She (Engineering); Md Rakibul Islam Prince (Engineering)

Other Acknowledgement(s):
Monish Mahesh Lokhande (Engineering)

Talk Presentation Abstract Number: 7042
Presentation Time: GRIS 134 at 12:00-12:20

A Non-Invasive Acoustic Sensing System for Sleep Bruxism Screening

STEM

Authors(s):
Aaruni Singh† (Engineering)

Abstract:
Sleep bruxism (teeth grinding and clenching) is a common condition that can lead to significant dental damage, insufficient sleep, and long-term health issues. Despite the relevance of this complication, reliable detection requires specialized clinical equipment and overnight lab stays, leaving many individuals unaware of their symptoms without proper testing. This project proposes the design and prototyping of a low-power, non-invasive acoustic sensing system for preliminary oral disorder screening using off-the-shelf components. Rather than relying on contact-based methods such as electromyography (EMG), which requires precise electrode placement and direct skin contact, this research expands on existing bruxism and sleep-disorder detection research by introducing an audio-based sensing approach using an earable device to capture characteristic acoustic signatures of grinding, clenching, snoring, and breathing irregularities. An acoustic solution offers improved user comfort, reduced setup complexity, and greater practicality for prolonged at-home monitoring. Signal processing techniques are integrated to distinguish relevant oral and respiratory events from background noise and typical sleep sounds. The system architecture focuses on low power consumption to allow for extended overnight use while maintaining practical performance. Although not intended to immediately replace comprehensive clinical diagnostics like polysomnography (PSG), the proposed prototype demonstrates the feasibility of minimally intrusive acoustic sensing as an accessible, scalable, and cost-effective tool for early-stage screening of the sleep oral disorder. With sufficient testing and development, this system could reduce reliance on expensive and complex laboratory-based evaluations, improving access to preventative dental health care.

Mentor(s):
Saeed Mohammadi (Engineering); Babak Ziaie (Engineering)

Other Acknowledgement(s):
Archana Dharanipragada (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7043
Presentation Time: GRIS 134 at 12:20-12:40

Evaluation of Control Strategies for Drone Path Tracking and Cooperative Multi-Agent Exploration of Indoor Environments

STEM

Authors(s):
Ediz Guzey† (PWL)

Abstract:
Unmanned aerial vehicles (UAVs) are increasingly utilized in agriculture, military operations, transportation, infrastructure inspection, and environmental conservation. Although UAV technology has advanced over the past decade, control systems for individual drones and coordination systems for teams of drones remain key areas of research. Building on previous work involving curvature-based velocity control of drones in a simulated racing environment, this study experimentally evaluates control strategies for simulated quadrotors in a high-fidelity simulation platform at two scales: a single drone tracking a planned path and a four-drone team exploring an unknown maze. For single-drone tracking, an A* algorithm was used to generate the shortest possible grid path through a maze. A family of eight controllers (pure pursuit on the raw path, pure pursuit on the Catmull-Rom cubic and quintic spline smoothings, direct cubic and quintic spline following, and three corner-aware, adaptive speed scheduling methods) was tested under both MaxDOF and ForwardOnly flight modes. A 220-configuration sweep (660 runs) measured lap time, cross-track error, wall clearance, and altitude stability. Adaptive velocity controllers, which fly straight sections at fast speeds and slow down for turns, had some of the fastest reliable lap times. The same principles were then applied at a multi-agent scale using decentralized exploration, shared frontier allocation with dynamic task reassignment, and local collision avoidance. The swarm achieved full coverage of mazes by distributing exploration workload and more efficiently navigating loopier, braided mazes, in which drones exhibited reduced backtracking behavior. The findings of this ongoing research will contribute to a larger study on multi-agent navigation and exploration.

Mentor(s):
Shreyas Sundaram (Engineering); Younggil Chang (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7044
Presentation Time: GRIS 134 at 12:40-1:00

Comparison of scanning electron microscopy and histological observations of human aorta tissue

STEM

Authors(s):
Bea Olivia Cabot† (HHS|Science)

Abstract:
Aortic vessel structure is known to change with aortic diseases, including aneurysms. Thorough characterization of these changes can allow for better risk assessment. Histology is commonly used to qualitatively and quantitatively review biological tissues at a cellular level. Histology typically involves staining tissues in order to differentiate between cell types and extracellular materials, such as collagen and elastin. Scanning electron microscopy (SEM) is an imaging technique which uses an electron beam to scan the surface of a tissue, producing a high-resolution image of the surface. SEM uniquely allows for detailed visualization of tissue topography. The objective of this project is to design a protocol for effectively collecting SEM images of human aorta tissue, with the purpose of using SEM in conjunction with histological analysis to better understand tissue structure. A collection of both healthy and diseased pediatric human aorta samples were provided by a collaborator from a collaborative repository. Data collected from these samples has the potential to improve understanding of pediatric aortic disease. Cross-sections (2-5 mm) of tissue samples were either processed and paraffin-embedded for histology, or dehydrated using a progressive series of ethanol and hexamethyldisilazane. Following dehydration, samples being prepared for SEM were sputter coated with gold palladium. The process of collecting SEM images involves locating a region of interest, adjusting working distance and scanning speed in order to improve resolution, and then setting magnification to the desired level. At high magnification, SEM images allow for a clear view of tissue differences between layers of the aorta, specifically between the adventitia and media. Red blood cells are also visible in some images. Further work will include extended comparisons between damaged and healthy tissues, as well as analysis on more regions of tissue samples.

Mentor(s):
Shubh Parag Mehta (Engineering); Cortland Hannah Johns

(Engineering); Craig Goergen (Engineering); Benjamin Landis (Indiana University)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7045
Presentation Time: GRIS 103 at 1:00-1:20

Enhancing Tennis Racket Feel Through Multi-Material Additive Manufacturing of Handle Pallets

STEM
SURF

Authors(s):
Drake R Augustine† (Engineering); Kyle Landon Friedrich‡ (Engineering); Megan Rose Magee‡ (Engineering)

Abstract:
The handle pallet of a tennis racket, located beneath the grip and over the frame, influences how impact vibrations are transmitted to the player, making it a promising component for optimization through additive manufacturing. Among a set of chopped fiber-reinforced polylactic acid (PLA) composite filaments evaluated, wood-filled PLA (PLA-Wood) exhibited the best balance of stiffness and vibration damping. This motivated the investigation of whether a multi-material design could further improve racket vibration behavior while maintaining the stiffness required for play. A lightweight multi-material handle pallet was fabricated using fused deposition modeling by combining PLA-Wood with thermoplastic polyurethane (TPU). Experimental modal analysis (EMA) was performed on both material specimens and tennis rackets with full pallets attached. Material testing characterized the vibration response of the multi-material design, while full-racket testing evaluated how the handle pallet influenced vibration transmission and Shock Ratio distribution across the entire string bed. Frequency response functions were analyzed in MATLAB to compare the original and multi-material handle pallets. Although TPU exhibited the highest material damping, it required combination with PLA-Wood to provide sufficient rigidity when gripped by an athlete. The multi-material pallet maintained a damping ratio comparable to the original pallet while reducing Shock Ratio across the string bed and exhibiting an enlarged sweet spot. These findings demonstrate that multi-material additive manufacturing can improve racket vibration behavior and establish a foundation for optimizing future material combinations, print architectures, and handle pallet designs to further improve player feel.

Mentor(s):
Jan-Anders E Mansson (Engineering); Adeline Nora Ripberger (Engineering)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

Talk Presentation Abstract Number: 7046
Presentation Time: GRIS 103 at 1:20-1:40

Risk Exposure of U.S. Industry Sectors to Oil Price Shocks

Business Case Study
SURF

Authors(s):
Santiago Melo Munoz† (Engineering)

Abstract:
Nearly one-fifth of the world's oil passes through the Strait of Hormuz, making geopolitical disruptions capable of increasing global oil prices within days. Although most U.S. manufacturers do not purchase crude oil directly, they are affected through higher transportation costs and petroleum-based material inputs. Understanding how oil price shocks propagate through these channels is important for estimating industry cost exposure.

This study estimates how changes in crude oil prices affect nineteen U.S. manufacturing industries. Using monthly U.S. government data from 2004–2026, regression models estimate the dynamic relationships between Brent crude prices, diesel prices, trucking freight rates, and refined petroleum products. Industry input-output tables are then used to translate these price changes into industry-specific cost impacts. Model robustness is evaluated by re-estimating without the major oil price shocks of 2008, 2014, and 2022, and uncertainty is quantified using 3,000 bootstrap resamples.

The estimated relationships are stable, outperforming naïve forecasting benchmarks in 23 of 24 comparisons, with approximately 90% of the total price adjustment occurring within three months. Under a sustained 25% increase in Brent crude prices, primary metals and food and beverage manufacturing exhibit the greatest exposure, with the most affected industry incurring approximately $2.4 million in additional annual costs per $500 million of demand.

The resulting decision-support tool enables users to evaluate alternative Brent crude price scenarios and estimate firm-specific cost exposure using company-specific information such as freight contracts, regional operations, and petroleum-based material usage. The framework provides a practical approach for supporting procurement, budgeting, and supply chain resilience decisions under volatile energy markets.

Mentor(s):
Stephan Robert Biller (DSB|Engineering); Steven R Dunlop (DSB)

Other Acknowledgement(s):
Dutt Jagdish Thakkar (DSB); Jorge Enrique Neira Garcia (Engineering)

Talk Presentation Abstract Number: 7047
Presentation Time: GRIS 103 at 1:40-2:00

Computational Design and Optimization of Functionally Graded TPMS Heat Exchangers

STEM
SURF

Authors(s):
Wyatt Soberg Catz†

Abstract:
Due to the development and growth of AI and data centers, there is a critical need for efficient heat exchangers capable of addressing higher thermal loads while minimizing pumping power. Recent advances in additive manufacturing have enabled the fabrication of more advanced heat exchangers that were previously impossible to produce. With this, Triply Periodic Minimal Surfaces (TPMS) have emerged as a candidate building block for heat exchanger design, as their unique customizability allows systematic exploration of geometric configurations tailored to the specific operating conditions. Using Computational Fluid Dynamics (CFD), we evaluate the fluid flow and heat transfer performance of a functionally graded TPMS assembly as a heat exchanger, with varying unit cell sizes and wall thicknesses. However, simulating an entire heat exchanger with these complex shapes has a prohibitively high computational cost. To address this, we use a two-step modeling approach. First, we use high-fidelity simulations to capture the performance of individual TPMS unit cells with varying wall thicknesses and sizes. Then we use this data to train a fast, simplified model capable of predicting macro-scale heat transfer performance without resolving complete geometric detail. To demonstrate the accuracy of this method, the results from the simplified model are compared with high-fidelity simulations. The results confirm that the simplified model predicts macro-scale performance at greatly reduced computational cost, while the optimized TPMS architectures significantly enhance convective heat transfer and reduce pumping power compared to uniform designs.

Mentor(s):
Jaewon Park (Engineering); Justin Weibel (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Talk Presentation Abstract Number: 7048
Presentation Time: GRIS 118 at 1:00-1:20

Pressure-Triggered Contact Sensing for Fully Mechanical Soft Robotic Response

STEM
SURF

Authors(s):
Juan Pablo Monge Mesen† (Engineering)

Abstract:
Soft robots offer unique opportunities for environmental interaction and task complexity that go beyond the reach of their rigid counterparts. Although soft architectures are intrinsically suited to sensing and responding to their surroundings, exploiting these abilities typically requires integrated electronic sensors and external subsystems that add complexity and hinder robot performance. Recently, embedding physical intelligence into soft systems has gained interest due to its ability to replace traditional electronics with mechanisms that respond to external stimuli, thereby providing the system with integrated sensing and actuation on a single physical substrate.

Here, we present a soft architecture that mechanically senses contact and, when integrated into larger systems, enables complex behaviors such as morphing and grasping. Our approach exploits the ability of constant-volume systems to increase their internal pressure under compression, yielding a 3D-printable unit that transforms small external forces into pressure differentials capable of triggering system-level responses. We show that varying the contained volume tunes the sensor's activation threshold across a range of contact forces, allowing the unit to be tailored to different applications. Furthermore, we integrate the unit into a morphing surface and a soft robotic end-effector, enabling each structure to sense and respond to contact mechanically. These structures reliably respond to contact forces as low as 5.5 N, demonstrating purely mechanical stimulus-responsive behavior without electrical control. The contact-driven actuation enabled by our unit paves the way for embedding physical intelligence directly into robotic hardware, expanding the design space for autonomous, electronics-free soft systems.

Mentor(s):
Juan Camilo Osorio Pinzon (Engineering); Jhonatan Steven Rincon Angarita (Engineering); Andres Arrieta Diaz (Engineering)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7049
Presentation Time: GRIS 118 at 1:20-1:40

Socioeconomic Status as a Moderator of ACT Outcomes in Caregivers of Children with Neurogenetic Conditions

Social Science
SURF

Authors(s):
Chenrui Yin† (HHS|Science)

Abstract:
Parents of children with rare neurogenetic conditions (NGCs) experience emotional, financial, and time strain, driven by their child's medical needs, behavioral challenges, and family's limited access to specialist care. Prior studies have shown that acceptance and commitment therapy (ACT) reduces distress among caregivers of children with special needs. Past studies have found that socioeconomic status (SES) is associated with caregiving burden, quality of life, and parenting stress in NGC caregivers. SES also moderates treatment outcomes in cognitive behavioral therapy and other psychological therapies in general populations. While ACT is designed to help caregivers change responses to difficult emotions and act in line with their values, it does not directly address financial or structural circumstances. Therefore, this study tested whether baseline SES indicators moderated the effect of ACT on depression, anxiety, stress, and perceived caregiving burden among NGC caregivers. Participants (n = 65) were NGC caregivers assigned to the ACT arm of Project WellCAST, a clinical trial focused on interventions to support caregiver well-being. Participants received individual, manual-guided ACT, delivered via telehealth by supervised graduate students (11 sessions in total). Baseline SES indicators included federal poverty level (FPL), education, employment, and rurality. Caregiving burden and psychological symptoms were self-reported at pretreatment and posttreatment. SES moderation was tested using aligned rank transform ANOVA. Results indicated that FPL significantly moderated changes in depression and stress, with medium-to-large effect sizes, such that caregivers with higher FPL showed greater improvement. Analyses of education, employment, and rurality are ongoing. Overall, findings suggest that caregivers with higher SES benefited more from ACT, and that lower-SES caregivers may need structural support to fully benefit from treatment.

Mentor(s):
Lyndsey Nicole Graham (HHS); Bridgette Kelleher (HHS); Daniel J Foti (HHS)

Other Acknowledgement(s):
Varun Aggarwal (Engineering)

Talk Presentation Abstract Number: 7050
Presentation Time: GRIS 118 at 1:40-2:00

Fluid-Powered Autonomy: Embedded Fluidic Oscillators for Pneumatic and Hydraulic Soft Robots

STEM
SURF

Authors(s):
Camila Uribe† (Engineering); Juan Pablo Monge Mesen‡ (Engineering)

Abstract:
Soft robots are designed to move more like organisms than machines, using compliant deformation to interact safely with their surroundings, absorb impacts, and adapt to unstructured environments. However, many soft robotic systems still rely on electrical controllers, sensors, valves, batteries, and timing circuits to coordinate actuation. These components increase system complexity and reduce the compliance that makes soft robots advantageous. This work presents a simplified soft NOT-gate oscillator that enables rhythmic actuation from a single compressed-fluid input, without electronic timing, onboard control circuits, or manual switching. The oscillator consists of three soft NOT gates arranged in a closed-loop triangular architecture, converting continuous fluidic input into alternating pressure outputs. We fabricate the device using soft 3D-printed materials, producing a compact and compliant architecture directly compatible with soft robotic bodies. To guide the design process, we also develop a lumped fluidic resistance-compliance model that estimates oscillation frequency for pneumatic and hydraulic operation. We integrate the proposed oscillator into two bio-inspired platforms: a pneumatically actuated, six-legged ant-inspired walker and a hydraulically actuated manta-ray-inspired swimming robot. In the walker, the oscillator coordinates alternating leg-actuation phases to generate terrestrial locomotion. In the manta ray platform, the same architecture drives fin flapping, rhythmic deformation, and bending sequences for underwater motion. By extending a single soft logic architecture across pneumatic and hydraulic robots, this work demonstrates a pathway toward more compliant, fluid-powered autonomy in untethered soft robotic systems.

Mentor(s):
Juan Camilo Osorio Pinzon (Engineering); Jhonatan Steven Rincon Angarita (Engineering); Andres Arrieta Diaz (Engineering)

Other Acknowledgement(s):
Jorge Enrique Neira Garcia (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7051
Presentation Time: GRIS 126 at 1:00-1:20

AI-Guided Engineering of Lipocalin Scaffolds for Programmable Small-Molecule Recognition

STEM

Authors(s):
Atharva Bhatta† (Science)

Abstract:
Lipocalins are a structurally conserved family of beta barrel proteins that bind small hydrophobic ligands. Their thermal and halostability, compact size, and ligand-triggered changes in intrinsic tryptophan fluorescence make them strong scaffolds for programmable small-molecule recognition. However, engineered lipocalins remain largely limited to naturally occurring ligands, leaving a gap for environmentally and clinically important synthetic targets such as PFAS, bisphenol A, microcystin toxins, and hydrophobic antibiotics.

This project develops a structure-conditioned, AI-driven design pipeline that learns transferable structure function rules from docked lipocalin ligand complexes and generates sequence variants optimized for new ligands. The core model represents each complex as a joint molecular graph and encodes spatial and physicochemical context with a custom transformer focused on the binding pocket. Explicit interaction edges connect ligand atoms to pocket residues within an 8Å cutoff to capture hydrophobic interactions. Training couples residue identity prediction with affinity rankings, enabling ligand-targeting mutations that improve hydrophobic complementarity, polarity matching, and steric fit. At inference, stochastic sampling generates candidate sequences predicted to improve affinity, and unstable variants are filtered using pretrained protein language model scores.

My role is wet-lab validation, focusing on binding affinity and selectivity. Designed variants will be expressed and purified using established yeast based workflows, then screened via intrinsic tryptophan fluorescence to estimate binding constants across target ligand classes. I will validate top candidates with isothermal titration calorimetry to obtain thermodynamic parameters and confirm specificity. Results feed back to the model to refine predictions. Together, this closed-loop framework aims to deliver a robust platform for programmable molecular recognition and next-generation.

Mentor(s):
Kanaga Vijayan Dhanabalan (Science)

Other Acknowledgement(s):
Hima bindu Kovvali (Science)

Talk Presentation Abstract Number: 7052
Presentation Time: GRIS 126 at 1:20-1:40

Machine-Learning-Driven Nuclear Band Reconstruction from γ–γ Coincidence Data

STEM
Data Mine

Authors(s):
Josiah W Beauchaine† (Science); Truman Carl Parrish‡ (Science)

Abstract:
This project develops a machine-learning framework for automated reconstruction of nuclear band structures from γ–γ coincidence data.

Reconstructing nuclear band structures typically requires expert interpretation of γ–γ coincidence relationships, where correlated transitions are organized into physically meaningful sequences. As modern detectors produce increasingly large and complex coincidence matrices, manual reconstruction becomes difficult to scale and prone to inconsistency. A data-driven approach is therefore needed to identify transition relationships and infer band membership more systematically.

A Monte Carlo simulation generates synthetic nuclear band structures and produces γ–γ coincidence matrices derived from those bands, ensuring that each dataset contains physically meaningful ground-truth labels. Peaks extracted from the coincidence matrices are converted into a graph representation in which nodes correspond to γ-ray transitions and edges encode observed coincidence relationships.

A two-layer graph attention network (GAT) is trained on this graph to learn representations associated with band membership. The attention mechanism allows the model to weight the most informative transition relationships rather than treating all connections equally. The resulting node embeddings cluster according to band structure, enabling direct comparison between predicted and true band assignments.

Mentor(s):
Ace Rounds (Science); Andy Jung (Science)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7053
Presentation Time: GRIS 126 at 1:40-2:00

Thermosensitive Histidine Dehydrogenase (HisD) Mutants in Salmonella typhimurium

STEM

Authors(s):
Olivia Nicole Safranek† (Science); Ruoqin Rachel Yang* (Science)

Abstract:
Temperature-sensitive mutations are important tools for studying protein stability and function. Often caused by single amino acid substitutions, these mutations allow proteins to function normally at permissive temperatures but become unstable or inactive at elevated temperatures. Such variants have been identified in DNA and RNA polymerases, biosynthetic enzymes, and phage capsid proteins.

Two temperature-sensitive hisD mutant strains, hisD6585 and hisD6589, were isolated from Salmonella enterica serovar Typhimurium LT2. These mutants grow at 30°C but lose function at 42°C due to defects in histidine biosynthesis, which depends on histidine dehydrogenase (HisD). The mutations are predicted to be single-base substitutions that produce amino acid changes affecting enzyme stability. The HisD enzyme (45.9 kDa) contains an NAD^+-binding site supported by two adjacent Rossmann-fold motifs, making the integrity of key residues essential for catalytic activity. Despite its role in histidine biosynthesis, no experimental structure of S. enterica HisD is currently available.

This project will determine the structures of wild-type and temperature-sensitive mutant HisD proteins using X-ray crystallography to identify structural changes responsible for loss of function at elevated temperatures. The wild-type enzyme has been examined through cloning, protein expression, and protein purification, with future directions including crystallographic analysis of the wild-type and mutant enzymes. Structural data will provide a foundation for future molecular dynamics simulations to investigate how altered residues affect protein stability, dynamics, and catalytic activity. Together, these studies will advance understanding of the molecular basis of temperature-sensitive mutations and their effects on protein function.

Mentor(s):
Nicholas Noinaj (Science); Laszlo Csonka (Science)

Other Acknowledgement(s):
Marlyn Michelle Bush (Science); Yi Lien (Science); Nourin Ferdausi (Science)

Talk Presentation Abstract Number: 7054
Presentation Time: GRIS 133 at 1:00-1:20

DNA Origami Nanocube Scaffold for Production of Multiple Therapeutic RNA Sequences

STEM

Authors(s):
Logan M Murray† (Engineering)

Abstract:
DNA origami nanostructures offer programmable, three-dimesnional scaffolds with growing potential for biomedical applications. The gCube, a DNA origami nanocube, has demonstrated the capacity for cellular uptake, positioning it as a promising platform for intracellular delivery enabling it to[LM1.1] influence cellular function. Alongside this, the relevance of therapeutic RNA to treat cancer and chronic disease continues to expand. We aim to provide a solid foundation for continued RNA production off of the gCube. Thus, we investigated the gCubes ability to be modified to act as a scaffold for RNA transcription utilizing different RNA polymerases. The gCube was designed to accommodate multiple promoter sequences to allow for the template strand and promoter to bind and accommodate transcription. Each polymerase was first tested independently, with double stranded promoter sequences used as a control. Only the relevant strands and enzymes were introduced to the gCube and the product was analyzed using a NanoDrop spectrophotometer to confirm RNA production. After confirming production, we used FRET (fluorescent resonance energy transfer) pairing to view transcription results in real time under a fluorescent plate reader. The gCube and double stranded control both produced similar concentrations of RNA when analyzed under the NanoDrop. The FRET pairing has shown expected results when testing controls. FRET analysis will be used to confirm the production from multiple polymerases and will be compared to double stranded controls. The constructs here can be used to further investigate induced intracellular RNA production, with future application in gene regulation, RNA therapeutics, and programmable synthetic biology.

Mentor(s):
Leopold Noel Green (Engineering)

Other Acknowledgement(s):
Derrick Dankwa (Engineering); Nicholas Jakalski (Engineering)

Talk Presentation Abstract Number: 7055
Presentation Time: GRIS 133 at 1:20-1:40

NASA Hydrogen Drone Refueling Project

STEM
SURF

Authors(s):
William Zheng†; Benjamin Tencza‡ (Engineering); Nicolas Bustamante‡ (Engineering)

Abstract:
Hydrogen fuel cell propulsion is a promising pathway for low-emission, long-endurance flight, but long term deployment in remote areas requires safe, repeatable refueling at high pressure without constant human supervision. In a NASA-funded University Student Research Challenge project, the long-term goal is a "forever-flying" hydrogen drone that can dock at ocean-based stations, generate hydrogen from water, and refuel to operate in remote environments with minimal maintenance. To enable this vision, the system must reliably connect a drone-mounted storage tank to a high-pressure supply line, transfer gas, and then undock, all while protecting sensitive onboard components.

This summer's work focuses on designing and testing a proof-of-concept autonomous refueling interface. The current setup integrates two staged pressure boosters, a network of valves and regulators, and a cylindrical linear actuator that brings a male quick-connect fitting into contact with a female counterpart on the refueling line. Leak-tightness and pressure performance are evaluated first with helium as a surrogate working fluid, using pressure transducers placed upstream and downstream of the quick-connects, along with soapy-water tests, followed by hydrogen testing once the system response and safe operating conditions areis validated. The refueling sequence gradually increases pressure, then vents the tank in controlled steps to assess stability and safety under realistic operating conditions.

By characterizing how the interface behaves during automated high-pressure refueling, this work provides critical data and design feedback for future docking mechanisms and control algorithms. In the broader project, these refueling capabilities will support hydrogen drones that can perform persistent ocean sensing for climate monitoring without frequent human intervention, helping translate clean propulsion research into practical tools for long-range, ocean-scale data collection.

Mentor(s):
Holman Lau (Engineering); Li Qiao (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7056
Presentation Time: GRIS 133 at 1:40-2:00

Investigating Zinc Incorporation During Zn-MFI Synthesis for Fuel and Chemical Production

STEM
SURF

Authors(s):
Alana N White† (Engineering)

Abstract:
Catalysts are materials that speed up chemical reactions, making the production of fuels and chemicals more efficient while reducing energy consumption and waste. Zn-MFI is a zinc-containing porous crystalline material that acts as a catalyst for converting lower-value hydrocarbons into higher-value chemicals used to manufacture products such as plastics, detergents, pharmaceuticals, and adhesives. However, preparing Zn-MFI consistently remains challenging because zinc must become part of the catalyst structure rather than forming separate zinc oxide (ZnO) particles, which can reduce catalyst performance.

This study compared two previously published synthesis methods to determine which most reliably produces Zn-MFI. The methods used different silica and zinc sources: tetraethyl orthosilicate (TEOS) with zinc gluconate or fumed silica with zinc nitrate hexahydrate. The resulting materials were analyzed using powder X-ray diffraction (XRD), which confirmed the expected MFI structure for both methods. Additional diffraction peaks were observed in several as-made samples and were consistent with previous studies, although their role in the synthesis process remains under investigation. Based on the XRD results, the method using fumed silica and zinc nitrate was selected for further optimization of the silicon-to-zinc (Si/Zn) ratio. Future characterization will use silicon nuclear magnetic resonance (NMR) spectroscopy to evaluate zinc incorporation into the catalyst structure. Additional characterization will include nitrogen physisorption to measure pore structure, elemental analysis to determine zinc content, and ammonia temperature-programmed desorption to measure the number and strength of proton sites. Together, these techniques will guide the development of a more reliable Zn-MFI synthesis strategy by identifying conditions that promote framework zinc incorporation, supporting improved catalysts for more efficient fuel and chemical production.

Mentor(s):
Rajamani P Gounder (Engineering); Sarah Gustafson Wagers (Engineering)

Other Acknowledgement(s):
Waire Olawolu (Engineering)

Talk Presentation Abstract Number: 7057
Presentation Time: GRIS 134 at 1:00-1:20

Engineering Technology: How Do Entry Pathways Relate to Preparation, Satisfaction, and Career Confidence?

STEM

Authors(s):
Japteg Singh Bamrah† (Polytechnic); Charis Knoerr† (PWL); William K Boyer‡ (Polytechnic); Martha Cherop Boss‡ (Polytechnic)

Abstract:
Engineering technology program enrolls students through increasingly diverse pathways, including direct admission, transfer, military affiliation and international status. Although these pathways shape students' expectations, academic preparation and access to institutional support, their relationships with satisfaction and career confidence remain underexamined. This study investigates how entry pathways shape perceived academic and career preparation, major satisfaction, and career confidence among engineering technology students. Using survey data from over 150 students from Purdue University and University of Toledo, the study describes pathway distributions and examines associations between pathway type, academic major, and preparation indicators. Results showed that direct admit students formed the most pronounced pathway group, while internal transfer students reported strong preparation and career-confidence patterns. Career confidence varied noticeably across pathways: internal transfer students showed one of the highest rates of confidence in finding a job after graduation, while students admitted after applying to a different major showed the lowest confidence. Major fit was also closely connected to career confidence. Students who believed they had chosen the right major were more likely to report confidence in future employment and correlation results further suggested that task value, interest in engineering technology coursework, and expectations of success were more strongly associated with satisfaction and job confidence than AP availability or counselor influence. Comprehensively the findings suggest that entry pathways are influential in shaping students' sense of program fit, satisfaction, self-efficacy and ability to connect with engineering technology coursework to future careers, therefore it is crucial to strengthen existing support structures to help students thrive within and beyond college.

Mentor(s):
Anne M Lucietto (Polytechnic)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7058
Presentation Time: GRIS 134 at 1:20-1:40

High-Resolution Thermal Warpage Measurement Using 3D Laser Vibrometry and Optical Profilometry

STEM
SURF

Authors(s):
Ishaan Brar† (Engineering)

Abstract:
Thermomechanical reliability, especially stress-induced warpage, is a major challenge in advanced electronic packaging. Digital Image Correlation (DIC) is commonly used to measure deformation during thermal loading, but it requires careful surface preparation, precise camera alignment, and extensive image processing, making experiments time-consuming and limiting measurement resolution. This project investigates the use of a three-dimensional Laser Vibrometer (3D LV) and high-resolution optical profilometry as complementary, non-contact techniques for measuring thermal deformation and warpage. The objective is to evaluate their ability to provide accurate, high-resolution measurements while simplifying experimental characterization.

A series of vibration and thermal validation experiments were performed to evaluate both measurement systems. Speaker and piezo actuator tests confirmed that the 3D LV could accurately detect known vibration inputs, including low-frequency motion down to 0.1 Hz. Thermal displacement measurements were then conducted on printed circuit board, aluminum, copper, and steel specimens using a custom-designed thermal stage. The measured displacement trends closely matched the expected thermal expansion behavior of each material. In parallel, optical profilometry was used to capture high-resolution surface topography and quantify changes in surface shape, providing an independent method for evaluating thermal warpage.

The results demonstrate that laser vibrometry and optical profilometry provide complementary information for characterizing thermally induced deformation. The laser vibrometer continuously measures displacement and vibration over time, while the optical profilometer captures detailed surface geometry with high spatial resolution. Future work will combine data from both techniques to reconstruct full-field warpage and establish a practical, high-resolution alternative to conventional DIC for the thermomechanical characterization of

Mentor(s):
Ujjawal Arya (Engineering); Ganesh Subbarayan (Engineering)

Other Acknowledgement(s):
David Matthew Czerwonky (Engineering)

Talk Presentation Abstract Number: 7059
Presentation Time: GRIS 134 at 1:40-2:00

Developmental Neurotoxicity of Trifluoroacetic Acid (TFA): Oxidative Stress and Neurotransmitter Responses in Zebrafish

STEM

Authors(s):
Maxwell J Gootee† (HHS|Liberal Arts|JMHC); Agampreet Kaur‡ (HHS|JMHC)

Abstract:
Trifluoroacetic acid (TFA) is an ultrashort-chain per- and polyfluoroalkyl substance (PFAS) formed from the degradation of certain fluorinated chemicals. Despite increasing concern over environmental TFA contamination, little is known about its effects during early development. Therefore, this study uses the zebrafish (Danio rerio) model to investigate the potential developmental neurotoxicity of TFA by evaluating oxidative stress and neurotransmitter responses. Zebrafish embryos were exposed to 0 (control), 0.04, 0.4, 4, or 40, or 400 ppb TFA within 0–2 hours post-fertilization (hpf) and maintained in the exposure solutions until 72 hpf. At 72 hpf, the larvae were washed 3× with fresh embryo water and transferred to filtered embryo water until 120 hpf. The zebrafish larvae were then collected for fluorescence imaging and biochemical analyses. Mitochondrial superoxide production was assessed using fluorescence microscopy, while antioxidant defense was evaluated by measuring catalase (CAT), glutathione S-transferase (GST), and glutathione peroxidase (GPx). Neurotransmitter responses were assessed by measuring glutamate levels. An increase in CAT activity and mitochondrial superoxide levels were observed following the developmental TFA exposure. These findings suggest that developmental TFA exposure may induce oxidative stress during early development and support further investigation into its potential neurotoxic effects.

Mentor(s):
Jennifer Freeman (HHS); Umamaheswari Sathisaran (HHS)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7060
Presentation Time: GRIS 103 at 2:00-2:20

Characterizing Structural and Mechanical Femoral Outcomes in a Murine Model of Alcohol Use Disorder and Type 2 Diabetes

STEM
SURF

Authors(s):
Isabelle Anne Hunt† (Engineering); Ava Fuchs‡ (Engineering); Sachenka Katrina Angel Aranguena‡ (Engineering); Jennifer Marie Bowles‡ (Engineering)

Abstract:
Alcohol use disorder (AUD) and type 2 diabetes (T2D) are prominent diseases, impacting 1 in 10 and 1 in 9 Americans, respectively. Both AUD and T2D have been found to pose systemic health risks, including an increased susceptibility to fractures. The concurrent presence of these diseases is common and may increase fracture risk further. However, the mechanisms driving the increase in fracture observed in this comorbid population have not been explored in clinical studies and preclinical work in animal models remains scarce, limiting the ability to predict and prevent fracture in this population.

To bridge this gap, a mouse model of AUD + T2D was generated using a high fat liquid diet in combination with streptozotocin (STZ) to induce T2D. To simultaneously induce AUD, 20% of the calories in the liquid diet were from the addition of ethanol. This model was generated alongside a control group, AUD only group, and T2D only group. Whole body dual energy x-ray absorptiometry (DEXA) scans were taken throughout the study and prior to sacrificing the mice to assess bone mineral density(BMD) and body composition. Left femurs underwent microcomputed tomography scanning (μCT) to assess microarchitectural measures and three-point bend testing to failure to measure whole-bone mechanical properties. Right femurs underwent fracture toughness testing to assess the bone's resistance to crack propagation. All bones were stored in phosphate buffered saline (PBS) at -20°C following harvest prior to testing.

We anticipate the combined AUD+T2D animals will have greater declines in BMD, cortical measures, trabecular measures, whole-bone mechanical properties, and fracture toughness measures than either disease state alone. We have begun refining this model through a

second iteration of this study that does not require a liquid diet but will not achieve endpoint measures until November 2026.

Mentor(s):
Joseph Wallace (Engineering); Dyann Marie Segvich (Engineering); Olivia Nicole White (Engineering)

Other Acknowledgement(s):
Andres Catalino Castillo Jimenez (Engineering)

Talk Presentation Abstract Number: 7061
Presentation Time: GRIS 103 at 2:20-2:40

A Looking Glass Into the Future of Disease in a Warmer World: Susceptibility to Metschnikowia bicuspidata Infection in Daphni

STEM
SURF

Authors(s):
Ana Martinez† (Science)

Abstract:
Climate change is transforming the world's ecosystems and, with them, parasite-host disease dynamics. Temperature affects host immunity, parasite growth, and development rates for both parasite and host, which in turn can generate nonlinear responses in disease prevalence. Rising temperatures affect host-parasite dynamics, but the extent and mechanisms of these effects remain poorly understood. Studying these dynamics is essential for predicting how climate change may reshape host-parasite relationships and, in turn, the health and structure of freshwater ecosystems worldwide. To test how disease susceptibility is affected by temperature, we exposed Daphnia dentifera to the parasitic yeast, Metschnikowia bicuspidata, for 24 hours at three temperatures (18°C "cold," 22°C control, 26°C "hot") across three clonal lines. Post-exposure spore density, measured via duplicate hemocytometer counts, served as a proxy for infection intensity. Temperature is positively correlated with Daphnia's metabolic rate, and infection occurs via ingestion of the needle-shaped spores of the yeast during filter feeding. Hence, we predicted higher spore intake and infection intensity at elevated temperatures. However, prior literature suggests host responses to temperature are complex, so this relationship may be nonlinear. We also expected differential susceptibility across clonal lines due to genetic variation. This study will tackle how temperature shapes host-parasite dynamics in Daphnia dentifera and Metschnikowia bicuspidata. Nonlinear or genotype-dependent patterns could indicate that immune or genetic factors moderate this system's response to temperature. As climate change becomes an increasingly critical driver of environmental change, it is imperative to study how host-parasite dynamics are affected.

Mentor(s):
Jonathan Lopez (Science); Catherine L Searle (Science)

Other Acknowledgement(s):
Jorge Enrique Neira Garcia (Engineering)

Talk Presentation Abstract Number: 7062
Presentation Time: GRIS 103 at 2:40-3:00

Synthesis of biotemplated palladium-coated nanorods on cellulose nanocrystals

STEM
SURF

Authors(s):
Halaya Vann† (Engineering); Raina Wang‡ (Engineering)

Abstract:
With the future growing demand for nanotechnology, nanorods will be increasingly sought after because of their unique surface-area-to-volume ratio compared to standard nanoparticles. Palladium nanorods will be desirable for their catalytic activity, chemical stability, and ultrasensitive sensing ability, making them valuable for applications in medicine/healthcare, environmental monitoring, and energy manufacturing. Our current project is motivated by the synthesis of palladium-coated nanorods using the novel biotemplate cellulose, which are intended to provide a cost-effective and environmentally friendly alternative to effective surface adsorption. We hypothesize that cellulose nanocrystals (CNC) will benefit from optimized palladium precursor concentrations and multiple coatings to achieve evenly coated palladium-CNC nanorods. Transmission electron microscopy (TEM) imaging and inductively coupled plasma (ICP) analysis are being used to characterize our findings and provide both qualitative and quantitative results, to determine if ideal coverage and coating thickness have been achieved. We expect to identify the most favorable palladium precursor concentration and coating cycles needed for palladium adsorption onto CNC, further advancing the development of uniform metal nanorods. These findings support the potential of this method as a sustainable and cost-effective pathway for producing metal nanorods for catalytic, sensing, and environmental applications.

Mentor(s):
Chao-Hsiang Chang (Engineering); Michael T Harris (Engineering)

Other Acknowledgement(s):
Waire Olawolu (Engineering)

Talk Presentation Abstract Number: 7063
Presentation Time: GRIS 118 at 2:00-2:20

Mapping the Stacking and Surface Chemistry Landscape of MXenes and Metal Carbides via DFT and Molecular Dynamics

STEM
SURF-SCALE

Authors(s):
Samiya Balu† (Engineering); Sahana Mukund‡ (Science)

Abstract:
Metal carbides are valued for their strength, high melting points, and useful electronic properties. A two-dimensional form of these materials, called a MXene, is only a few atoms thick but still conducts electricity like a metal while remaining chemically adjustable, making it attractive for batteries, electromagnetic shielding, and targeted drug delivery. Despite growing interest, the full range of possible atomic layer arrangements for these materials, including different stacking sequences and surface chemistries, has not been systematically mapped.

Predicting which arrangements are stable can be done with density functional theory (DFT), a computational method that calculates the lowest energy configuration of a structure, but this method becomes too computationally expensive to apply across a vast range of candidate structures.

This project addresses that gap by generating many possible stacking arrangements of metal and carbon layers, including different surface terminations for MXenes, and using DFT to relax each structure into its most stable configuration. We run molecular dynamics simulations on the stable structures, which track how atoms move and interact over time at elevated temperatures to further understand the stability.

As an initial case study, we relaxed a titanium based MXene structure and simulated its atomic motion at room temperature, obtaining lattice parameters that closely matched previously reported experimental and computational values.

Building on this validation, we plan to expand the approach to a much larger set of carbide and MXene structures in order to construct a structural database describing their stability and properties. This database is intended to help guide future experimental synthesis efforts and to serve as training data for a machine learning interatomic potential, a model that can approximate DFT level accuracy at a fraction of the computational cost.

Mentor(s):
Aidan Damian Pantoya (Engineering)

Other Acknowledgement(s):
Alejandro H Strachan (Engineering); Rushik Desai (Engineering); CJ Holdeman (Engineering)

Talk Presentation Abstract Number: 7064
Presentation Time: GRIS 118 at 2:20-2:40

Miniaturizing X-Ray Fluorescence Spectroscopy Through Simulation-Driven Vacuum Chamber Design

STEM
SURF-SCALE

Authors(s):
Ashwin Natarajan†

Abstract:
X-ray fluorescence (XRF) spectroscopy has become an increasingly prevalent technology due to its atomic detection capabilities. This technique involves firing x-rays at a substance which triggers a shift in the atoms' higher orbital electrons. The subsequent release of energy can then be analyzed to identify the atomic composition of the sample. Current downscaling efforts aim to decrease the size of such machines while maintaining accuracy. However, a crucial feature that is lost in this downscaling is the presence of a vacuum chamber, which is used to remove air molecules that interfere with readings. This paper describes the process used to design a handheld XRF machine with the inclusion of a vacuum chamber.

Our team utilized Geant4, an open-source Monte Carlo simulation toolkit for particle-matter interactions, to perform parametric simulations of a mock XRF system, allowing us to identify the optimal geometric configuration to maximize elemental detection efficiency while minimizing background interference. The optimized parameters, together with cost constraints, guided the design of the setup in SIEMENS NX (CAD software). Finite element analysis in Ansys was then used to test the model's mechanical properties.

By overcoming one of the primary limitations of existing handheld XRF systems, this work yielded a functional XRF setup that includes a vacuum chamber, establishing a foundation for a new caliber of portable analytical instruments. Achieving laboratory quality accuracy in a handheld package could broaden the application of XRF technology to lead detection in adult femurs and the detection of PFAS substances, a family of persistent environmental contaminants known as forever chemicals, in consumer products.

Mentor(s):
Abu Sayed Mohammed Sayam (HHS); Aaron James Specht (HHS)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Talk Presentation Abstract Number: 7065
Presentation Time: GRIS 118 at 2:40-3:00

Comparison of Neutron Detectors and Evaluation of Shielding Materials for Space Microelectronics

STEM
SURF-SCALE

Authors(s):
Jack G Darby† (Engineering)

Abstract:
Neutron radiation can present a significant functional risk to microelectronics and safety hazard to personnel aboard spacecraft and/or satellites, making effective (weight-cost sensitive) shielding a valuable tool for radiation hardening. This research investigates the shielding properties of various materials using a conventional BF3 detector and Purdue University's novel Centrifugally Tensioned Metastable Fluid Detector (CTMFD). Neutron count rates will be measured with and without shielding materials of various types and thicknesses. The resulting count rates can be analyzed using an exponential attenuation formula, allowing estimation of effective attenuation coefficients. The resulting attenuation coefficients will be used to compare the neutron shielding performance of the tested materials. This research is expected to identify promising shielding solutions for protecting spacecraft microelectronics and personnel from neutron (and analogous) charged particle cosmic radiation.

Mentor(s):
Rusi P Taleyarkhan (Engineering); Stepan Ozerov (Engineering); Everett John Nally (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Talk Presentation Abstract Number: 7066
Presentation Time: GRIS 126 at 2:00-2:20

Supply chain regionalization and the viability of an AI server hub for Latin America: a system dynamics analysis of Panama

STEM
UREP-C or UREP-LA

Authors(s):
Natasha Catherine Farias Cisneros† (PWL)

Abstract:
The rapid growth of artificial intelligence (AI) is driving unprecedented demand for computing infrastructure, yet the hardware value chain behind it, from advanced AI chips to the servers built around them, remains concentrated in East Asia and exposed to geopolitical disruption. As supply chains regionalize in response, Latin America remains peripheral, importing nearly all the AI hardware consumed by its rapidly growing data center market. Downstream activities such as server assembly and distribution offer the region's most realistic entry point, and Panama's location, logistics infrastructure, and free trade zones make it a strong candidate. Yet little research has examined the conditions under which Panama could develop a viable and self-sustaining regional AI server assembly and distribution hub. This study develops a system dynamics model of hub viability linking four subsystems: demand and order fulfillment, hub capacity, workforce pipeline, and inventory and upstream supply. A reinforcing loop connecting delivery reliability, hub attractiveness, and foreign direct investment interacts with three balancing loops arising from technician shortages, backlog accumulation, and inventory buffering. Three simulation scenarios examine (1) the hub's endogenous development under baseline conditions, (2) its response to an upstream semiconductor supply disruption, and (3) its resilience under the same disruption when supported by coordinated policy interventions including investment incentives, STEM workforce development, and inventory management. Results reveal two distinct dynamic patterns. Without policy support, hub attractiveness rises initially but declines as backlog erodes delivery reliability. Coordinated intervention prevents this decline only when foreign direct investment expands capacity sufficiently, revealing a critical investment threshold for sustained hub performance.

Mentor(s):
Reem Khir (Engineering)

Other Acknowledgement(s):
Zoila Castillo (Universidad Tecnológica de Panamá)

Talk Presentation Abstract Number: 7067
Presentation Time: GRIS 126 at 2:20-2:40

An automated workflow for Multi-Omics Analysis using Solvent Touch Extraction.

STEM
UREP-C or UREP-LA

Authors(s):
Jesus Esteban Ladino Giraldo† (PWL)

Abstract:
The purpose of this study was to develop an automated analytical workflow for the characterization of lipids, proteins, and other biomolecules by integrating Solvent Touch Extraction (STE) with automated robotic sampling and mass spectrometry analysis. The platform combines a DexArm robotic arm with a custom hardware components and software designed to do sample recovery, solvent handling, tissue sampling and sample transfer, thereby reducing manual intervention and improving workflow reproducibility. The robotic system provides a standardized approach for minimally invasive extraction directly from biological tissues.

The analytical workflow was coupled with desorption electrospray ionization mass spectrometry (DESI-MS) to evaluate its performance using beef, cattle liver, and tilapia fillet tissues. Using this approach, approximately 140 individual lipid species distributed across 10 lipid classes were characterized, while membrane-associated proteins were quantified at an average concentration of 0.4 mg/mL. The automated STE workflow reduced sample preparation requirements and analysis time while maintaining efficient analyte recovery for downstream mass spectrometry analysis.

Beyond multi-omics characterization, the flexibility of the robotic platform coupled to STE, enables adaptation to a wide range of analytical applications. By modifying the extraction solvent, sampling coordinates, and mass spectrometry acquisition parameters in positive and negative ion modes, the system could be configured for characterization of food spoilage biomarkers, environmental contaminants such as per and polyfluoroalkyl substances (PFAS), pharmaceutical compounds, toxins, and other classes of molecules. The integration of automated hardware, customizable software, and solvent-based sampling establishes a versatile platform with potential applications in food safety, environmental monitoring, and toxicological studies.

Mentor(s):
Christina R Ferreira (Centers & Institutes); Ryan T Hilger (Science)

Other Acknowledgement(s):
Devender Arora (Other); Venkatesh P Thirumalaikumar (Agriculture)

Talk Presentation Abstract Number: 7068
Presentation Time: GRIS 126 at 2:40-3:00

A Conductive Polymer-Based Approach to Soft Tactile Sensing for Robotic Manipulation

STEM
UREP-C or UREP-LA

Authors(s):
Jeronimo Contreras Castaneda† (Engineering)

Abstract:
Soft tactile sensing has gained increasing attention in robotics as a means of improving manipulation through compliant, adaptable sensors capable of detecting contact. The objective of this work is to assess the feasibility of conductive silicone polymer as an alternative tactile sensing material for localizing touch and recognizing contact shapes. To evaluate the performance of this material in a robotic application, an experimental setup was developed consisting of three main components: a robotic hand, a teleoperation glove, and a conductive polymer-based sensing element. The robotic hand, based on the ORCA design, was fabricated and assembled with a custom wrist mechanism that provides two additional rotational degrees of freedom, enabling a more versatile manipulation platform for testing. A teleoperation glove was also made to control the hand during experiments, allowing controlled interactions with the sensing material. The sensing element consists of a conductive PDMS-based polymer instrumented with sixteen electrodes distributed around its perimeter, with Electrical Impedance Tomography (EIT) used to reconstruct conductivity changes produced by external contact.

Current efforts focus on characterizing the conductive polymer, assessing the performance of the robotic hand and teleoperation glove, and optimizing the reconstruction process to evaluate touch localization and contact shape recognition under different loading conditions. Since the experimental characterization is ongoing, quantitative performance metrics have not yet been established.

Successful evaluation of the proposed sensing approach would demonstrate the potential of conductive polymer-based tactile sensing as a low-cost, compliant alternative to conventional sensing technologies. This work could contribute to the development of more adaptable robotic systems by enabling improved tactile perception for dexterous manipulation and safer human-robot interaction.

Mentor(s):
Ramses Martinez (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7069
Presentation Time: GRIS 133 at 2:00-2:20

Bioinspired Continuum Robot

STEM

Authors(s):
Eain Drae Oo† (Engineering); Denyse Isingizwe† (Engineering)

Abstract:
Hard robots often tackle robustness and flexibility while soft robots offer infinite degrees of freedom but lack structural integrity. Most robotic arms are developed for industrial purposes, and the smaller versions are rigid and often expensive. In this project, the bioinspired continuum robot arm was developed to aid in farming/harvesting of fruits, particularly a strawberry. It is inspired by an octopus' tentacle to move quickly in all directions at any angle while maintaining its structural strength. With circular disks for the main base, each section of the tentacle is supported by four springs and is able to reach 2 feet in the x, y, and z directions. Its portability and flexibility are reinforced by compression springs and wires, which allow bending and rotating at least 100 degrees. The 3D-printed prototype is designed to cut and carry more than 20g (standard weight of a fresh strawberry) with the help of grippers and a camera to optimize the cutting angle and run softwares on destination to reach success angle accuracy. The whole system is powered by a battery-motor actuator that produces mechanical energy that moves the pulleys and wires to allow bending and twisting. While this version is made for agricultural purposes, the continuum robot has the potential to reach for items in irregular pathways due to its flexibility and support people with mobility issues due to portability.

Mentor(s):
Timothy M Whalen (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7070
Presentation Time: GRIS 133 at 2:20-2:40

Collapse of the Human Thermal Body Plume: Modeling and Characterization of Gravity-Dependent Gas Exchange

STEM

Authors(s):
Henry Ewald† (Engineering); Alvin Hu‡ (Engineering)

Abstract:
On Earth, gravity influences gas exchange through buoyancy and biothermal convection, generating a 'human thermal body plume' (HTBP) that drives airflow around the body and facilitates gas exchange. In contrast, natural convective forces are absent in a microgravity environment, rendering exhalants diffusion-driven and leading to CO_2 accumulating as a "bubble" around the astronauts' heads. This biophysical phenomenon leads to CO_2 rebreathing that is concerning aboard the International Space Station (ISS), where cabin CO_2 levels already average 4,000 ppm – concentrations linked to significant cognitive impairment, including reduced decision-making ability and diminished attention span in otherwise healthy individuals.

To investigate HTBP behavior, we developed a high-fidelity computational fluid dynamics model, capturing the biophysical impact of gravity and temperature gradients in governing gas exchange. For experimental validation, we constructed a multipoint CO_2 sensing headset to characterize the local flow distributions and experimentally validate CFD predictions. Additionally, we integrated electroencephalography (EEG) capabilities, enabling future studies on the cognitive effects of HTBP breakdown.

To physically simulate microgravity gas transport, we explored the collapse of the HTBP under reduced temperature gradients. Human participants performed metronomic breathing in standing and supine positions while CO_2 measurements were recorded in varied thermal conditions. As ambient temperatures approached skin temperatures, we observed a hypercapnic deadzone immediately in front of the face. These findings highlight the role of convective airflow in maintaining respiratory and cognitive health, and underscore the need for improved ventilation management in both terrestrial and space applications. The validated CFD model provides a computational framework to inform the design of life support technologies that compensate for the absence of gas exchange.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
D. Marshall Porterfield (Agriculture|Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7071
Presentation Time: GRIS 133 at 2:40-3:00

Beyond the Game: Exploring Sport, Culture, and Community Through Experiential Learning in Türkiye

Humanities

Authors(s):
Aarushi Gupta† (Science)

Abstract:
Sport extends beyond athletic competition and serves as a lens through which identity, community, culture, and public life can be understood. As part of Purdue Honors College's Sport, Culture, and Society study abroad program in Türkiye, I explored how sport intersects with everyday life through immersive site visits, cultural engagement, and reflective observation.

Through visits to the Türkiye Weightlifting Federation, Türkiye Athletics Federation, Konyaspor Stadium, an esports facility, KOMEK community education centers, the Turkish Parliament, and cultural sites including the Mevlana Museum, Blue Mosque, bazaars, and public markets, I examined the broader social role of sport within Turkish society. I explored how these experiences challenged and reshaped my understanding of the relationship between sport and society by using field journals, personal reflection, and comparative analysis,

Throughout the program, I observed that sport functions not only as competition, but also as a source of identity, community connection, and cultural expression. Experiences at sports organizations highlighted how athletes and teams represent communities and national pride, while visits to educational programs and public spaces demonstrated how relationships, traditions, and shared experiences contribute to community development. Additionally, observing government institutions revealed how power, public investment, and social structures influence opportunities within sport and society.

Altogether, comparing my experiences in Türkiye with my experiences in the United States challenged my previous assumptions that sport, culture, religion, and public life exist separately. However, I developed a deeper understanding of how interconnected these elements are in shaping collective identity and belonging. This experience demonstrates how experiential learning abroad can expand perspectives on sport as a meaningful social and cultural institution.

Mentor(s):
Dwaine H Jengelley (JMHC); Natasha Duncan (JMHC)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7072
Presentation Time: GRIS 134 at 2:00-2:20

City Sounds: How Increasing Noise Impacts the Host-Seeking Behavior of a Frog-Biting Mosquito

STEM

Authors(s):
Nina Rose Hall† (Science)

Abstract:
Animals are increasingly exposed to anthropogenic noise such as road traffic. Although animals have developed strategies to cope with natural noise, the effects of excessive anthropogenic noise on insects with flagellar ears remains largely unknown. In this study, we focused on Uranotaenia lowii, a unique species of mosquito that relies on auditory cues to locate anuran hosts, to examine how traffic noise affects their ability to respond to frog calls and their strategies to overcome this sensory pollutant. One mechanism that could allow Ur. lowii to overcome noise is Spatial Release from Masking (SRM), a phenomenon where listeners can detect sounds when they originate from different spatial locations than competing background noise. We hypothesized that these frog-biting mosquitoes are affected by noise and use SRM to improve their ability to detect frog calls. To test how Ur. lowii females are impacted by anthropogenic noise, we performed behavioral experiments using road traffic noise and frog calls presented at different signal-to-noise ratios. We also used speakers broadcasting frog calls and traffic noise from spatially distinct directions to test the use of SRM as a mechanism to improve their ability to find frog calls. Mosquito responses, response latency, and flight trajectory were quantified to further analyze the effects of noise on host-seeking behavior. Investigating how Ur. lowii are impacted by noise and the mechanisms underlying hearing in noisy conditions can deepen our understanding of urbanization effects on species interactions.

Mentor(s):
Ximena Bernal (Science); Richa Singh (Purdue University)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7073
Presentation Time: GRIS 134 at 2:20-2:40

Effects of Cancer-Associated Fibroblasts on Pancreatic Cancer Cell Migration Under Hypoxic Conditions

STEM

Authors(s):
Ambhranee Yakkundi† (Science)

Abstract:
Tumors often create low-oxygen environments, allowing cancer cells to resist treatment and spread aggressively. Cancer cell cytoskeletons play a key role in their migratory patterns. While studies have investigated these patterns, few examine how these patterns change under hypoxic conditions. We observed that hypoxic conditions affected the cytoskeleton of cancer cells through the formation of microtubule-rich networks and enhanced mitochondrial localization and activity, ultimately linking these effects to increased cancer cell migration.

Following these studies, we are investigating how cancer-associated fibroblasts (CAFs) promote pancreatic cancer cell migration in hypoxia. CAFs, the predominant stromal cell type in pancreatic tumors, contribute to tumor progression and metastasis. CAFs are reprogrammed by cancer cells to promote paracrine signalling and extracellular matrix remodeling, contributing to tumor invasiveness. However, it is critical to explore how these mechanisms are affected by hypoxic conditions. We are using time-lapse imaging to track the migratory characteristics of fluorescently-labeled co-cultures of CAF-19 and PANC-10.05 cells under hypoxic conditions. In understanding CAF-mediated pancreatic cancer cell migration in a low-oxygen tumor microenvironment, we can provide future insight into its role in mitochondrial trafficking, epithelial-to-mesenchymal transition (EMT), and cancer cell proliferation.

Mentor(s):
Chi Zhang (Science)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7074
Presentation Time: GRIS 134 at 2:40-3:00

Optimization of a Folate Conjugated Fully Modified miR-34a for Enhanced Stability, Uptake, and Activity

STEM

Authors(s):
Aindri Abhishek Singh† (PWL)

Abstract:
MicroRNAs (miRs) are small noncoding RNAs that regulate genes at the post-transcriptional level. Tumor-suppressive miRs are often downregulated in cancer, making their restoration a viable therapeutic strategy. MiR-34a is one such tumor-suppressive miR that shows potent anti-cancer activity. However, poor stability, lack of targeted delivery, and endosomal entrapment have limited its clinical application. We developed a folate-mediated delivery strategy that leverages folate receptor overexpression in cancer cells for targeted delivery of miR-34a. We then sought to identify an optimal fully modified miR-34a (FM-miR-34a) construct by systematically varying the i. number of phosphorothioate (PS) linkages in the antisense strand and ii. the length of the sense strand, parameters known to influence nuclease resistance, duplex stability, and Argonaute (Ago) loading. To accomplish this, we synthesized antisense strands with 3’ PS linkages, ranging from 1 to 7. Each antisense strand was annealed to four corresponding sense strands of 12, 15, 18, and 21 nucleotides, to create a matrix of 28 constructs. All the strands harbored alternating 2′-fluoro and 2′-O-methyl ribose modifications. Constructs were evaluated for serum stability, cellular accumulation, and biological activity. Constructs with four or more PS linkages demonstrated marked improvement in serum stability across all sense-strand lengths. Cellular accumulation varied with sense strand length, with 15- and 18-nucleotide long sense strands demonstrating higher uptake. To overcome endosomal entrapment, we evaluated the ability of varying numbers of cleavable deoxythymidine (dT) linkers to improve endosomal escape, resulting in increased cytosolic accumulation of FM-miR-34a. Together, these findings identify lead Fol-FM-miR-34a candidates with enhanced stability, cellular uptake, and biological activity, providing a framework for the development of more effective RNA interference (RNAi) therapeutics against cancer.

Mentor(s):
Shreyas Ganesan Iyer (Science); Andrea L Kasinski (Science)

Other Acknowledgement(s):
Digambar Kumar Waiker (Science); Alejandra Romero Alzate (Science)

Talk Presentation Abstract Number: 7075
Presentation Time: GRIS 103 at 3:00-3:20

Modeling Thin Membrane Response to Time-Varying Forces

STEM
SURF

Authors(s):
Carman Stanton† (Engineering)

Abstract:
The field of optomechanics often involves exciting mechanical vibrations in membrane structures using optical forces. To interpret results from electromagnetic simulations and optomechanics experiments, this project models the membrane response to spatially and temporally varying optical forces from laser beams. We model the membrane as a stretched elastic sheet governed by the damped wave equation and describe its motion as a sum of its natural vibration patterns, called modes, each with a characteristic frequency. The response is computed with two independent methods: a Fourier transform approach built on a Green's function, and a direct projection method that integrates each mode's motion forward in time. For a square membrane five millimeters wide and one hundred nanometers thick under high tension, the two methods agree to better than one percent. Initial results show that the motion of the membrane due to the force from a laser pulse is dominated by the lowest few modes at frequencies of tens of kHz. We expect the response time to be set by the period of the fundamental mode, tens of microseconds here, together with damping, which controls how quickly the ringing decays. This framework provides design guidance for membrane-based sensors and a foundation for future experimental comparison.

Mentor(s):
Hatim Bamoumen (Engineering); Farhan Ishraque Zahin (Engineering); Kevin J Webb (Engineering)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7076
Presentation Time: GRIS 103 at 3:20-3:40

Movement Pattern Analysis in Football (Soccer)

STEM
SURF

Authors(s):
Pranav Tallapaka† (Engineering); Boyang Zhang‡ (Engineering)

Abstract:
While professional soccer matches generate massive amounts of player location data, turning these raw numbers into a clear understanding of team strategy remains a major challenge. This project establishes a data-driven framework to systematically identify, classify, and analyze professional soccer player movement patterns across various phases of play. This research uses the exact game timeframes to study how players move right before and after major plays, aiming to find the best movement styles for specific game situations. We then apply clustering methods to group and classify these detected periods into distinct movement patterns. Following this classification, we utilize reinforcement learning to model the possible movements and understand the underlying tactical patterns players follow. The ultimate goal is to identify which offensive and defensive movement patterns are most effective under different game situations. By bridging advanced data engineering and machine learning with spatial data in

sports, this work offers coaches, analysts, and stakeholders a deeper, algorithmic understanding of tactical dynamics and situational performance.

Mentor(s):
Jan-Anders E Mansson (Engineering); Daniel Castro Mesa (Engineering)

Other Acknowledgement(s):
Lipi Roy (Engineering)

Talk Presentation Abstract Number: 7077
Presentation Time: GRIS 103 at 3:40-4:00

Soft Growing Robot Cap's Sensor Integration

STEM
SURF

Authors(s):
Ana Clara de Medeiros Morais† (Engineering); Dominic Nathaniel Muniz‡ (Engineering)

Abstract:
Aircraft wing inspection is challenging because it is costly and time-consuming. One potential way to reduce inspection costs and time is to use flexible autonomous systems to navigate confined spaces. Soft-growing vine robots, a type of flexible robot that accesses hard-to-reach areas via an air-growing mechanism, are one such option. These robots enable inspections without disassembling wing parts, while navigating inside the wings and deploying mini-scanning robots to investigate potential cracks and defects, improving efficiency. However, soft-growing vine robots currently lack the full sensing capabilities needed to perform autonomous tasks, such as automatic obstacle-avoidance, thereby limiting their performance in constrained environments. To address this sensing gap, this study integrates sensors into the cap of a soft-growing vine robot to improve environmental perception and enable more effective access to inspection targets. We first tested time-of-flight (ToF) sensors and gyroscopes to evaluate their accuracy and repeatability in determining the robot's position and surroundings. Based on these calibration experiments, the initial cap was redesigned to incorporate both sensors and a camera for operator visibility. Further sensor tests were conducted on a moving robot to develop an obstacle-avoidance program based on sensor data. The final experiment assessed the accuracy of the obstacle-avoidance system's implementation. These findings provide the foundation for a more robust environmental perception system for soft-growing robots, enabling effective navigation to areas within the wings for inspection. Further steps in this design include adapting the placement of the ToF sensors to better detect shiny and metallic objects commonly found in aircraft systems, and advancing toward a fully autonomous robotic system that eliminates the need for teleoperation.

Mentor(s):
Laura Helen Blumenschein (Engineering); Priyanka Balkrishna Bhovad

(Engineering); Ethan Michael DeVries (Engineering); Jack Rearden Ferlazzo (Engineering)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7078
Presentation Time: GRIS 118 at 3:00-3:20

BioSimulateAI: Turning Plain-Language Descriptions into Multi-Scale Biological Simulations

STEM
SURF

Authors(s):
Aarush Agarwal† (Engineering)

Abstract:
Biologists often want to test an idea about how a living system behaves, such as how a signal travels through a cell, before running costly experiments. Turning such ideas into working mathematical models is powerful but slow, error-prone, and requires fluency in both biology and advanced mathematics. Because biology unfolds at many scales at once, a single model often must combine several very different kinds of math, making the task even harder. This project asks whether that process can be automated, so a researcher can describe a system in plain English and

receive a working multi-scale simulation without writing code. We built BioSimulateAI, a web-based platform that reads a plain-language description and translates it into an executable computational model. To keep models grounded in real biology, it first retrieves known interactions from five established

biological databases. It then generates three connected simulations: chemical signaling inside a cell, the spread of molecules through tissue, and the movement and sorting of individual cells. A built-in checker rejects setups that violate basic physical laws, and a feedback loop tunes the model until its behavior matches user-defined targets. Using a known cell-signaling pathway as a test case, the platform reproduced several expected behaviors from one short description and tuned

itself automatically, cutting its error by about 99 percent in a few rounds. BioSimulateAI shows that everyday language can become trustworthy, multi-scale biological models in minutes rather than weeks, lowering the barrier for researchers without a computational background and speeding the cycle of testing biological ideas.

Mentor(s):
Linlin Li (Engineering)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7079
Presentation Time: GRIS 118 at 3:20-3:40

Investigating Performance of Nanosilica and Non-traditional and Natural Pozzolans in Type IL Cementitious systems

STEM
SURF

Authors(s):
Aryan Daga† (Engineering)

Abstract:
Concrete is the most widely used construction material in the world, and consists of cement, water and aggregates. However, cement production contributes to approximately 8% of the total global CO2 emissions. To mitigate the heavy usage of cement, the industry has been implementing supplementary cementitious materials (SCMs) to partially replace cement in concrete mixtures. As of recent times, the availability of traditional SCMs, such as fly ash and slag, has declined, creating a need to identify alternative supplementary materials. Previous research shows that Non-traditional and Natural Pozzolans (NNPs) can enhance mechanical and transport properties, as well as durability. Another common strategy for enhancing concrete performance is the use of admixtures, such as nanosilica (nS), which has been shown to improve durability and accelerate hydration. Despite the individual benefits of NNPs, nanosilica, and Type IL cement, a significant knowledge gap remains regarding their combined effects in concrete systems. Therefore, this research investigates the mechanical properties, durability, and hydration behavior of concrete mixtures incorporating Type IL cement, selected NNPs, and varying nanosilica dosages. Optimal concrete mixtures were developed based on prior mortar studies and evaluated through compressive and flexural strength testing, durability assessments including water absorption, electrical resistivity, formation factor, rapid chloride penetration testing, and hydration characterization using isothermal calorimetry and thermogravimetric analysis. The results indicate a positive synergistic interaction between NNPs and nanosilica in Type IL cement systems, leading to enhanced performance in both mechanical and durability-related properties. The next phase of this project involves investigating the replacement of traditional aggregates with waste products from mines to further increase the possible sustainability of concrete.

Mentor(s):
Anelya Zhussupbekova (Engineering)

Other Acknowledgement(s):
Alberto Castillo (Engineering); Jan Olek (Engineering); Raikhan Tokpatayeva (Engineering); Varun Aggarwal (Engineering)

Talk Presentation Abstract Number: 7080
Presentation Time: GRIS 118 at 3:40-4:00

Beyond Task Completion: Training Computer-Use Agents to Evaluate Usability

STEM
SURF

Authors(s):
Rishab Sai Vempati† (Science)

Abstract:
Computer-use agents (CUAs) are AI systems that operate interfaces the same way a person does, they view the screen and issue clicks and keystrokes. CUAs are usually built with the objective of completing tasks as efficiently as possible, and this same capability makes them promising candidates for a different yet adjacent role: evaluating the usability of interfaces, a process that today requires inefficient and expensive studies with real design experts. However, a standard CUA is a poor replacement for a design expert. It is built to complete tasks rather than to judge the experience of using an interface, and we find that frontier models and existing agents can barely tell a usable interface from an unusable one. Judging usability is a different skill than completing tasks; it requires exploring an interface, noticing where it violates good design, and weighing how much those flaws would hinder a real user. This project investigates how training a screenshot-based CUA to assess usability changes its behavior, and whether the resulting agent surfaces usability problems that an off-the-shelf agent glosses over. We build uxWeb, a dataset of interactive website clones paired with defect-augmented variants produced by injecting usability defects grounded in Shneiderman's golden rules, and we fine-tune the agent with a margin-based contrastive objective that pulls apart usable and less usable interfaces. We then run both standard and trained agents on web interfaces containing known usability issues and compare their judgments. This study characterizes how training affects agent behavior, with the goal of informing recommendations for designing agents that better reflect human usability judgment. Such agents could make early-stage usability evaluation faster, cheaper, and more accessible to designers.

Mentor(s):
Jason Wu (Science)

Other Acknowledgement(s):
Nuela Enebechi (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7081
Presentation Time: GRIS 126 at 3:00-3:20

The Impact of a Snack Inspired by the Dieta de la Milpa on Cardiovascular-Kidney-Metabolic Health in Hispanic Individuals

STEM

Authors(s):
Kaylei Lank† (PWL); William Scott Akert‡ (PWL); Seyedeh Nooshan Mir mohammad ali‡ (HHS); Brandon M Kistler‡ (HHS); Allison Melissa Meilner Moffitt‡ (PWL)

Abstract:
Cardiovascular-kidney-metabolic (CKM) syndrome is a disorder characterized by dysfunctional adipose tissue progressing to other metabolic diseases, including diabetes, high blood lipids, high blood pressure, and chronic kidney disease. These conditions are highly prevalent among Hispanic individuals. Healthy dietary patterns can help prevent or slow the advancement of CKM. However, for the Hispanic population, standard CKM dietary patterns may be less accessible due to affordability, availability, or usual dietary habits. Dieta de la milpa (diet of the cornfield) is a healthy dietary pattern from Mesoamerica, heavily dependent on corn, beans, squashes, and chiles, that has been suggested to be beneficial for CKM health, but data is limited. Our objective was to evaluate the short-term effects of a Milpa-inspired snack on CKM health markers. Twelve individuals who meet minimum waist and BMI requirements and identify as Hispanic will have CKM measures such as blood pressure, blood glucose, and urine collected at baseline and every two weeks, totaling six weeks. During weeks 2 to 4, participants will be instructed to eat 50g of a Milpa-inspired snack daily, while in the first and last 2 weeks, participants will maintain their regular dietary habits excluding the Milpa snack. The goal of this study is to obtain preliminary findings on the impact of a Milpa-inspired snack on CKM outcomes, particularly individual variability, to inform future sample size calculations. We hypothesize that data collected from this pilot study will show short-term improvements in metabolic parameters, such as blood glucose and blood pressure, but no improvement in kidney function.

Keywords: CKM, Dieta de la Milpa,

Mentor: Annabel Biruete (Nutrition)

Mentor(s):
Annabel Biruete (HHS)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7082
Presentation Time: GRIS 126 at 3:20-3:40

Process-Level Digital Twin Guide for Flow Optimization and Interoperability in a Semiconductor Backend Manufacturing Plant

STEM
UREP-C or UREP-LA

Authors(s):
Ana Susana Deng Guan† (PWL)

Abstract:
The final stage of semiconductor manufacturing, Assembly, Test, and Packaging (ATP), determines product quality, traceability, and production lead time. This stage often operates with fragmented information systems, where equipment data, enterprise systems (e.g., Manufacturing Execution System (MES) and Enterprise Resource Planning (ERP)), and supply chain planning remain isolated. This fragmentation forces management to rely on partial or outdated plant data, limiting the plant's ability to respond to demand changes and supply disruptions. Most existing digital twin implementations also fail to address this, as they tend to model individual machines rather than the entire production flow.

To address this gap, this research develops a methodological guide for a process-level digital twin integrating the simulation layer with conceptual MES and ERP representations. The Low-profile Quad Flat Package, 64-lead (LQFP-64) for automotive microcontrollers serves as the case study, selected in response to the vulnerabilities that the COVID-19 semiconductor shortage exposed in the automotive semiconductor supply chain. The model is parameterized based on literature, generic industry data, and supplier information, covering the backend process from wafer preparation to final testing and packaging. A representative plant layout is simulated in FlexSim (a discrete-event simulation tool) to identify key variables, resource constraints, process times, and bottlenecks.

A preliminary analysis verified the simulation logic and identified wire bonding as the primary bottleneck limiting throughput. Demand variation scenarios were then evaluated to assess their effects on bottlenecks, lead time, and cycle time, while the effects of supplier disruptions will be examined in a subsequent phase. By capturing these dynamics at the full production-flow level, this work addresses the existing gap and establishes a foundation for digital twin implementation in backend manufacturing systems.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
Young-Jun Son (Engineering)

Other Acknowledgement(s):
Seung Ho Woo (Engineering); Kamelia Sepanloo (Engineering); Seonho Woo (Engineering)

Talk Presentation Abstract Number: 7083
Presentation Time: GRIS 133 at 3:00-3:20

Understanding Differences in Active Learning Classroom Typologies

Humanities
Wilke

Authors(s):
Odalis Joana Campos Vasquez† (Liberal Arts|JMHC)

Abstract:
Active-learning pedagogies are an instructional approach that according to research, have demonstrated positive outcomes for neurodivergent and neurotypical students alike. Classrooms in universities around the globe have transformed traditional classrooms into physical spaces that promote and practice active-learning. Despite existing literature, less work has been focused to understand how effective active-learning space arrangements are in supporting the teaching and learning environment. Active-learning typology and pedagogical structures vary widely. Consequently, evidence shows that these spaces may be counter-productive for students with neurodivergences. For example, some classroom arrangements can make it difficult for a student with ADHD to focus. Similarly, a student with ASD may face challenges when experiencing an active-learning classroom that promotes face-to-face collaborative work arrangements. To approach this research, we have devised a survey to collect students' experiences in active-learning classrooms and provide qualitative assessments of different classroom typologies. Based on the survey, we will collect demographic data, perceptions, attitudes, and preferences of active-learning across various higher education institutions that promote this instructional approach. Students will be assessed at a single point during that academic term. We aim to uncover the potential benefits and barriers to learning active-learning classrooms experienced by students.

Mentor(s):
Barbara Young (Liberal Arts)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7084
Presentation Time: GRIS 133 at 3:20-3:40

Temperature Annealing Properties of a Commercial Optical Transceiver in the Subcritical Pile and Nuclear Reactor

STEM
SURF-SCALE

Authors(s):
Brandon Anthony Farber† (Engineering)

Abstract:
Microelectronics are crucial components of modern space systems, requiring reliable operation in radiation environments. Commercial-off-the-shelf (COTS) devices have emerged as an alternative to radiation-hardened-by-design (RHBD) components because their low cost, accessibility, and short lead times make them a more practical option for many space and aerospace applications. Among these devices, optical transceivers, possessing photonic integrated circuits (PICs), enable high speed communication. Many of these devices have not been characterized under radiation. Furthermore, high temperatures can induce annealing within PICs, partially reversing radiation-induced damage and potentially extending device lifetime. Understanding this relationship is essential for evaluating the viability of these devices for high radiation environments. This study continues the characterization of a the FTLX8574D3BCV, an optical transceiver, by investigating its thermal behavior during neutron irradiation at Purdue's PUR-1 Reactor. Device temperature and bit-error rate (BER) are monitored throughout irradiation using a thermocouple and a Bit Error Rate Tester (BERT). Temperature and BER measurements obtained during neutron irradiation will be analyzed to evaluate the relationship between device temperature, radiation-induced degradation, and thermal

annealing. These measurements will be compared throughout irradiation to characterize the thermal response of the optical transceiver and its impact on communication performance. This work provides insight into the thermal effects of neutron irradiation on COTS optical transceivers and establishes a methodology for evaluating the influence of thermal annealing on radiation-induced degradation. The results will help assess the feasibility of deploying COTS optical transceivers in radiation-intensive environments and guide future radiation characterization studies.

Mentor(s):
Andrew Owen Fewell (Engineering); Peter Bermel (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering)

Talk Presentation Abstract Number: 7085
Presentation Time: GRIS 134 at 3:00-3:20

Bumblebee, a Foundation Model for Particle Physics Discovery

STEM

Authors(s):
Cara Suh† (Science)

Abstract:
Modern collider experiments produce high-dimensional events composed of variable sets of particles, making reconstruction and classification challenging. Bumblebee is a transformer-based foundation model for particle physics discovery, inspired by BERT (Bidirectional Encoder Representations from Transformers) and adapted for particle physics by removing positional encodings and embedding particle four-vectors along with particle type and detector-level information. Bumblebee is pretrained through masked particle modeling to learn relationships between generator-level and reconstructed representations of collision events. In dileptonic top-quark pair events, the original framework improved reconstruction resolution by 10–20% relative to a supervised baseline and transferred to downstream tasks, including toponium and initial-state classification. The most recent work updates the original Bumblebee study using Monte Carlo samples generated for Run 3 conditions. In addition to evaluating the existing reconstruction and masked-particle pretraining pipeline, the updated study explores alternative optimization strategies, including the Modified Differential Method of Multipliers (MDMM), to better balance multiple training objectives and constraints. These developments test the applicability of Bumblebee under more recent simulated collision conditions while establishing a more flexible framework for continued model development. This work examines the continued applicability of Bumblebee's event representation and masked-particle pretraining approach, as well as preparing the model for future studies that use a broader range of simulated processes and downstream particle-physics tasks. Investigations into applying novel architectures and training approaches to improve generalization are ongoing. These developments aim to transform Bumblebee into a scalable foundation model for a broader range of particle-physics applications.

Mentor(s):
Miaoyuan liu (Science)

Other Acknowledgement(s):
Andrew James Wildridge (Science); Jack Patrick Rodgers (Science)

Talk Presentation Abstract Number: 7086
Presentation Time: GRIS 134 at 3:20-3:40

Couples Perceptions of Family Functioning in Military Families with a PTSD Service Dog: A Convergent Mixed Methods Analysis

Social Science

Authors(s):
Tatum Reese Ebbeskotte† (Science|Vet Med)

Abstract:
Although prior research has explored how service dogs influence veterans' and partners' perceptions of family functioning independently, little is known about how these perceptions align within couples. This study seeks to compare perceived levels of family functioning between veterans with service dogs for post-traumatic stress disorder (PTSD) and their cohabitating partners. This study also aims to understand how survey and interview data might converge or diverge. A total of 17 couples, consisting of one veteran and their cohabitating partner, independently completed an online survey and a semi-structured interview. Survey data were analyzed in dyads using Pearson's correlation coefficient and matched pairs t-tests to investigate the level of alignment in survey responses between veteran and partner responses. Interview data was analyzed using a directed content analysis to determine how responses mapped onto the McMaster Family Assessment Device (FAD). Both data types were compared in the context of the seven FAD domains utilizing a convergent mixed methods approach. Data from the FAD suggests a trend toward unhealthy functioning within couples, particularly in the domains of behavioral control, roles, and affective responsiveness. Analysis showed that dyads were in alignment across all domains. This diverges with interview data where responses highlighted strengths in problem-solving, roles, and behavioral control, both within and across couples. Collectively, findings indicate an alignment of perceptions of family functioning between veterans and their partners, while also highlighting a divergence between data types. While survey responses trended towards unhealthy functioning, interview data suggested that couples perceived benefits to family functioning from the service dogs. Findings will inform the integration of service dogs, perhaps creating space to intentionally and proactively discuss how a service dog could impact family functioning.

Mentor(s):
Leanne Nieforth (Vet Med)

Other Acknowledgement(s):

Talk Presentation Abstract Number: 7087
Presentation Time: GRIS 134 at 3:40-4:00

Structural and Electronic Investigation of ACIGS Chalcopyrites using Density Functional Theory

STEM

Authors(s):
Yutika Vasudeo Sawant† (Science|JMHC)

Abstract:
(Ag,Cu)(In,Ga)Se2 (ACIGS) is a promising thin-film photovoltaic material with a high absorption coefficient, highly tunable bandgap, and reported record power conversion efficiencies approaching 24%. Solution processing enables high-throughput manufacturing of films at lower capital costs. However, their performance is limited by defect-driven non-radiative recombination. To address this, we present a rigorous structural and electronic investigation of ACIGS chalcopyrites using first-principles-based density functional theory (DFT). We first systematically benchmark four DFT functionals, ranging in accuracy and cost: PBE, PBEsol, static HSEsol, and fully relaxed HSEsol, to establish a highly accurate computational baseline. We evaluate lattice parameters, formation energies, density of states, and band structures (which yield electronic band gaps) of the four ternary endpoints of the ACIGS system (CuInSe2, CuGaSe2, AgInSe2, and AgGaSe2) and compare them against experimental data. Next, we investigate cation mixing between these endpoints at several Ag/Cu and Ga/In mixing ratios (10%, 25%, 50%, 75%), constructed using the special quasirandom structures (SQS) approach, and calculate the structural and electronic properties of such alloyed structures using DFT. This rigorous mapping of both the pristine and alloyed structures provides a robust foundation for future calculations of defect formation energies and chemical potential phase diagrams under varying processing conditions. In turn, this will establish the thermodynamic growth windows required to suppress defect formation, guiding the synthesis of high-efficiency ACIGS solar absorbers using solution processing.

Mentor(s):
Arun Kumar Mannodi Kanakkithodi (Engineering)

Other Acknowledgement(s):
Yi Yang (Engineering); Bipasa Samanta (Engineering)

VIRTUAL PRESENTATIONS

Presentations available on the Symposium website July 27-31, 2026. Presentations sorted by program (if any) and then by first author's last name. Only presenting authors (italicized) and mentors are listed. Contributing authors and acknowledgements are listed in the abstract book online.

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9000 Rosen Center for Advanced Computing Anvil REU Project #3-Elastic Cloud Scheduling for Anvil
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Eric Jin; Howie Lin; Mihir Ahlawat; Haniye Kashgarani

9002 GTAP Insight Engine: AI Agents for Scientific Computing
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9003 Rosen Center for Advanced Computing Anvil REU Project #3-Elastic Cloud Scheduling for Anvil
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9004 Pelican as a Data Delivery Mechanism for HPC Workflows on Anvil
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9005 Beyond Accuracy: A Calibrated Instrument for Certifying the Trustworthiness of LLM-Generated Clinical Hypotheses
Utkarsh Bali; Xuanyu Chen; Pengyi Shi

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9006 Systematic Gap Analysis for SoC Curriculum Development
Eileen Koh; Shauna Nicole Adams; Kerrie Douglas; Jill Anne Folkerts

ADDITIONAL PRESENTATIONS

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Peyton Rose Collier; Ellen M Schellhase; Monica Miller

9008 Hyperspectral Imaging and Machine Learning Pipeline for Non-Destructive Defect and Strain Mapping in 2D Semiconductors
Shashwat Goel; Srivalli Akella; Sanket Goel

9009 Bayesian Parameter Estimation for Nonlinear Dynamical Systems
Ansh Grover; Sabine Brunswicker

9010 Audit of Use of Enoxaparin for Off Label Indications Post Cardiac Surgery
Kylie Elizabeth Hall; Ellen M Schellhase

9011 Low-Cost Microfluidic Devices for Live Zebrafish Imaging of Wound Healing and Immune Response
Vianca Jelu; Qing Deng

9012 Vancomycin Functionalized DNA Hydrogel on Titanium Surfaces Against Implant Infections
Ikechi M Johnson; Leopold Noel Green; Luis Gabriel Montalvo Gonzalez; Jeffery Godwin Chibueze Ibekwe

9013 Analysis of Interventions made by Specialist Pharmacists during Annual Review of Cystic Fibrosis Patients
Emma Claire Kruyer; Ellen M Schellhase

9014 Anthracycline Maximum Lifetime Doses and Cardiotoxicity Risk Assessment Tools
Jessica Anna Malecki; Ellen M Schellhase; Monica Miller

9015 A Simulated Comparison of Propulsor Placement in Cargo Planes Implementing Boundary Layer Ingestion
Maximilianne Manuel; Michelle S Ulmer

9016 Hardware-aware code optimization using LLM fine-tuning with pairwise multi-objective DPO driven by a Lagrangian relaxation
Stefan Teodor Maxim; James C Davis; Huiyun Peng

9017 Modelling Multiple Pathologies of Alzheimer's Disease Using Human-Mouse Chimeric Brains
Akhil Pinnapareddy; Ranjie Xu; Yanru Ji

9018 A Stability-Aware Machine Learning Framework for Immune-Related Prognostic Gene Signatures in Breast Cancer Relapse
Ramya Prasanna; Nan Kong; Laia Vancells Lopez; Shen Chang

9019 AI's Effect on Cybersecurity Insider Threats
Sloka Sanampudi; Marcus K Rogers; Tatiana Ringenberg

9020 A Cloud-deployed Platform to Generate Expert-Annotated Data for AI-assisted Nursing Skills Assessment
Eric Tang; Shen Chang; Nan Kong

9021 Analysis of Semaglutide Eligibility in Hospitalized Patients Receiving High Intensity Statins
Brooke Thornburg; Ellen M Schellhase

9022 Evaluating Bayesian Optimization in Mixed-Variable Infrastructure Selection
Taylor Scott Vicente; Xiaoyu Liu

9023 Heuristic-Based Chemoenzymatic Retrosynthesis Planner for Complex Chemicals in Drug Manufacturing
Sahil Yadav; Karthik Sankaranarayanan; Sowmya Alichy

Virtual Presentation Abstract Number: 9000
Presentation Time: July 27-31 on Symposium Website

Rosen Center for Advanced Computing Anvil REU Project #3- Elastic Cloud Scheduling for Anvil

STEM
Anvil REU

Authors(s):
Angello Bravo† (PWL); Shelby Stall† (PWL)

Abstract:
Anvil HPC is a supercomputing cluster funded by the National Science Foundation (NSF) and can be accessed by scientific researchers to perform large computations and simulations. Kubernetes, on the Anvil Cloud, is an application that dynamically deploys, scales, and schedules computing systems to manage containers across the machines in the cluster. Currently, the dynamic node manager is used to convert workloads on Kubernetes to run on HPC, but allocates a whole node containing multiple GPUs, all of which may not be needed depending on the size of the job.

To address this, interLink is used to bridge the gap by creating a Virtual Kubelet in Kubernetes that is scheduled via Slurm, a remote scheduler that allocates the requested CPU and GPU resources. By using the tunneled deployment method for interLink, the system is secured by an SSH tunnel with the ACCESS program to utilize the system and can scale to enable multiple users at once. The interLink plugin is installed on the login nodes, and the virtual kubelet serves as the bridge between this plugin and the interLink API to connect the Anvil HPC system to the Avil Cloud system.

Additionally, Kubeflow, a tool that supports the creation of machine learning pipelines, provides a use case for this architecture. Model training and parameter tuning require higher compute power that is not available in Kubernetes. InterLink will serve as the connection between Kubernetes and a remote HPC system, so these tasks can be run with higher compute power. This can be extended to create connections from small systems to more powerful computers while keeping existing workflows and methods. The value of a scheduler for GPU nodes is greater efficiency in resource usage and waste reduction, so that vacant GPUs within the node can be utilized by other small jobs. With the growing need for GPU resources for AI, machine learning, and data-intensive applications, this allows for greater access and a higher job capacity.

Mentor(s):
LJ Lumas (PWL); Frank C Bakhit (PWL)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9001
Presentation Time: July 27-31 on Symposium Website

GTAP Insight Engine: AI Agents for Scientific Computing

STEM
Anvil REU

Authors(s):
Eric Jin† (Science|JMHC); Howie Lin† (PWL)

Abstract:
This project aims to create an AI agent for the analysis of datasets from the Global Trade Analysis Project. Their data contains over 800 model variables and dimensions. Analyzing multidimensional and relational datasets is complex; it requires knowledge of database systems and other data science techniques outside economic researchers' field of expertise. However, agentic LLMs can be proficient at this task.

Strong open-weight LLMs were used as a base, and handcrafted tools were built to allow the agent to perform actions autonomously. These included a query and RAG agent to identify variables the user wants and run SQL queries in a database hosting the datasets, and a Python interpreter environment where the agent could run code to analyze the data. A multi-step reasoning pipeline was also used to improve the quality of the responses and limit usage of the LLMs' context windows. All features were packaged into a web application frontend using the Chainlit framework. Having access to agentic AI tools like this one has the potential to significantly boost researcher productivity by giving them access to high-quality data analysis that they otherwise could not perform on their own.

Mentor(s):
Mihir Ahlawat (PWL); Haniye Kashgarani (PWL)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9002
Presentation Time: July 27-31 on Symposium Website

GTAP Insight Engine: AI Agents for Scientific Computing

STEM
Anvil REU

Authors(s):
Howie Lin† (PWL); Eric Jin† (Science|JMHC)

Abstract:
Programming experience and complex data processing are major bottlenecks in data-intensive research. This challenge is evident in the Global Trade Analysis Project (GTAP); for instance, the organization's 2023 paper alone, Investing in Nature Can Improve Equity and Economic Returns, required the manual manipulation of 42 separate spreadsheets, complex acronyms, and formulas. Processing and visualizing such data demands expertise across multiple software programs and coding languages, which significantly increases preprocessing-to-analysis overhead for both new and experienced researchers. Customizable AI agents designed for project-specific workflows offer a flexible solution to this bottleneck by automating highly technical, repetitive tasks and handling errors autonomously. Aiming to accelerate the workflow of GTAP researchers, we developed a specialized data query and analysis agent using Python. Preloaded with GTAP data, the agent provides accurate zero-shot and one-shot query responses. It can execute containerized Python commands, query datasets using SQL, generate Matplotlib visualizations, communicate in multiple languages, and utilize Retrieval-Augmented Generation (RAG) with full transparency to perform advanced contextual functions. Preliminary testing demonstrates that the agent can retrieve GTAP data, answer representative research queries, and automate routine data-processing tasks. Ultimately, this project demonstrates the potential for self-built, self-hosted agents to improve research workflows. This work establishes a scalable framework that other research teams can adopt to build their own locally hosted agents, ensuring that as research data grows, the system's utility scales alongside the project.

Mentor(s):
Mihir Ahlawat (PWL); Haniye Kashgarani (PWL)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9003
Presentation Time: July 27-31 on Symposium Website

Rosen Center for Advanced Computing Anvil REU Project #3- Elastic Cloud Scheduling for Anvil

STEM
Anvil REU

Authors(s):
Shelby Stall† (PWL); Angello Bravo† (PWL)

Abstract:
Anvil HPC is a supercomputing cluster funded by the National Science Foundation (NSF) and can be accessed by scientific researchers to perform large computations and simulations. Kubernetes, on the Anvil Cloud, is an application that dynamically deploys, scales, and schedules computing systems to manage containers across the machines in the cluster. Currently, the dynamic node manager is used to convert workloads on Kubernetes to run on HPC, but allocates a whole node containing multiple GPUs, all of which may not be needed depending on the size of the job.

To address this, interLink is used to bridge the gap by creating a Virtual Kubelet in Kubernetes that is scheduled via Slurm, a remote scheduler that allocates the requested CPU and GPU resources. By using the tunneled deployment method for interLink, the system is secured by an SSH tunnel with the ACCESS program to utilize the system and can scale to enable multiple users at once. The interLink plugin is installed on the login nodes, and the virtual kubelet serves as the bridge between this plugin and the interLink API to connect the Anvil HPC system to the Avil Cloud system.

Additionally, Kubeflow, a tool that supports the creation of machine learning pipelines, provides a use case for this architecture. Model training and parameter tuning require higher compute power that is not available in Kubernetes. InterLink will serve as the connection between Kubernetes and a remote HPC system, so these tasks can be run with higher compute power. This can be extended to create connections from small systems to more powerful computers while keeping existing workflows and methods. The value of a scheduler for GPU nodes is greater efficiency in resource usage and waste reduction, so that vacant GPUs within the node can be utilized by other small jobs. With the growing need for GPU resources for AI, machine learning, and data-intensive applications, this allows for greater access and a higher job capacity.

Mentor(s):
LJ Lumas (PWL); Frank C Bakhit (PWL)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9004
Presentation Time: July 27-31 on Symposium Website

Pelican as a Data Delivery Mechanism for HPC Workflows on Anvil

STEM
Anvil REU

Authors(s):
Branden Turner† (PWL)

Abstract:
Researchers increasingly rely on large-scale computing workflows that require large datasets, but accessing that data efficiently remains a persistent bottleneck. This is especially relevant on HPC systems like Anvil, an NSF-funded supercomputer accessed by researchers through ACCESS. To address data-access limitations in HPC environments, Pelican delivers data from federated sources such as the Open Science Data Federation (OSDF), a network of data origins and caches. It uses the HTTP protocol to stream data pieces rather than downloading an entire dataset. The big question is: is Pelican a viable alternative to S3 and local storage for large compute workloads on Anvil? Three benchmarks address this question. Benchmark 1 tests cache behavior by using an 8.5Gb NCAR dataset to test the time to first byte and concurrent load across a SLURM array. We test three different ways of getting this data: local GPFS, Pelican cold caching, and Pelican warm caching. Benchmark 2 compares performance across three data-access methods: downloading from scratch, using local data, and streaming from an origin with Pelican. We test this against a feed forward neural network workflow which reads a tiny portion of that data, run through a 50 task SLURM array to test concurrent behavior. Finally in benchmark 3, we test IO in a real ResNet50 workflow using a subset of the Imagenet1k. We test against local S3, local GPFS, and Pelican streaming. One issue is dataset discovery: OSDF and Pelican offer no real way to find datasets without already knowing an endpoint. Even once a dataset is found, its ability to be streamed depends on how it is packaged; if it's compressed, data pieces can't be streamed. Other than these obstacles, Pelican performs well for streaming, with downloading wasting 99.9% of data and taking 19x as long. Pelican caching provides a major boost in speed, speeding up 7x once cached. Concurrent streaming showed no degradation when using Pelican, whereas local did.

Mentor(s):
Guangzhen Jin (PWL); Bithi De (PWL)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9005
Presentation Time: July 27-31 on Symposium Website

Beyond Accuracy: A Calibrated Instrument for Certifying the Trustworthiness of LLM-Generated Clinical Hypotheses

STEM
DUIRI

Authors(s):
Utkarsh Bali† (DSB); Xuanyu Chen† (Science)

Abstract:
Hypothesis-driven clinical prediction promises models that are accurate and explainable, yet the promise is only half met: hypotheses from large language models (LLMs) are judged by accuracy alone, and higher accuracy can come from a feature that stands in for a protected attribute, tracks a confounder, or leaks the outcome. We ask whether such hypotheses can be interpretable, trustworthy, and accurate together. On four MIMIC-IV tasks (in-hospital mortality, discharge destination, length of stay, and 30-day readmission) we develop CLIP-H, which discovers interpretable hypotheses, certifies them statistically, and audits their faithfulness. A Top-K sparse autoencoder over patient-profile embeddings surfaces latent clinical concepts, an LLM turns each into a falsifiable hypothesis scored for fidelity and de-duplicated, and a hypothesis is retained only if it controls the false-discovery rate and stays stable under bootstrap resampling on a held-out split, so multiple testing is paid once. Survivors form binary features in a logistic model whose per-concept weights are read directly, so predictions decompose into named clinical concepts. Beyond accuracy, a calibrated audit separates predictive value from faithfulness: for each hypothesis we commit to its expected direction and strength before any outcome is seen, compare this with the measured effect, place the agreement between a random baseline and an all-feature oracle, and flag demographic proxies and leakage. CLIP-H stays competitive with strong classical and black-box baselines, matching them on some tasks and trailing slightly on others, while replacing the black box with concepts a clinician can read. Its certified concepts agree with their expected direction well above chance; expected effect sizes track measured ones only loosely, and a few concepts still behave as demographic proxies. CLIP-H offers clinical prediction that is interpretable by construction, statistically certified, and auditable for trust.

Mentor(s):
Pengyi Shi (DSB)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9006
Presentation Time: July 27-31 on Symposium Website

Systematic Gap Analysis for SoC Curriculum Development

STEM
SURF-SCALE

Authors(s):
Eileen Koh† (Engineering); Olyver Fierro‡ (Engineering); Junyi Xiu* (Vanderbilt University); Nathan Grant Clark* (Engineering)

Abstract:
To cultivate talent in microelectronics for national defense, the workforce development program SCALE (SCalable Asymmetric Lifecycle Engagement) provides members access to an educational repository of lectures, presentations, courses, tools, and other resources developed by subject-matter experts organized by verticals. Each vertical has a set of educational standards developed by a task force of educators and employers that details the essential collection of knowledge, skills, and abilities a student of the respective vertical must possess for competency. Focusing specifically on the SCALE System-on-Chip (SoC) vertical standards, this work aims to conduct a systematic gap analysis of the SoC curriculum by identifying the benchmarking gap, perception gap, and learning gap as guided by the approach of Vinish et al., 2022. Around n = 110 education resources were independently assessed by two undergraduates of the SoC vertical. Benchmarking gap analysis are derived through checking for satisfaction of the SoC vertical standards; the findings are supported by comparison to prior mappings done by AI. Perception gap is evaluated through comparing the SoC vertical standards with analysis of SoC job posting descriptions in SCALE's archive. Learning gap results are derived through analyzing the experience and meta-data observations of the evaluators as representative users of the SCALE curriculum, providing insights into how the intended users interacts with the resources and interprets curriculum coverage. Conducting a systematic gap analysis of the SCALE SoC curriculum, this research identifies well-represented and underserved SoC vertical standards, reveals strong and weak connections between industry practice and SCALE education, and alignment of educator and student expectations. This work will inform employers, recruiters, alumni, current students, faculty, and industry mentors in future defense-oriented microelectronics curriculum development and reform.

Mentor(s):
Shauna Nicole Adams (Engineering); Kerrie Douglas (Engineering); Jill Anne Folkerts (Engineering)

Other Acknowledgement(s):
CJ Holdeman (Engineering); Gabriella Coloyan Fleming (Purdue University)

Virtual Presentation Abstract Number: 9007
Presentation Time: July 27-31 on Symposium Website

A Medication Safety Analysis of Delayed Critical Medication Administration

STEM

Authors(s):
Peyton Rose Collier† (Pharmacy)

Abstract:
Introduction: Delayed administration of critical medications can lead to adverse patient outcomes. St Bartholomew's Hospital(SBH) continuously monitors medication safety to identify opportunities to reduce delays in medication administration and improve patient care.

Objective: To evaluate delays in medication administration greater than two hours after the scheduled administration time and characterize critical medication delayed doses.

Methods: An observational analysis of medication administration data from April 2025 through April 2026 was conducted using Microsoft Excel®. A total of 222,560 medication doses were analyzed using formulas and pivot tables to summarize dose trends. Delayed doses were categorized as 2-3 hours, 3-4 hours, 4-6 hours, and greater than 6 hours. Critical medications were identified using the SBH Critical Medications List.

Results: Of the 222,560 medication doses analyzed, 112,794 were identified as critical medications. The largest proportion of delayed critical medications occurred within the 2-3 hour interval, accounting for 43,535 delayed doses (38.6% of delayed critical medications). Enoxaparin, piperacillin-tazobactam, and bisoprolol were the most frequently delayed medications. Enoxaparin accounted for 6,583 delayed doses (5.84% of delayed critical medications), including 2,831 doses within the 2-3 hour category (6.5% of delayed doses in this interval). Oncology wards demonstrated the highest frequency of delayed enoxaparin administration.

Conclusions: Most delayed doses of critical medication occurred within 2-3 hours of the scheduled dose. Enoxaparin and piperacillin-tazobactam represented a substantial proportion of delayed medications, suggesting opportunities to improve medication administration workflows. Continued monitoring of delayed-dose reporting may help reduce medication-

related patient safety risks and support quality improvement initiatives at SBH.

Mentor(s):
Ellen M Schellhase (Pharmacy); Monica Miller (Pharmacy)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9008
Presentation Time: July 27-31 on Symposium Website

Hyperspectral Imaging and Machine Learning Pipeline for Non- Destructive Defect and Strain Mapping in 2D Semiconductors

STEM

Authors(s):
Shashwat Goel† (PWL); Srivalli Akella†

Abstract:
The performance and reliability of semiconductor thin films are strongly influenced by microscopic defects, including grain boundaries, vacancies, strain fields, and compositional inhomogeneities, which affect their optical and electronic properties. Conventional characterization techniques are often destructive, time-consuming, or unsuitable for rapid, large-area analysis, motivating scalable, non-destructive alternatives. This work presents an integrated hyperspectral imaging and machine learning framework for quantitative defect and strain mapping in two-dimensional (2D) transition metal dichalcogenide (TMD) thin films, including WS_2 on silicon nitride membrane substrates. Naturally occurring and engineered defects are selected as regions of interest and analyzed using hyperspectral data cubes. The data are preprocessed through illumination correction, background normalization, spectral smoothing, wavelength calibration, and optical density conversion. Material states are identified using linear spectral unmixing based on singular value decomposition (SVD) when reference spectra are available; otherwise, principal component analysis (PCA) followed by K-means clustering is used for unsupervised classification. The resulting classifications are converted into composition maps and refined through spatial filtering and interpolation to generate quantitative maps of defect distribution and strain-sensitive optical response. These maps are incorporated into finite element analysis (FEA) to estimate stress and strain distributions. The framework is validated using laser-induced graphene (LIG) samples with tunable defect densities. Raman spectroscopy maps with known graphitization levels provide ground truth for evaluating classification accuracy and model generalization. This work establishes a scalable, non-destructive platform for linking material heterogeneity with device-relevant properties and enabling rapid characterization of advanced semiconductor materials.

Mentor(s):
Sanket Goel (Bits Pilani Hyderabad Campus)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9009
Presentation Time: July 27-31 on Symposium Website

Bayesian Parameter Estimation for Nonlinear Dynamical Systems

STEM

Authors(s):
Ansh Grover† (Science)

Abstract:
Estimating physical parameters from noisy data is a central challenge when dealing with nonlinear dynamical systems. System Identification (SysID) is the process of constructing mathematical models of dynamical systems directly from measured input-output data. The inverse problem in SysID involves recovering the physical parameters of these systems, for example, the drag coefficient in an aircraft. When the initial conditions are also unknown, they must be estimated jointly with the parameters. This makes the inverse problem rather difficult as both enter the observed data nonlinearly, so the two sources of uncertainty cannot be cleanly separated. In safety-critical systems, a single best-guess parameter value is not enough, we need to know exactly how confident that estimate is. This requires the full posterior distribution over the parameters rather than a point estimate. Exact Bayesian methods such as MCMC provide this but are too computationally expensive for real-time or high-dimensional use, since they require repeatedly simulating the system for every candidate parameter value. Laplace-based approximations offer a faster alternative by approximating the posterior locally around its most likely value, though this can break down under heavy noise, sparse data, or irregular forcing. This work systematically compares three such approaches on a mass-spring-damper system, used here as a controlled benchmark: the Laplace Approximated Posterior (LAP), the faster MAP-Laplace approximation, and a Gaussian-Process-based method (GP-LAP) that replaces repeated numerical simulation with a gaussian process surrogate fit directly to the data. The same three methods will subsequently be extended to more complex, higher-dimensional systems, including a double pendulum and a 3-DOF aircraft model, to evaluate how each approach scales beyond this benchmark.

Mentor(s):
Sabine Brunswicker (Polytechnic)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9010
Presentation Time: July 27-31 on Symposium Website

Audit of Use of Enoxaparin for Off Label Indications Post Cardiac Surgery

STEM

Authors(s):
Kylie Elizabeth Hall† (Pharmacy)

Abstract:
ACC/AHA and ESC guidelines support off-label low molecular weight heparin use for patients with atrial fibrillation (AF) or post-operative AF following prosthetic valve surgery. GUI0643 was created to provide guidance on the dosing and monitoring of off-label enoxaparin at St Bartholomew's Hospital (SBH).

This audit assessed compliance with GUI0643, including appropriate patient selection, dosing, and monitoring of enoxaparin therapy.

A retrospective review of 150 SBH patients with indications to be anticoagulated post-surgery from 03/03/2026 to 30/05/2026 was conducted. Patients were identified through monthly theatre lists and data was collected from electronic health records. Data included: weight, serum creatinine, anticoagulation indication, enoxaparin dosing, and factor Xa monitoring. Doses received were compared to the guideline. Data was categorized and assessed nominally.

The post-cardiac surgery anticoagulation indications included: post-operative AF (61), mAVR (57), AF (34), mMVR (15), PE history (1), LV thrombus (1), and DVT history (1). Of these, 107 (71.3%) received the correct dose. The indications for anticoagulation in patients who received an incorrect dose included LV thrombus (1/1, 100%), post-op AF (24/61, 39.3%), AF (12/34, 35.3%), mAVR (8/57, 14.0%), and mMVR (1/15, 6.7%). Seventy-six patients were still on enoxaparin after 5 days; only 16 (21.1%) were increased to the full dose at this time. Anti-Xa activity monitoring was done in 6 patients, 4 of which met criteria for monitoring (CrCl <20ml/min or weight >144kg).

The audit shows suboptimal compliance with GUI0643 which may leave patients at an increased risk of thrombus. Increasing education around the guideline may help to increase compliance.

Mentor(s):
Ellen M Schellhase (Pharmacy)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9011
Presentation Time: July 27-31 on Symposium Website

Low-Cost Microfluidic Devices for Live Zebrafish Imaging of Wound Healing and Immune Response

STEM

Authors(s):
Vianca Jelu† (Science|JMHC)

Abstract:
Zebrafish embryos are widely used as a model organism for studying wound healing and immune cell behavior due to their optical transparency and genetic accessibility. However, traditional microfluidic devices used for live imaging are often expensive and require specialized fabrication techniques, limiting accessibility for many research settings. This project focuses on the development and application of a low-cost polyethylene terephthalate (PET) lamination method for constructing microfluidic devices that support long-term imaging of zebrafish embryos.

Zebrafish embryos were prepared and imaged using PET-laminated devices designed to immobilize specimens while preserving natural tissue dynamics. Imaging experiments were conducted to observe calcium signaling and neutrophil recruitment following induced injury. These devices enabled stable, high-quality imaging over extended time periods and allowed for simultaneous observation of multiple embryos.

The findings from this work support the effectiveness of PET-based microfluidic devices as a cost-efficient alternative to traditional fabrication methods while maintaining reliable imaging conditions. This work contributes to increasing accessibility to advanced imaging techniques and supports broader applications in developmental biology and immune response research.

Mentor(s):
Qing Deng (Science)

Other Acknowledgement(s):
Shelly Guo Tan (Science)

Virtual Presentation Abstract Number: 9012
Presentation Time: July 27-31 on Symposium Website

Vancomycin Functionalized DNA Hydrogel on Titanium Surfaces Against Implant Infections

STEM

Authors(s):
Ikechi M Johnson† (Engineering); Lara Teresa Muniz‡ (Engineering)

Abstract:
Implant-associated infection remains a major cause of failure in titanium-based orthopedic and dental devices because bacterial adhesion and biofilm formation occur rapidly after implantation and are difficult to eradicate once established. Current antimicrobial coatings can reduce early colonization, but many rely on antibiotic burst release, metal ion exposure, or polymer systems that may lose activity over time, compromise host integration, or offer limited programmability for prolonged infection control. This study presents a programmable antimicrobial surface coating for titanium alloy based on a DNA hydrogel interface functionalized with vancomycin as the operational antimicrobial agent, designed to provide biologically durable, surface-confined, and tunable antibacterial activity. The coating strategy will use covalent anchoring chemistry to immobilize a DNA-derived hydrogel layer and present antibiotics in a controllable architecture, enabling adjustment of antibiotic density and release behavior while preserving the modularity of the coating platform. Repeated impedance measurements will confirm successful antibiotic-loaded hydrogel coating, while microbiological studies against clinically relevant strains such as Staphylococcus aureus, Escherichia coli, and Bacillus subtilis will demonstrate bacterial susceptibility to encapsulated vancomycin, as well as bacterial-responsive vancomycin release from the DNA hydrogel relative to uncoated and unloaded controls. By combining the programmability of nucleic acid materials with the clinically established functionality of antibiotics, this platform addresses a key translational gap in orthopedic implant coatings: the need for antimicrobial surfaces that are effective, adaptable, and durable under biologically relevant conditions without depending solely on conventional antibiotics.

Mentor(s):
Leopold Noel Green (Engineering); Luis Gabriel Montalvo Gonzalez (Science); Jeffery Godwin Chibueze Ibekwe (Engineering)

Other Acknowledgement(s):
Nicholas Jakalski (Engineering)

Virtual Presentation Abstract Number: 9013
Presentation Time: July 27-31 on Symposium Website

Analysis of Interventions made by Specialist Pharmacists during Annual Review of Cystic Fibrosis Patients

STEM

Authors(s):
Emma Claire Kruyer† (Pharmacy)

Abstract:
Cystic fibrosis (CF) is a multifaceted disorder requiring the utilization of a multidisciplinary team to create a collaborative management plan that best serves the needs of each patient. At Barts Health NHS, a pharmacist is involved at each annual review (AR) clinic to provide medication optimization services.

The study objective was to analyze the interventions made by CF specialist pharmacists in the AR clinic.

A retrospective review of clinical interventions by a CF specialist pharmacist during AR clinic at Barts Health NHS was completed. Data was pulled from reviews between May and November 2025, creating a pool of 16 individuals. Patient charts and finalized clinic reports determined the type of intervention, sorted into medication reconciliation, counseling, and prescribing. Descriptive statistics were completed to evaluate the data.

A total of 64 CF pharmacist interventions were documented, finding medication reconciliation as the primary intervention (n=36, 56.25%) followed by counseling (n=23, 35.94%) and prescribing (n=5, 7.81%). The most reported medication reconciliations were medication list review (n=16, 100%) followed by adherence documentation (n=13, 81.25%). Of the counseling subtype, potential switches between related medications had the highest intervention rate (n=11, 68.75%). Prescribing a new rescue pack (n=3, 18.75%) was written more than a modulator prescription (n=2, 12.5%).

The data reveals the impact of specialist pharmacists in the AR clinic through the creation, on average, of four interventions per CF patient. This highlights the role of pharmacists in generating a more holistic approach to patient-centred care and medication optimization.

Mentor(s):
Ellen M Schellhase (Pharmacy)

Other Acknowledgement(s):

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Virtual Presentation Abstract Number: 9014
Presentation Time: July 27-31 on Symposium Website

Anthracycline Maximum Lifetime Doses and Cardiotoxicity Risk Assessment Tools

STEM

Authors(s):
Jessica Anna Malecki† (Pharmacy)

Abstract:
Background

Anthracyclines are chemotherapies commonly utilized to treat various cancers; however, their use comes with dose-limiting cardiotoxicity. A literature search on cardiotoxic risk reduction via maximum cumulative anthracycline doses and other methods is critical to best support the care of oncology patients at SBH.

Objective

The objective was to develop tools for tracking maximum cumulative anthracycline dose and dose conversions to limit cardiotoxicity.

Methods

Literature search results were synthesized with anthracycline package inserts, summary of product characteristics, and current National Health Service (NHS) guidelines. Synthesis was organized into a table containing dose reduction criteria for renal and hepatic impairment, conversion factors, and maximum cumulative doses. A Microsoft Excel® dose conversion calculator and a table to stratify cardiotoxicity risk were created.

Results

The medications (maximum dose; conversion factor) included in the dose conversion calculator were daunorubicin (550; 0.6), liposomal daunorubicin with cytarabine (N/A; N/A), doxorubicin (450; 1), liposomal doxorubicin (N/A; N/A), epirubicin (900; 0.8), intravenous idarubicin (150; 5), oral idarubicin (400; N/A), and mitoxantrone (140; 10). Dose (mg/m2) of each anthracycline can be entered, which are then automatically converted to doxorubicin equivalent doses and summed.

A cardiotoxicity risk stratification table based on previous cardiovascular disease, cardiac biomarkers, demographic and cardiovascular risk

factors, previous cardiotoxic cancer treatment, and lifestyle risk factors was also developed to guide cardioprotective strategies.

Conclusion

The literature search revealed a lack of consensus on anthracycline maximum doses and dose conversions. Additionally, it validated the benefits of limiting cardiotoxicity via maximum cumulative anthracycline doses and risk assessment as early as possible.

Mentor(s):
Ellen M Schellhase (Pharmacy); Monica Miller (Pharmacy)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9015
Presentation Time: July 27-31 on Symposium Website

A Simulated Comparison of Propulsor Placement in Cargo Planes Implementing Boundary Layer Ingestion

STEM

Authors(s):
Maximilianne Manuel† (Engineering|JMHC)

Abstract:
Boundary layer ingestion (BLI) has emerged as a useful technology in the advancement of aviation. This technology works by recovering energy from the fuselage boundary layer, the layer of air that has stuck to the body of an aircraft due to friction and fluid viscosity, and using engines to accelerate low momentum air, thus minimizing overall propulsive requirements. While previous research has demonstrated the theoretical benefits of BLI for commercial aircraft, specifically those with low wing configurations, comparatively little attention has been given to how the placement of a BLI propulsor influences a plane's aerodynamic performance in high wing transport style aircraft configurations. This study experimentally investigates the effect of propulsor placement on both the aerodynamic and propulsive performance of a cargo aircraft-inspired fuselage using a low cost test platform. The objective of this research is to examine how propulsor installation affects performance. A simplified cargo plane model with interchangeable engine locations will be designed to evaluate four main BLI propulsor placements. Testing will be performed against the different propulsor placements in a variety of different airspeeds using computational fluid dynamics simulations, namely SimScale. The ratio between drag eliminated and thrust generated will be analyzed and compared against predetermined standards to evaluate aerodynamic ability for each configuration. Furthermore, thrust and power consumption will be measured in newtons and watts, respectively, for each differently placed propulsor to determine propulsion performance, The experimental results will be compared to identify how different variations in propulsor locations influence propulsive and aerodynamic ability. By developing an experiment that can be replicated, this work has the potential to provide experimental data and in

Mentor(s):
Michelle S Ulmer (Engineering)

Other Acknowledgement(s):

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Hardware-aware code optimization using LLM fine-tuning with pairwise multi-objective DPO driven by a Lagrangian relaxation

STEM
VIP

Authors(s):
Stefan Teodor Maxim† (Science); Arjun Sandeep Gupte‡ (Engineering); Ahmed Tarek Ibra Elmersawy‡ (Engineering); Andre Lee‡ (Engineering)

Abstract:
This paper explores several methods for fine-tuning large language models for pairwise-comparison-based code optimization. The study began with a traditional static weighted penalty vector, which proved unstable when optimization objectives conflicted. The algorithm was therefore extended to use a modified multi-objective Direct Preference Optimization framework that provides stable pairwise classification and improved convergence through Lagrangian relaxation. A composite reward was introduced to adapt to the training stage, so code correctness could dominate during early training, while performance objectives became more influential in later training stages. In addition, a dynamic constrained utility function was developed to handle hard deployment constraints and sparse evaluation data without requiring a separate reward model. The dynamic penalty tensor captures the target hardware platform: for datacenter deployment, the tensor emphasizes throughput, while for mobile platforms, it prioritizes energy efficiency. Pairwise preferences are derived directly from benchmark results and hardware-counter measurements. To mitigate the noise inherent in hardware benchmarking, uncertainty-aware penalties were used. Each candidate program was benchmarked multiple times, and sampled integration was applied to compute the final averaged performance estimate. Experiments were performed on the Codenet dataset, which contains 120K code snippets. Using QLoRA, we fine-tuned a range of LLMs, starting with Pythia, a small model with 70M parameters and scaling to larger models, including Code Llama 7B/13B/34B, Qwen Coder 2.5/3, and the latest Qwen 3.6 27B dense model. When only two objectives were used, even the small models converged. However, when the number of objectives was increased to include throughput as the main optimization target, with CPU cycles, memory, energy, and latency as constrained objectives, fine-tuning converged only for the larger LLMs.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
James C Davis (Engineering); Huiyun Peng (Engineering)

Other Acknowledgement(s):

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Presentation Time: July 27-31 on Symposium Website

Modelling Multiple Pathologies of Alzheimer's Disease Using Human-Mouse Chimeric Brains

STEM

Authors(s):
Akhil Pinnapareddy† (Liberal Arts|Vet Med)

Abstract:
Alzheimer's disease (AD) is the leading cause of dementia and is characterized by tau protein aggregation and amyloid beta (Aβ) plaque pathology. In approximately half of AD cases, transactive response DNA-binding protein 43 (TDP-43) is also found to aggregate in patient brains, resulting in greater cognitive deficits and neurodegeneration than tau and Aβ alone. Translational models that reproduce all three hallmarks are therefore needed to study mechanisms of severe and late-stage AD. Here, two human–mouse chimeric approaches were tested in Rag1-/- mice. In the first, human induced pluripotent stem cell (hiPSC)-derived vascularized neuroimmune organoids, which contained human neurons, microglia, astrocytes, and blood vessels, were pre-exposed in vitro to seeding-competent postmortem AD brain extract and then transplanted into adult mice, with the aim of establishing seeded pathology within a mature, multicellular human graft. In the second, human neural progenitor cells (hNPCs) were transplanted neonatally to generate chimeric brains, which were then seeded by intracerebral injection of AD brain extract. The pre-exposed organoids did not survive transplantation, precluding pathological analysis for that approach. In the hNPC chimeras, immunostaining revealed both Aβ and tau pathology in human neurons, whereas TDP-43 aggregation was barely detected. Together, these results show that hNPC chimeras can recapitulate Aβ and tau pathology from patient-derived seeds, while indicating that modeling TDP-43 proteinopathy and sustaining pre-seeded vascularized organoid grafts will require further optimization.

Mentor(s):
Ranjie Xu (Vet Med); Yanru Ji (Vet Med)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9018
Presentation Time: July 27-31 on Symposium Website

A Stability-Aware Machine Learning Framework for Immune-Related Prognostic Gene Signatures in Breast Cancer Relapse

STEM

Authors(s):
Ramya Prasanna† (Science|JMHC)

Abstract:
Prognostic gene signatures stratify patients into high or low relapse risk, reducing unnecessary chemotherapy. Breast cancer's molecular heterogeneity, spanning at least five intrinsic subtypes, makes it a persistent prognostic challenge and a testbed for signature methodology. Since immunotherapy efficacy depends on the tumor immune microenvironment, an immune related prognostic gene signature (IRPGS) is valuable for stratifying relapse risk and identifying who benefits from immune targeted therapy versus standard treatment. Many IRPGSs have been built using ML frameworks, yet these signatures often show limited accuracy, poor reproducibility, and nonconsensus among selected genes, leaving robustness and stability underexplored. This study uses ten established survival ML algorithms, including Random Survival Forest, LASSO, Ridge, CoxBoost, and survival support vector machines, combined in 101 combinations to construct IRPGSs predicting breast cancer relapse risk. Stability analysis is performed using Nogueira's measure as the primary metric, Jaccard and Hamming distance as interpretable baselines, and Kuncheva's index for chance corrected comparisons at fixed subset sizes. Training data is sourced from GSE42568, GSE21653, and GSE20711, with independent validation from GSE88770. Immune related genes are filtered using ImmPort, then subjected to univariate Cox regression by survival stratification. Performance is evaluated using time dependent ROC/AUC and Kaplan-Meier analysis, and biological significance is assessed through GSEA using KEGG pathways. This analysis is expected to rank the 101 combinations by feature selection consistency rather than C-index alone, identifying immune genes repeatedly selected across bootstrap resamples versus those appearing by chance. The output will be a consensus gene set that is predictive and stable, forming the basis of a final IRPGS chosen for reproducibility across cohorts rather than the single highest test-set C-index.

Mentor(s):
Nan Kong (Engineering); Laia Vancells Lopez (Engineering); Shen Chang (Engineering)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9019
Presentation Time: July 27-31 on Symposium Website

AI's Effect on Cybersecurity Insider Threats

STEM

Authors(s):
Sloka Sanampudi† (Polytechnic)

Abstract:
Artificial intelligence is becoming more and more integrated into cybersecurity as organizations continue to use it as a tool for threat detection and incident response. While AI can strengthen these defensive capabilities for companies, it may also introduce unintended insider threat risks by enabling unauthorized access, facilitating insider misuse of company data, and creating vulnerabilities through unregulated use of the systems.

Employees may unknowingly expose private information by entering sensitive data into public AI tools. At the same time, malicious insiders can use these AI tools to create phishing campaigns, generate social engineering content, write malware, or create harmful scripts. On the other hand, AI can help security teams improve anomaly detection/email sentiment analysis, identify suspicious user behavior, and support faster incident response. This dual role of AI is the central focus of this research study.

This study will use a mixed-methods survey to collect both quantitative and qualitative data from adults in the United States who are recruited through Prolific. The Qualtrics survey will measure computer misuse behaviors using the Computer Crime Index Revised (CCIR), along with questions on AI use and exposure within organizations, organizational AI control and monitoring practices, and perceptions of AI as an insider threat risk.

The survey results will be used to provide a better understanding of how AI can affect insider threats in organizations, from both a defensive and offensive perspective. This research may help organizations improve their cybersecurity policies, employee training, and the safe use of AI technologies. It will also add to current research on the relationship between AI and cybersecurity as more organizations continue to depend on AI tools.

Mentor(s):
Marcus K Rogers (Polytechnic); Tatiana Ringenberg (Polytechnic)

Other Acknowledgement(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9020
Presentation Time: July 27-31 on Symposium Website

A Cloud-deployed Platform to Generate Expert-Annotated Data for AI-assisted Nursing Skills Assessment

STEM

Authors(s):
Eric Tang† (Science)

Abstract:
Automated analysis of nursing procedure videos can assist teaching staff in nursing programs and contribute to achieving education outcomes by making skills assessment more efficient, especially while facing a shortage of nursing faculty nationwide. Our lab developed a prototypical Video-Language Model (VLM) that demonstrated the feasibility of this AI-assisted approach based on online nursing skills demo videos. To train this VLM for future clinical use, here we created a cloud-deployed platform to generate expert annotations from real nursing skills videos. We designed this platform to support a two-phase annotation system, where phase-1 reviewers provide preliminary annotations for phase-2 evaluation and revision by highly experienced experts.

This project combined a Flask backend with an HTML/JS frontend, providing customized, user-friendly tools for temporal annotation. Deployment is handled via Google Cloud Run, with restricted video hosting on Kaltura.

Our platform gives experts a secure, web-based interface to review videos, map start and end timestamps of specific steps, and attach comments and ratings. Annotations are stored as reviewer-specific records, allowing multiple experts to evaluate the same videos independently. This captures variation in clinical judgement, enabling the model to learn from different viewpoints. Notably, unique features of our platform include (1) recording multiple dimensions of clinical evaluation, allowing experts to rate performance quality, correctness, and difficulty; and (2) supporting annotation of specific clinical events, such as sterile field breaches.

The platform is currently deployed and used by experts to generate high-quality datasets that will train the VLM to offer personalized instructor-like feedback to nursing students. Our work will lead to the development of an AI-assisted educational tool, which can ultimately be used by nursing

centers nationwide for a stronger nursing workforce and better patient care.

Mentor(s):
Shen Chang (Engineering); Nan Kong (Engineering)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9021
Presentation Time: July 27-31 on Symposium Website

Analysis of Semaglutide Eligibility in Hospitalized Patients Receiving High Intensity Statins

STEM

Authors(s):
Brooke Thornburg† (Pharmacy|JMHC)

Abstract:
Bart's Health NHS Trust is a network of five hospitals including St. Bartholomew's Hospital (SBH), home to the largest cardiovascular center in the United Kingdom. Semaglutide is a GLP-1 agonist that has shown efficacy in reducing the risk of major cardiovascular events in people with cardiovascular disease and obesity. The aim of this study was to evaluate patient eligibility for semaglutide for cardiovascular risk reduction across the Trust.

Data was gathered from hospital admissions between May 2025 and May 2026. Patients were eligible for semaglutide if BMI was > 27 kg/m² and diagnosed with myocardial infarction, stroke, or peripheral artery disease. Inpatients prescribed atorvastatin 80mg were selected to reduce the study population. 190 patients with admissions over a 7-day period in May 2026 were screened for eligibility.

In total, 116 patients met eligibility criteria for semaglutide. Of these patients, 60.3% were diagnosed with MI, 25% with stroke, and 5.2% with PAD. 63.8% of patients met eligiblity prior to admission with 36.2% being newly eligible at admission. Across the Trust, 41.4% of eligible patients were seen at SBH. SBH had the most newly eligible patients (73.8%).

Eligibility for semaglutide was established for nearly two-thirds of patients across the Trust, more than half of which were newly eligible. SBH will admit the most eligible patients, of which, the majority will be newly eligible. Next steps include estimating financial cost to the Trust and developing and implementing protocols for prescribing, dispensing, and counseling semaglutide.

Mentor(s):
Ellen M Schellhase (Pharmacy)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9022
Presentation Time: July 27-31 on Symposium Website

Evaluating Bayesian Optimization in Mixed-Variable Infrastructure Selection

STEM

Authors(s):
Taylor Scott Vicente† (PWL)

Abstract:
In design landscapes featuring combinatorial explosions of categorical choices (i.e. specific sensor technologies, suppression agents, or containment solutions) with continuous physical parameters, selecting the optimal configuration is computationally expensive and lengthy, making traditional grid-search methods potentially intractable under strict resource or time constraints. We are studying the problem of designing an automated, data driven, decision-making blueprint for the design of highly configurable systems. To solve this problem, our ongoing research explores the application of Gaussian Process Regression with Bayesian Optimization (GPR-BO) for infrastructure selection. We are developing a mixed-variable surrogate model to map categorical and continuous inputs into a unified search space, utilizing a constrained acquisition function that balances the exploration of uncertain configurations with the exploitation of high-performing systems. We apply our methodology to the design of a fire safety system in an extraterrestrial habitat. In these closed-loop environments, fire poses a critical threat so selecting highly efficient detection and suppression infrastructure is paramount to long-term operation. Designing these safety systems is a highly complex, non-linear optimization problem, facilitating the evaluation of our GPR-BO methodology. By actively learning the model's "safety response surface," the GPR-BO navigates away from infeasible configurations. We are currently evaluating the GPR-BO methodology against random-search baselines to assess its computational efficiency and scalability.

Mentor(s):
Xiaoyu Liu (PWL)

Other Acknowledgement(s):

Virtual Presentation Abstract Number: 9023
Presentation Time: July 27-31 on Symposium Website

Heuristic-Based Chemoenzymatic Retrosynthesis Planner for Complex Chemicals in Drug Manufacturing

STEM

Authors(s):
Sahil Yadav† (PWL)

Abstract:
[Abstract Redacted]

Mentor(s):
Karthik Sankaranarayanan (Agriculture|Engineering); Sowmya Alichy (Agriculture)

Other Acknowledgement(s):