



Program Progress Performance Report for University Transportation Centers

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From Concepts to Deployment

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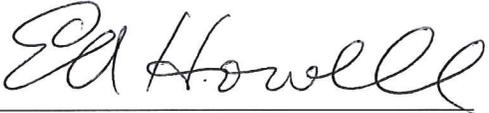
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Signed: 
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Part 1: ACCOMPLISHMENTS

Major Goals -- There have been no changes to program goals.

Major Activities

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Revised the experiment scenarios based on the observed issues during the experiments
- Redesigned experiment scenarios focusing on the driver's cognition load and the impacts of human machine interfaces
- Recruited experiment participants focusing on the elderly group
- Completed data archiving and analyses using the experiment data
- Tested eye tracker and EEG sensor and the redesigned experiments with biosensors integrated

Accessibility-Based Evaluation of Transportation and Land-Use Planning: From Laboratory to Practice/ Implementation of Access-Based Evaluation

- Seek answers to four questions: what has been the impact of mobility-based evaluation; what difference would a shift to accessibility-based evaluation make; what are the obstacles to accessibility-based evaluation; and what are ways of overcoming those obstacles.
- Work to overcome an obstacle identified in the first part: the lack of project-level tools for accessibility analysis.

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Collected CTL automatic passenger count (APC) and automatic vehicle location (AVL) data; directly observed CTL onboard bus route passenger origin-destination (OD) flows; bus route passenger OD flows with indication of a demographic variable (gender)
- Processed CTL APC data for research and outreach efforts; estimated CTL OD flows from processed APC data
- Developed preliminary models on attitudes toward dynamic ridesharing options using data from a large stated preference survey
- Investigated factors that influence the quality of bus route-level origin-destination flows
- Refined software that allows estimation of socio-economic and travel characteristics of a population of transit users
- Used CTL-derived knowledge and expertise to complete an externally funded "companion project" based on data collected on Central Ohio Transit Authority (COTA) routes:
- Secured a new, externally funded project on bus-pedestrian safety using CTL-derived knowledge and infrastructure and began work
- Submitted a subcontract proposal for a federally funded SBIR project that would use CTL expertise and infrastructure
- Refined and used CTL-based education activities in one course

Region V Transportation Workforce Assessment and Summit

- Reproduced some content from the Summit (held in December 2015) in the form of a webinar in March 2016.
 - Highlighted three speakers from the Summit.
 - Continued to foster relationships with Summit speakers and attendees.
 - As a result of the webinar, we had an industry contact us to connect them to a speaker.
- Assembled data from a Summit exercise and developed an analysis of responses. This analysis will serve as a basis for a TRB paper.
- A draft report of the Region V Transportation Workforce Assessment has been compiled.
 - Identified a list of transportation occupations that fit a high-demand, high-wage scenario.

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Literature review on how social networking services (SNS) disseminate and propagate evacuation-related information during no-notice evacuations
- Design and conduct surveys to collect data for understanding both SNS usage behavior and evacuation decision-making under emergency situations
- Construct a mixed logic model to describe information sharing (post/repost) patterns through SNS during no-notice evacuations

Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Foot prints

- Continue to incorporate Transportation related topics in ENE-WRM Curriculum
- Research experience to the ENE undergraduate Trenton Barnes at Purdue University (2016 Summer)
- Internship for ENE undergraduate Aquil Frost at ODOT Lebanon, OH office (2016 Summer)
- Continue to impart education in transportation to middle school and high school students, as a part of this grant and another grant from Federal Highway Administration (FHWA) 2016 Summer
- Accepted to present at two conferences
 - ASEE-NCS Conference, Mt Pleasant, MI: presented on 18 March 2016 (curriculum integration)
 - TASME Conference, Toronto, Canada: submitted in April 2016 and accepted to present in July
- University student undergraduate research application by Aquil Frost under Dr. Kandiah's mentorship -- air pollution due to agricultural equipment

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- Developing a new methodology for traffic signal timing optimization under user equilibrium based traffic conditions

Develop Preliminary Engineering Design and Study the Benefits of Providing an Access to the Indiana Toll Road at State Road 327 near Orland

- A new toll interchange was designed at the junction of the Indiana Toll Road and State Route 327 near Orland, Indiana.

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Assembly of database of New Mobility-allied industry sectors within Southeast Michigan
- Finalized relational mappings for non-geospatialized data related to cluster formation
- Finalized New Mobility Cluster Catalyzing Projects mappings for several Southeast Michigan scenarios
- Completed revised Case Study Analysis for 3 existing New Mobility Clusters

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Develop new GIS-based data-driven analytic methods to support site-identification criteria at locations of high-demand for connectivity enhancement and social access provision.
- Develop a framework and process for physical and spatial design, within the existing SMART multi-stakeholder, multi-sector leadership engagement, that draws on local knowledge in refining needs assessment, and in identifying possible access-related program partners and private service providers that might be coupled with existing public transportation systems at key New Mobility Hub (NMH) locations.
- Prepare a framework and process to identify existing multi-source funding structures to support enhancement of connectivity and access-related programs, in order to aid in the assembly of coupled sources of support for multi-stakeholder projects.
- Complete the execution of a series of spatial design prototypes, at varying scenario conditions and scales that demonstrate design possibilities and opportunities for the incorporation of new connectivity and access-supporting spaces.

Tracking bicyclists' route choices, case study

- This study has two major components: (i) an online survey with questions on bicycling preferences, (ii) collecting bicycle trip data (origins, destinations and routes) using a cell phone app CycleTracks,
- The first component of the study is almost complete. We are working on preparing the report.
- The second part of the study (collecting data using CycleTracks) will begin in August.

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Conducted a review of literature on chloride corrosion and carbonation of concrete structures
- Conducted a preliminary review of literature on Markov-based deterioration modeling of structures
- Identified bridges with concrete decks in the inventory of Ohio DOT (ODOT). One bridge with a long history of inspection records was selected and its attribute data along with the inspection reports were received from ODOT
- Started investigating the Markov-based formulation of the bridge deterioration model in AASHTOWare BrM (formerly known as PONTIS)

Methods for improving bicycle sharing system balance

- Developed a rolling-windows approach to the simulation of usage and (im)balance of the CoGo system

Truck Activity and Wait Times at International Border Crossings

- Received additional geo-fence based time and location data for trucks using the Ambassador Bridge and Blue Water Bridge

Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Produced queuing time and inspection time statistics for various quarters and time-of-day and day-of-week combinations
- Determined cause of troublesome results at Ambassador Ontario-to-Michigan inspection facilities and developed approaches to proceed with data analysis and rectify issue for future data; implemented new geo-fences
- Held meeting of OSU and MTRI partners in Columbus, OH to discuss progress, methods, results and future steps
- Prepared draft report of queuing and inspection time statistics to demonstrate format of a potential regular report

Evaluation of Heavy Vehicles on Capacity Analysis for Roundabout Design

- Data collection continued throughout the spring; alternative methodologies of analysis were considered.

Roadway Traffic Data Collection from Mobile Platforms

- Performed repairs to platform and replaced malfunctioning LiDAR sensors to prepare for regular data collection
- Collected preliminary data from sensing platform
- Designed manual bus-based data collection procedures and began collecting data using the procedures
- Discussed concept of operational data collection with OSU's Transportation and Traffic Management (a potential stakeholder)

Information and Transportation Choices, Long- and Short-Term, that Link Sustainability and Livability

- Interactive accessibility information intervention strategy to affect people's long-term travel behavior by influencing their residential location choices.
- An interactive online accessibility mapping application is developed for the proposed strategy to provide users personalized neighborhood accessibility information to different types of potential destinations using different modes of transportation based on their work locations and travel needs, and assist their residential location decision-making process.

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- Developing hybrid background detection covering the weaknesses of both XYZ Cartesian and spherical coordinate based methods
- Applying backtracking methods to account for specific issues caused by occlusion.
- Preliminary method for placing estimated dimension box back onto the point cloud; designing and implementing specific format for TScan outputs; collecting data at selected intersections; evaluating the accuracy of tracking results

Standardized Metrics for Accessibility: Establishing a Federal Policy-Relevant Knowledge Base

- Gathered and selectively chose appropriate quotations from focus groups and interviews to include in the final report.
- Expanded bibliography and included additional relevant citations in final report; writing and editing of final report.

Integration of ground access to airports in measures of inter-urban accessibility

- Developed measures of airport access as a by-product from a calibrated spatial interaction model.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Laboratory testing of sensor package completed; initial design of housing for sensors developed
- Preliminary mobile testing of sensor package underway; discussions with bus operators and site visit to determine mounting location conducted.

Intermodal Infrastructure Investment Decisions and Linkage to Economic Competitiveness

- Intermodal facility location model that incorporates downside risk management to determine a system level strategic intermodal facility investment plan under freight commodity flow uncertainty.
- The applicability of the model was illustrated by the numerical experiments using U.S. national level data
- The proposed methodology provides national-level policymakers with tools to develop policy and regulatory decisions; enables local and regional stakeholders to make coordinated, more informed investment decisions that maximize their investment potential.

Using Naturalistic Driving Performance Data to Develop an Empirically Defined Model of Distracted Driving

- Conducted second round of data analysis based on feedback from the initial round of data analysis. The analyses included: 1) a Markov approach; 2) population spline fitting.
- The first draft of a manuscript presenting analysis results was revised

A Study of the Usage Potential of a Proposed Expanded Commuter Rail Station at Chicago State University

- Student survey data was compiled and statistical analysis was begun.
- Transportation geodatabase was completed in preparation of travel time analysis for CSU staff addresses.

Synthesis of Best Practices for Agency-wide Freight Data and Information Management

- Conducted a literature review on the state of practice in freight data synthesis and management; evaluated the usability of self-assessment tools in the National Cooperative Highway Research Program (NCHRP) report 814
- Determined that not all parts of the NCHRP tool were necessarily relevant to data collection; tested a simple data collection method to build matrices of freight activities, data entities, data sets, and business areas with the Wisconsin DOT.
- Evaluated that method and found that it was not entirely comprehensive; built a survey that modified the functionality of the NCHRP tool; customized the survey with default responses by state; began the distribution process with the ten Midwestern state planning divisions.

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- conducted numerical investigations and assessments of the refined models for bus route-level transit passenger origin-destination (OD) flow estimation using automatic passenger count (APC) data capturing clusters of flow patterns across bus trips.

Integrating multiple sources of data for the estimation of transit origin-destination flows

- Made progress on developing a methodology to determine an appropriate number of clusters.
- Assessing the refined models using empirical data on routes with familiar flow patterns and passenger trip purposes.
- Presented at a national conference.

LIDAR based vehicle classification AND Segmenting, grouping and tracking vehicles in LIDAR data

- Extracted and cleaned roughly 8 days (2 hr per day) of vehicle trajectory data; data is being prepared for public release in the near future.
- Segmenting axles to measure their spacing and using 3D information to improve classification.

Advancing Traffic Flow Theory Using Empirical Microscopic Data

- During this period this work has examined three sources of data, with the respective findings-
 - LIDAR equipped probe vehicle to monitor ambient vehicles in situ while driving through the traffic stream. These data provide nuances of driver behavior over long stretches of freeway
 - Single Vehicle Passage loop detector data- millions of individual vehicle actuations from loop detectors to understand nuances of traffic behavior. This work is revealing that individual driver behavior does not only on the lead vehicle but also vehicles in the adjacent lane
 - Revisiting the NGSIM data- using the lessons learned from, and tools developed for the LIDAR analysis this work revisits the NGSIM data set, the current gold standard for microscopic traffic flow study, and examines several errors evident in those data in an effort to provide much cleaner data.

Specific Objectives

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Provide a robust environment for driving simulator experiments to address driver behavior under real-time travel information provision.
- Explore the role of human factors in driver's perception and cognition of the provided information in the context of driver route choice decision and safety concerns.
- Using the collected data, construct reliable models to better assess the comprehensive value of real-time travel information beyond (including) the benefits of travel time savings.
- Integrating the biosensors into the driving simulator experiments to explore and quantify driver's workload in processing the real-time information.
- Establishing models to quantify the impacts of the content, amount and modality of real-time information on travelers' decision-making process.
- Investigating advantages and disadvantages of physiological and psychological measurements in analyzing drivers' decision-making process with real-time information provision.

- Provide transportation policy makers and public/private transportation information providers' better performance measures of the benefits of real-time travel information with consideration of qualitative aspects of information process.
- Through driving simulator experiments, provide graduate and undergraduate students an opportunity to better understand the present state-of-the-art in human factor-related research on travel behavioral modeling and safety in transportation.

Accessibility-Based Evaluation of Transportation and Land-Use Planning: From Laboratory to Practice/ Implementation of Access-Based Evaluation

- Through case studies, explore the ways in which mobility based tools and thinking have shaped transportation planning.
- Quantitatively demonstrate the difference in planning evaluation when carried out in an accessibility framework.
- Through focus groups and interviews, identify obstacles to the adoption of accessibility-based evaluation.
- Develop graphical and quantitative approaches to overcoming these obstacles.

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Sustain, develop, and showcase the CTL as a living lab infrastructure supporting research, education, and outreach
- Archive and process data on passenger flows, vehicle locations, and community perceptions and travel patterns related to a technology-enhanced transit service

Region V Transportation Workforce Assessment and Summit

- Build community with many types of transportation stakeholders; Survey summit participants.

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Understand people's SNS usage behaviors and sharing patterns under no-notice evacuations
- Understand people's evacuation decision-making process with disaster- or/and evacuation-related information from multiple sources
- Develop an agent-based evacuation decision-making model under heterogeneous information sources with consideration of individual's preference in terms of posting/reposting behavior through SNS

Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Foot prints

- Building an inventory of current GHG emissions from on-road vehicles
- Identifying or conceptualizing alternative transportation scenarios that could reduce the GHG emissions
- Incorporating transportation related educational components into Air Quality Engineering course
- Mentoring and training undergraduate students in transpiration related air quality research

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- Completing the development of a new methodology for traffic signal timing optimization under user equilibrium based traffic conditions

Develop Preliminary Engineering Design and Study the Benefits of Providing an Access to the Indiana Toll Road at State Road 327 near Orland

- The roadway alignment, both horizontal and vertical, was designed according to AASHTO and INDOT standards.
- Subsurface investigations were performed and a subsequent Hot Mix Asphalt section was designed.
- A single toll plaza featuring three toll bays (one interchangeable) was designed.

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Refine graphical depictions between underlying regional assets, extant regional infrastructures, and nascent new mobility opportunities (events) in producing emerging industry clusters.
- Refine description of specific industry agents within the new mobility economy via existing industry classification structures (NAICS & Others) for the local area of Southeast Michigan
- Complete automation of the data to visualization process for industry sector cartographies

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Utilize a data-driven GIS-based platform to assemble and evaluate existing transportation system data, demographic data and the distribution of social service delivery. Building on this data, evaluate potential NMH sites within the existing transportation system to: (i) identify existing levels of service; (ii) evaluate access for local populations proximate to hub locations (using existing accessibility metrics); (iii) identify networked ridership at locations within the system at each location; and (iv) identify existing locations most capable of enhancing accessibility levels relative to systemic capacity and demographic needs.
- Draw upon the UM-SMART MOBI-network for New Mobility entrepreneurship to identify existing and emerging private sector mobility solutions active within the study area that could partner with NMH locations (eg: car share, bike share, e-vehicle share charging locations, IT-enabled connectivity platforms). This activity will also assess spatial requirements for the accommodation of such services within identified site areas.
- Produce a series of prototypical design solutions, at varying scales, locations and intensities of intervention for the Chicago metro. These demonstrate the potential of project concepts for application in a variety of other US metros.

Tracking bicyclists' route choices, case study

- Identify the needs of OSU bicyclists; generate information on origins, destination and routes of bicycling trips that could be utilized for making targeted investments; identify the priority areas that need such investments; investigate and demonstrate the use of smartphones for collecting travel data

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Better understanding of underlying physical and chemical processes of corrosion in reinforced and prestressed concrete bridges
- To analyze data of attributes and history of the condition-state of bridges along with environmental conditions and bridge maintenance policies in ODOT to assess the applicability of existing Markov-based concrete bridge deterioration models for deterioration modeling of selected Ohio bridges
- Revise and refine existing concrete bridge deterioration models to accommodate the regular stream of bridge condition inspection data
- Develop methods to update the parameters of these models on a regular basis as new data becomes available

Methods for improving bicycle sharing system balance

- This paper tackles the re-balancing issue for bicycle sharing systems where bikes must be removed from full stations and replenished at empty ones.
- Devised a rolling window approach to this problem.

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Obtain geo-fence-based truck time and location data for trucks crossing the Ambassador and Blue Water bridges
- Process data into information on times trucks incur at various activities at and near the border crossing facilities
- Interpret processed information into results of general and targeted interest; Deliver targeted information to stakeholders

Evaluation of Heavy Vehicles on Capacity Analysis for Roundabout Design

- Data collection; methodology solidification; analysis and results

Roadway Traffic Data Collection from Mobile Platforms

- Investigate and demonstrate ability to obtain meaningful traffic flow and speed estimates from a mobile platform emulating transit bus service; determine reliable uncertainty quantifications for the traffic flow and speed estimates that can lend insight for use in an operational setting; generate interest among potential stakeholders

Information and Transportation Choices, Long- and Short-Term, that Link Sustainability and Livability

- Propose an interactive accessibility information intervention strategy intended for assisting the full range of transportation-relevant decisions made by the general population.

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- Finalize the development of the algorithm; demonstrate the feasibility of tracking objects at intersections with a low-end LiDAR

Standardized Metrics for Accessibility: Establishing a Federal Policy-Relevant Knowledge Base

- Propose a means of assembling a reliable and trustworthy data set for evaluating accessibility performance, but to do so while minimizing the burden on current agencies and without suppressing the creativity and distinctiveness of initiatives at the local and regional level.

Integration of ground access to airports in measures of inter-urban accessibility

- To classify and organize assessments of airports based on their access characteristics. To produce maps and data exploration tools for the quantitative measurement of access, by airport origin.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Identify key sensor components required for mobile air quality monitoring unit
- Develop and implement air quality monitoring unit on a mobile platform
- Collect ambient and transportation-related air quality data using the unit mounted on a mobile platform and stationary sensors
- Investigate contribution of the data collected to that collected using stationary sensors

Intermodal Infrastructure Investment Decisions and Linkage to Economic Competitiveness

- Explore the impacts of uncertainty in commodity flow on strategic intermodal facility investment plans by incorporating downside risk analysis in the investment decision-making process
- Propose a methodology that provides national-level policymakers with tools to develop policy and regulatory decisions and enables local and regional stakeholders to make coordinated, more informed investment decisions that maximize their investment potential.

Using Naturalistic Driving Performance Data to Develop an Empirically Defined Model of Distracted Driving

- Finish the revised data analysis; publish the results in a peer-reviewed journal

A Study of the Usage Potential of a Proposed Expanded Commuter Rail Station at Chicago State University

- Compile and analyze student transportation survey results; Compare travel times to CSU with and without improved 95th St. Metra stop

Synthesis of Best Practices for Agency-wide Freight Data and Information Management

- Provide a snapshot of the current state of data management at each state Department of Transportation (DOT) in the Mid America Freight Coalition (MAFC).

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data and Integrating multiple sources of data for the estimation of transit origin-destination flows

- Improve transit passenger OD flow representation and estimation; quantify the achieved improvements with respect to other state-of-the-practice and art methods; demonstrate the feasibility of the new model and methods and their ability to produce interpretable results.

Modeling CO2 Emissions as a Function of Transportation, Land-Use, and Regulation Variables

- Quantify the magnitudes of the impacts that changes in certain variables have on CO2 emissions in select US urbanized areas.
- Identify the policy implications of the findings; document findings based on US data in the form of papers.

Significant Results

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Cognitive load is the most significant human factor that affects driver perception of real-time travel information.
- Information cognitive load is impacted by Information provision modalities, including visual and verbal modalities.
- Drivers' individual attributes (such as demographical and socio-economic characteristics) are important to determine the attitude toward the provided real-time travel information.
- To enhance the reliability of physiological data, comprehensive biosensors, including electroencephalogram, are preferred.
- The calibration of biosensors is required for each participant to have reliable assessment of driver's physiological measurements.
- The driver's mental workload during information processing and be identified and quantified by leveraging eye tracker together and EEG.
- The real time mental signal output from EEG can enhance the questionnaire-based psychological quantification results.
- Drivers' emotion derived from the given travel context and real-time information in the experiments cannot reflect the realism because the simulated environment cannot simulate urgency associated with the travel context.

Accessibility-Based Evaluation of Transportation and Land-Use Planning: From Laboratory to Practice/ Implementation of Access-Based Evaluation

- The use of formal models in decision processes suggests that a generalized "mobility thinking" rather than formal evaluation per se tends to drive decision-making.
- Accessibility based evaluation can either magnify or reverse the impact of mobility improvements.
- Accessibility-based is impeded by technical, institutional, and political constraints.

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- OD flow data were manually collected and provided to researchers evaluating the performance of OD estimation models and data collection technologies
- An externally funded project that was generated because of CTL expertise and infrastructure was completed, and another externally funded project was begun
- CTL infrastructure, data, and context were successfully used in an OSU transportation course taken by undergraduate civil engineering students

Region V Transportation Workforce Assessment and Summit

- Overwhelmingly, occupations in highest demand are those in the career and technical sector of transportation.
- Openings for Truck drivers eclipse all other occupations.
- Other positions that include computer applications and development skills are in high demand in the transportation sector.
- Apprenticeship data is not centralized in the United States. Not all states have an online presence for a list of registered (with Department of Labor) apprenticeships.
- Transportation occupations are grouped under several career clusters. For example, engineering is under Architecture and Construction Career Cluster, while others are under the Transportation, Distributions, & Logistics (TDL) Career Cluster.

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Different trust levels on disaster- and evacuation-related information depending on different sources, SNS users, and the reputations of the organizations, institutions or authorities are observed.
- SNS posting/reposting frequency during a no-notice evacuation is highly related to their socio-economic characteristics, SNS usage behavior, level of trust of information from SNS, and level of trust of information from sources other than SNS.

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- Developed a new methodology for traffic signal timing optimization under user equilibrium based traffic conditions to significantly reduce intersection vehicle delays

Develop Preliminary Engineering Design and Study the Benefits of Providing an Access to the Indiana Toll Road at State Road 327 near Orland

- The approximate cost of the facility was estimated to be \$6.8 million.

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Developed recommendations for the support of New Mobility industry sectors.
- Developed workshop method for project presentation to industry partners (forthcoming 2016).

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Identified a large number of existing and uncoordinated entities aiming to deliver access to Health, Learning, Food and alternate mobility options that are physically difficult to access given current physical locations, and transit connectivity.
- Initial financial analysis developed through the projects suggest that leveraging publically-owned and operated spaces of transit infrastructure as a spatial product for access-delivery may produce significant cost savings and ease of access for transit users.
- IT-enabled access provision will form a significant and emerging domain in the coming years, and guidance is required to assist public officials in understanding the scope of transformation through rethinking existing single-use transit spaces as "platforms for access".

Methods for improving bicycle sharing system balance

- Showed that previously unsolvable problems can actually be solved satisfactorily when a longer window range is used.

- The penalty for this added window (look-ahead) is added computational effort but this is manageable for the relatively small sample system analyzed here (Columbus, Ohio).

Truck Activity and Wait Times at International Border Crossings

- Obtained new data with refined geo-fences to be used in future project

Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Finished debugging data processing codes; used debugged codes in "operational" modes; designed and implemented new geo-fences

Roadway Traffic Data Collection from Mobile Platforms

- Necessary platform repairs and sensor replacements were undertaken; bus-based (manual) data collection procedures were designed and tested; preliminary automatically collected, van-based data and manually collected, bus-based data were collected
- Interest in the concept of regular flow and speed data collection from transit buses was piqued in a potential stakeholder

Information and Transportation Choices, Long- and Short-Term, that Link Sustainability and Livability

- Results show that participants in the experimental group are statistically significantly different from participants in the control group, in terms of their ratings of the importance of accessibility related factors, the selected neighborhood's accessibilities, automobile usage, and walk and transit usage after their relocation.
- The proposed strategy can effectively affect participants' long-term travel behavior by influencing their residential location
- The developed interactive online accessibility mapping application is built on generally available data and provides personalized accessibility information to users, thereby can be readily replicable throughout a range of metropolitan context by planners and policy-makers.

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- We have developed a hybrid method of background identification to account for the weaknesses in the two different background methods developed so far
- Backtracking has been implemented to tackle the problem of occlusion using a two-prong approach
- In evaluating the algorithms with data, we discovered the following
- Cartesian coordinate based system works in dense and slow moving traffic to identify vehicles but fails in non-paved areas.
- Proposed Hybrid method of background removal chooses between the two methods based on nature of specific parts of the intersection to achieve results superior to the individual underlying methods
- The detection rate for identifying vehicles is greater than 98%.
- The existing box placement method has difficulties in determining orientation of very slow moving vehicles.
- Existing algorithms can detect/track pedestrians provided sufficient density of points are returned

Integration of ground access to airports in measures of inter-urban accessibility

- The work has generated a paper for peer review that has expanded the scope to include time series variations in city access all the way from large hubs to small regional airports.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- A prototype sensing unit was fabricated; calibration of the prototype against US EPA Federal Reference Method/Federal Equivalent Method instrumentation has been conducted; initial testing of the sensor unit on a mobile platform (personal vehicle) is currently on-going.

Intermodal Infrastructure Investment Decisions and Linkage to Economic Competitiveness

- Investing in intermodal terminals is preferable to investing in ports under low allowed system level downside risk.
- Port intermodal projects tend to be associated with high downside risk, but can reduce expected system costs significantly, and are hence preferable under higher allowed system level downside risk.
- The expected system costs increase with the decrease in downside risk as fewer intermodal projects are feasible under it, and this reduces the flexibility in commodity flow distribution.
- The cost variance increases with the decrease in allowed system level downside risk due to the need to fully allocate commodity flows for different realizations of emerging infrastructure projects.
- The optimal solution is highly dependent on the allowed system level downside risk. Different sets of investment plans are obtained by varying this parameter.

Synthesis of Best Practices for Agency-wide Freight Data and Information Management

- Analysis will indicate the maturity of freight data management as well as an analysis of each DOT's freight data architecture

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- Numerical investigations conclusively confirm that the variational Bayes aspect of the developed estimation method determine overall flow patterns that are superior in accuracy to those determined by state-of-the-practice and -art methods when only one cluster is present.

Integrating multiple sources of data for the estimation of transit origin-destination flows

- Numerical investigations indicate that the degradation in quality of the estimation results is substantial when fewer clusters are assumed than actually present.
- Preliminary empirical investigations where multiple OD travel patterns are known to follow different trip purposes are indicating promising results.

Modeling CO2 Emissions as a Function of Transportation, Land-Use, and Regulation Variables

- Policies aimed at reducing CO2 emissions should focus on different sets of variables depending on the overall characteristics of the specific urbanized area and any existing policies aimed at reducing CO2 emissions.

Key Outcomes and Other Achievements

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- The driving simulator experiment scenarios were updated.
- Participants register and schedule the driving simulator experiments through the experiment website.
- The driving simulator experiments are being carried out.
- The driving simulator experiment data have been carefully archived and analyzed.
- Research findings and experiences have been summarized and presented in relevant international conferences.

Accessibility-Based Evaluation of Transportation and Land-Use Planning: From Laboratory to Practice/ Implementation of Access-Based Evaluation

- We have developed and demonstrated new approaches to project-level accessibility analysis of transportation projects and land-use developments.

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Directly observed CTL OD flows were summarized for stakeholders and research efforts
- A presentation based on CTL data and concepts was made at a national conference
- An article based on CTL data and concepts was accepted for publication in a peer-reviewed journal
- Extension of bus route passenger OD flow collection to include a demographic variable was implanted on a routine basis
- An externally funded project using CTL-derived knowledge and infrastructure was obtained and begun
- Thirteen undergraduate students were collected data on a regular basis
- Two abstracts using CTL infrastructure and expertise were accepted for presentation at a statewide conference heavily attended by transportation practitioners

Region V Transportation Workforce Assessment and Summit

- Exceeded the number of registrants for a webinar.

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Two sets of online surveys to understand SNS usage behavior and evacuation decision-making under emergency situations are conducted for students, staffs and faculty members in Purdue University.
- A mixed logit model is developed to explore the contributing factors that affect people's posting/reposting behavior on SNS during a no-notice evacuation.

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- Completed a case study for methodology application as documented in a Ph.D. dissertation containing details of literature review, methodology development, and application, as well as summary and conclusion

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Completion of key findings into a 10 minute film for distribution to project partners.
- Completion of data and mappings for final DOT reporting.

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- A methodology of evaluating potential for access-enabling architectures has been developed and prototyped including the development of a database, analysis model and illustrative prototypes to test the assertions of the original research question.
- Work has been assembled and disseminated to disciplinary venues, and a preliminary assembly of materials has been developed for dissemination in video format.
- The authors have been invited to the tri-annual "LaFargeHolcim Foundation Forum for Sustainable Construction" to host a two days workshop engaging in part, to content of this project as a means to rethink infrastructure space at the urban and regional scale.

Methods for improving bicycle sharing system balance

- The paper also notes that a heuristic derived from the same approach could be used for larger systems.
- The paper is illustrated with results from 54 problem instances derived from variants of the base data. The results are derived on a standard computer with widely available tools such as Python and CPLEX.

Truck Activity and Wait Times at International Border Crossings

- Additional data were obtained

Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Identified causes of troublesome data
- Implemented new geo-fences
- Determined new truck activity time statistics
- Produced statistics in format for reporting to potential stakeholders
- Confirmed adjustments that needed to be made to Blue Water Michigan-to-Ontario inspections times to allow comparisons across years; adjustments were needed because of changes in locations of inspection facilities and inspection geo-fences

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- Determined a possible method for removing background from LiDAR data; results confirm the feasibility of tracking objects with the low-end LiDAR sensor.

Integration of ground access to airports in measures of inter-urban accessibility

- Link google access maps for ground transport access to places; assessment of airport access by measuring and plotting the time varying levels of passenger embarkation; web site also quantifies the share of these access services by airline carrier.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- A functional, calibrated sensor prototype unit is ready for deployment.
- Meetings with CABS administrators reinforced their commitment to using their buses as platforms for empirical data collection and their enthusiasm for this project; meetings with CABS operators allowed a narrowing of alternatives for mounting locations on CABS buses.

Intermodal Infrastructure Investment Decisions and Linkage to Economic Competitiveness

- Categorize intermodal projects into several groups: intermodal projects with low risk, intermodal projects that are not optimal in any scenario regardless of allowed system level downside risk, Intermodal projects that may or may not be included depending on the allowed system level downside risk.

Using Naturalistic Driving Performance Data to Develop an Empirically Defined Model of Distracted Driving

- Identifying variables that potentially predict distracted driving and creation of the algorithm to identify distracted driving and estimate the level of distraction using kinematic/driver performance indicators.

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- Additional numerical results that provide clear validation of the estimates; present aspects of research at a national conference.

Integrating multiple sources of data for the estimation of transit origin-destination flows

- Presentation at an international conference was accepted; the method developed to determine the number of clusters is promising.
- Validation of the methodology using empirical data is revealing promising results.

Modeling CO2 Emissions as a Function of Transportation, Land-Use, and Regulation Variables

- Quantified the magnitudes of the impacts that changes in certain variables have on CO2 emissions in select US urbanized areas.
- Identified the policy implications of the findings.

Efforts to Disseminate Results

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Presentation at an international conference: D. Song and S. Peeta, "Psychological Effects of Real-Time Travel Information for Heterogeneous Driver Classes", 7th International Conference on Applied Human Factors and Ergonomics (AHFE 2016).
- Abstract submitted to an international conference: D. Song and S. Peeta, "Psychological Effects of Real-Time Travel Information on Route Choice Behavior of Heterogeneous Travelers – Analysis of Interactive Driving Simulator Experiment Data", 2016 INFORMS Annual Meeting.

Accessibility-Based Evaluation of Transportation and Land-Use Planning: From Laboratory to Practice/ Implementation of Access-Based Evaluation

- Website to facilitate the adoption of the accessibility metrics by planners in practice; initiated discussions with EPA's Smart Growth Program about developing this tool further; article in-revise-and-resubmit status in Transport Policy

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Presentation made at a national conference; article accepted for publication in a peer-reviewed journal
- Final report was submitted for an externally supported project, report was presented through a national webinar
- Paper was prepared and submitted for presentation at an international conference; 2 abstracts accepted for presentation at a statewide conference

Region V Transportation Workforce Assessment and Summit

- Webinar information was disseminated via the website, MTWC network database, the National Network for the Transportation Workforce (NNTW) and other social media channels.

Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Foot prints

- Presentations in public forums -- Accepted to present research progress at two conferences:
 - ASEE-NCS Conference, Mt Pleasant, MI: presented on 18 March 2016 (curriculum integration)
 - TASME Conference, Toronto, Canada: submitted in April 2016 and accepted to present in July
- Incorporated into course curriculum, "Air Quality Engineering", "Urban Water Problems" for undergraduate students
- Summer Transportation Institute (STI) for middle school and high school students

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- Submitted a technical paper to Journal of Network Economics for review and possible publication

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- SMART has a database of over 16000 transportation professionals and leaders worldwide. We have announced the work through our website (see <http://um-smart.org/blog>), through our targeted news, held a range of multi-sector meetings regarding the work.
- Project Team has engaged MTC at U Michigan <http://www.mtc.umich.edu/>
- Zielinski named as part of Faculty Council, Thün invited to join MTC executive board. Project team will seek support to apply findings from this project to new work engaging autonomous vehicle sector / potential cluster in SE Michigan.
- Project team has made presentations referring to the work in the following contexts: Urban Land Institute conference and New York Chapter Breakfast; Automotive & Personal Mobility Global Agenda Council of the World Economic Forum; ICLEI Eco-Mobility Festival,

Johannesburg, South Africa; University of Brasilia (UNB) Sustainable Mobility Conference; Advanced Transportation Technologies Conference, Seattle, Washington, Mobility-as-a-Service leadership meeting in Helsinki Finland; For Young India Conference, Delhi India; ICT India Mobility-as-a-Service Summit, Gothenburg, Sweden; Gothenburg Mobility Research meeting, Gothenburg Sweden; Inter-American Development Bank Retreat; MobileTechnology Association of Michigan in Lansing Michigan; Mobility-as-a-Service Panel at TU Global Telematics Conference in Michigan, Center for a New Urbanism Annual National Conference Panel.

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Conference paper to national ACSA conference submitted and accepted; journal paper prepared, submitted to OASE, submitted and accepted.

Tracking bicyclists' route choices, case study

- Creating a website for this project. (<http://u.osu.edu/cycletracks/details/>). Since the page is still under construction, please access the site with the password: CYCLETRACKS_IRB

Methods for improving bicycle sharing system balance

- Paper written and being sent for review.

Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Mock report for dissemination of results was drafted

Information and Transportation Choices, Long- and Short-Term, that Link Sustainability and Livability

- Prepared a paper for TRB presentation; preparing a paper for journal publication.

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- Indiana Department of Transportation (2016), TScan description on the Employee Resource Internal News. June 2nd 2016.
- Presentation of the results at the 4th International Symposium on Transportation Safety, July 10, 2016, Shanghai, China.
- Preparing conference papers for the coming 2017 Annual TRB Transportation Meeting, Washington, D.C, January, 2017.

Integration of ground access to airports in measures of inter-urban accessibility

- Presentation at the TRB and completion of two MA thesis projects related to this theme.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Research findings presented by undergraduate students at the OSU Denman Forum/Spring Research Expo in March 2016.
- On-going discussions regarding the use of these data by faculty in the OSU College of Public Health resulted in one spin-off proposal using the sensor prototype design.

Intermodal Infrastructure Investment Decisions and Linkage to Economic Competitiveness

- Paper submitted for peer review (July 2016): Risk Management in a Systems View of Intermodal Facility Investment under Uncertainty in Freight Commodity Flow

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data and Integrating multiple sources of data for the estimation of transit origin-destination flows

- Prepared and presented at TRB

Plans for Next Reporting Period (July 1, 2016 – December 31, 2016)

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Design additional scenarios to investigate the cognitive load in the driving simulator experiments with biosensors integrated.
- Recruit more participants to complete driving simulator experiments with biosensors.
- Collect data of participant's gaze points and focusing patterns in relation to real-time information using eye-trackers.
- Collect data from biosensors to analyze driver's cognitive load associated with receiving and processing real-time travel information.
- Analyze the experiment data to identify critical factors in traveler decision-making process and the psychological effects of travel information provision.
- Construct analytical model to characterize driver's cognitive load in processing real-time travel information.
- Summarize research findings into journal papers and research reports and present our research findings at international research conferences.

Accessibility-Based Evaluation of Transportation and Land-Use Planning: From Laboratory to Practice/ Implementation of Access-Based Evaluation

- Complete a draft of a second article to focus on accessibility-based evaluation of transportation; improve the website to make it accessible to practitioners; (potentially) hold stakeholder workshop in Washington DC under EPA auspices

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Data collection: Collect automatic vehicle location (AVL), automatic passenger counter (APC), Wi-Fi derived OD flow, and directly observed OD flow data
- Research: Exploit manual, web-based, and automatic data-driven investigations to generate and investigate research hypotheses
- Use CTL-based modules in OSU courses
- Develop analytical and methodological skills of graduate students; offer data collection opportunities for graduate and undergraduate students
- Discuss results and future efforts with transit, transportation, planning, and other agencies, and prepare and submit/deliver articles and presentations

Region V Transportation Workforce Assessment and Summit

- Complete the Final Report; administer survey to Summit participants.

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Explore the effects of information from different sources on evacuation decision-making during no-notice evacuations.
 - Agent-based model to explore the interactions between posting/reposting behavior on SNS and evacuation decision making process.
- Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Footprints*

- Using MOVES and GREET to estimate the GHGs with alternative energy sources as fuels; training one more student in Fall 2016 in MOVES and GREET software
- Presenting at a peer reviewed national or international conference

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Paper entitled "Mapping Economic Clusters: Visualizing Emerging Opportunities" is in preparation for submission to *Spaces and Flows: An International Journal of Urban and ExtraUrban Studies*: Expected Submission Fall 2016.

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Work from this grant presented to thought-leaders at Ford Motor Company, awarded a 2016-2018 Ford Alliance Grant of \$220K to support further development of the project methodologies and applications and produce a toolkit to enable applications across US.

Tracking bicyclists' route choices, case study

- Complete the report on the online survey; collect smartphone data and analyze the results

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Identify appropriate Markov-based probabilistic deterioration models for prediction of the future condition-state of concrete bridge decks
- Examine the sensitivity of the models to their input parameters; start exploring Bayesian-based techniques to update the parameters of Markov-based deterioration models with new data on a regular basis

Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Produce summary statistics and visualizations for stakeholder comparison

Roadway Traffic Data Collection from Mobile Platforms

- Process preliminary automatically collected, van-based and manually collected, bus-based data and refine data collection and processing procedures based on analysis of processed data
- Collect data on a regular schedule; develop validation protocols

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Complete preliminary mobile testing of the prototype unit through continued sampling and analysis of data collected.
- Fabricate additional sensor units based on the prototype design; continue progress toward deploying units on CABS buses (e.g., iterate on design of box for mounting); collect on-road data on one of the bus routes.

Using Naturalistic Driving Performance Data to Develop an Empirically Defined Model of Distracted Driving

- Finish second round of data analysis; finish manuscript revision/preparation and submit to a peer-reviewed publication; present results to peers at meetings/conferences

A Study of the Usage Potential of a Proposed Expanded Commuter Rail Station at Chicago State University

- Complete statistical analysis of student survey; complete travel time analysis with and without Metra station at 95th Street; disseminate information to campus community

Synthesis of Best Practices for Agency-wide Freight Data and Information Management

- Identify point of contact in the planning division of each DOT; points of contact will provide our office a list of data experts; distribute the survey individually to each expert and assist if necessary; upon completion of the survey, produce a comparative report of the results

Integrating multiple sources of data for the estimation of transit origin-destination flows

- Continue conducting empirical investigations to further validate the quality and interpretability of the flow estimates determined by developed model and estimation methods.

PART 2: PRODUCTS

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Presentation at an international conference: D. Song and S. Peeta, "Psychological Effects of Real-Time Travel Information for Heterogeneous Driver Classes", 7th International Conference on Applied Human Factors and Ergonomics (AHFE 2016).
- Websites -- Experiment website is available at: www.purdue.edu/drivingsimulator -- website provides participants a brief description of the driving simulator experiment, an online survey, and an experiment registration and scheduling system

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Publications, conference papers, presentations
 - Mishalani, R.G., M.R. McCord, and H. Reinhold, 2015. Transit Route-level OD Flow Determination from Passengers' Mobile Devices' Wi-Fi Signals: Methodology and Empirical Evaluation. Accepted for publication in *Transportation Research Record* (acknowledgement of federal support: yes)
 - Mishalani, R.G., M.R. McCord, and H. Reinhold, 2015. Transit Route-level OD Flow Determination from Passengers' Mobile Devices' Wi-Fi Signals: Methodology and Empirical Evaluation. Accepted for publication in *Transportation Research Record* (acknowledgement of federal support: yes)
- Websites -- includes among other things, activities and results from this project: <http://transitlab.osu.edu/campus-transit-lab>

- Technologies or techniques:
 - Commercial-grade state-of-the-practice automatic vehicle location technologies, passenger information systems, and automatic passenger counter technologies implemented on an operational bus service provide data that are regularly downloaded and stored
 - Systematic data collection using mobile-based Wi-Fi sensing technologies is regularly conducted, and techniques are developed to produce OD flow estimates from the data
- Databases that include bus location, position, and speed data, bus passenger boarding and alighting data, estimated and observed bus passenger origin-destination flows are developed and updated
- Physical collections: bus passenger origin-destination flows; manually assisted, Wi-Fi based flow data
- Software or NetWare -- Various codes for archiving, processing, and analyzing the rich and large datasets collected through the Campus Transit Lab
- Educational aids or curricula:
 - Data obtained from the CTL, as well as the physical infrastructure, are used in classes
 - Data are provided to students conducting independent research or project activities not associated with the project
 - Hands-on experience in transit data collection is provided to graduate and undergraduate students associated with the project
 - Experience with practical transit planning and operations issues is provided to graduate students through outreach activities

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Websites
 - https://purdue.qualtrics.com/SE/?SID=SV_died8aIRw4GW6z3 (Instruction and questionnaire on SNS usage)
 - https://purdue.qualtrics.com/SE/?SID=SV_bp9O15m57GBx3cF (Instruction and questionnaire on evacuation decision making process)
- Databases -- questionnaire on SNS usage; questionnaire on evacuation decision making process.

Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Footprints

- Publications, conference papers, and presentations
 - Ramanitharan Kandiah. 2016. Incorporating Educational and Research Components to Enhance Environmental Engineering Curriculum. 2016 ASEE-NCS Conference. Mount Pleasant, MI. March 18–19, 2016. (Oral)
 - Ramanitharan Kandiah, Krishnakumar Nedunuri and Benjamin Rives. 2016. Estimation of Greenhouse Gas Releases from major highways in Ohio. *20th Technological Advances in Science, Medicine and Engineering Conference (TASME)*. Toronto, Canada. July 2-3, 2016. (Accepted for Oral Presentation)

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- Publications, conference papers, and presentations -- presented a technical paper at 2016 Annual TRB meeting, and submitting a technical paper to Journal of Network Economics for review and possible publication
 - Models -- Developed a new model for traffic signal timing optimization under user equilibrium based traffic conditions
- Develop Preliminary Engineering Design and Study the Benefits of Providing an Access to the Indiana Toll Road at State Road 327 near Orland*

- Presentation of the findings was presented to INDOT, Steuben County, and Indiana Toll Road personnel.

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Project video completed Dec 2015, currently being formatted for distribution via SMART project partner network (Fall 2016)

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Peer- Reviewed Conference Paper and Journal Articles:
 - K. Velikov and G. Thün. "Assembling Urban Platforms for Appropriation: Protean Prototypes," at *ACSA 104th National Conference, Shaping New Knowledges*, Seattle, WA, Mar. 17-19, 2016. (acknowledgement of federal support)
 - K. Velikov, G. Thün, "Urban Platforms for Appropriation: Protean Prototypes" in *OASE Journal for Architecture: OASE #96: SOCIAL POETICS_ The Architecture of Use and Appropriation*, E. Vervloesem, M. Goethals, H. Yegenoglu, M. Dehaene, eds: NAI 010 Publishers, Vol 96 : 98-105. (acknowledgement of federal support)
- Databases -- "Access-Enabling Agents in Chicagoland": excel-based geo-encoded database assembling public, NGO and private organizations delivering access to "Health, Learning, Food and alternate mobility options for the Chicagoland metro.
- Audio or Video products:
 - "Protean Prototypes: Access Enabling Architectures for Chicagoland Part I" (video) 19:31 <https://vimeo.com/108468499> --
 - "Protean Prototypes: Access Enabling Architectures for Chicagoland Part II" (video) 7:59 <https://vimeo.com/108468500> --
 - *This pair of videos assembles and illustrates the range of mappings and design prototypes developed through the project.

Tracking bicyclists' route choices, case study

- Publications, conference papers, and presentations; paper for the 2017 TRB's Annual Meeting. In addition to this, we expect to have at least one more scholarly paper based on the smart phone data.
- Website for this project. (<http://u.osu.edu/cycletracks/details/>). Still under construction, please access the site with the password: CYCLETRACKS_IRB

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- A MATLAB code for a Markovian-based probabilistic deterioration modeling of concrete bridge structures has been developed

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Vehicle location and timing technologies in use on operating trucks and virtual geo-fences are combined to produce unique datasets.
- Aggregated longitudinal and disaggregated, truck trip-level databases are developed for truck times incurred in multiple activities.
- Various codes developed to process raw data into times truck incurred at various locations and to process truck trip-level times into summary measures

- Amassed unique aggregated longitudinal and disaggregated, truck trip-level data

Evaluation of Heavy Vehicles on Capacity Analysis for Roundabout Design

- Incremental time-phase data on human behavior was recorded at 10Hz for future analysis.

Roadway Traffic Data Collection from Mobile Platforms

- Educational aids or curricula -- Hands-on experience in data collection and flow estimation to student(s) associated with the project
- Upgraded sensor platform to detect vehicle presence and speeds is developed
- Data and Research Material -- LiDAR data that can be processed into vehicle locations and speeds are collected and stored; manually collected data on observed vehicles and moving observer times are collected and stored

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- Engineering application for counting vehicles by maneuvers based on TScan output files; user interface for Scan Data Collection; developed technique of tracking objects with low-end LiDAR; built a research unit integrated with the Purdue mobile lab; estimated statistical models for classifying objects

Integration of ground access to airports in measures of inter-urban accessibility

- Airport access and service mapping website: the registered name for this site is <http://sky.geogv.org/>.
- Blog for this project: <http://blog.geogv.org>.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Publications, conference papers, and presentations -- La Susa, T., E. van Dommelen, S. Liyanaarachchi, B. Wildey, A. May, M. McCord, R. Mishalani, and G. Sivandran. Mobile Air Quality Monitoring. Presentation at the 2016 Undergraduate Research Forum at The Ohio State University, Columbus, OH, March 2016. (Acknowledgement of federal support: yes)
- Website for data visualization in near-real-time is under development. More details will be forthcoming in the next progress report
- Spatial-temporal database of CO, O3, and NO2 concentrations is being established.

Intermodal Infrastructure Investment Decisions and Linkage to Economic Competitiveness

- Paper: Benedyk, I.V., Peeta, S., Zheng, H., Guo, Y. and Iyer, A.V. (2016) 'Dynamic Model for System-Level Strategic Intermodal Facility Investment Planning', Transportation Research Record Journal of the Transportation Research Board, 2548, DOI: 10.3141/2548-04

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- Paper: Landgraf, A., Mishalani, R.G., McCord, M.R. Goel, P.K. Estimating Transit OD Flows using Boarding and Alighting Data: An Efficient Variational Bayes Method and Clustering-based Extension that Recognizes Multiple Latent OD Flow Matrices. Presented at the Transportation Research Board 95th Annual Meeting, Washington D.C.

LiDAR based vehicle classification AND Segmenting, grouping and tracking vehicles in LiDAR data

- Papers:
 - Lee, H., Coifman, B., "Using LiDAR to Validate the Performance of Vehicle Classification Stations," *Journal of Intelligent Transportation Systems*, Vol 19, No 4, 2015, pp 355-369..
 - Coifman, B., Wu, M., Redmill, K., Thornton, D. "Collecting Ambient Vehicle Trajectories From an Instrumented Probe Vehicle- High Quality Data For Microscopic Traffic Flow Studies" [in review] *Transportation Research Part C*.
- Websites: Coifman, B., *An Overview of the On-Going OSU Instrumented Probe Vehicle Research*, January 9, 2015 revision
 - <http://www2.ece.ohio-state.edu/~coifman/documents/LIDARexs150109.pdf>
 - http://www2.ece.ohio-state.edu/~coifman/documents/LIDAR_Tracking_ex_150109.avi

PART 3: PARTICIPANTS & COLLABORATING ORGANIZATIONS

Partnership Organization Information

Accessibility-Based Evaluation of Transportation and Land-Use Planning: From Laboratory to Practice/ Implementation of Access-Based Evaluation

- EPA, Washington DC -- conversations about a workshop on the topic of accessibility based evaluation, possible interest in the web tool
- Research, Education and Outreach from Campus Transit Laboratory (CTL)*
- Clever Devices, Woodbury, New York – In-kind support; Ohio Department of Transportation, Columbus, Ohio – Financial support; Mid-Ohio Regional Planning Commission – In-kind support; Central Ohio Transit Authority – In-kind support

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Jin-Hyuk Chung, Professor (Co-PI), Department of Urban Planning and Engineering, Yonsei University, Seoul, Korea -- Collaboration

Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Footprints

- Regional Air Pollution Control Agency (RAPCA)- Dayton, OH: Demonstration of air quality measurements, guest lecture for Summer Transportation institute on Greenhouse gases, MOVES demonstration
- Summer Research Training for Central State Undergraduates at Purdue university

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- City of Chicago -- In-kind support of city of Chicago's traffic signal timing design procedure, field deployed signal plans, and traffic counts
- Develop Preliminary Engineering Design and Study the Benefits of Providing an Access to the Indiana Toll Road at State Road 327 near Orland*

- Steuben County Economic Development Corporation, Steuben County, Indiana.

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- NEXT Energy, Detroit, Michigan -- SMART collaborates closely with NEXT Energy, Michigan's nonprofit industry accelerator. The nature of the collaboration has involved data sharing and in-kind support.
- Michigan Environmental Council; Trans4M, a coalition of Michigan based sustainable transport efforts; Wayne State University; Detroit Future City, Detroit collaborative Design Center.
- Project is supported with an active University Research Project (URP) from Ford Motor Company. (2014-2016)

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Project is supported with an active Alliance project from Ford Motor Company.

Tracking bicyclists' route choices, case study

- The Ohio State University's City and Regional Planning Program -- financial assistance in the form of tuition waivers. OSU's College of Engineering contributed financial assistance through TREP funding.

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Ohio Department of Transportation, Columbus, Ohio – In-kind support.

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Michigan Tech Research Institute, Ann Arbor, Michigan – In-kind support, facilities, collaborative research, personnel exchanges.
- CEVA Logistics – In-kind support – truck location and timing data

Integration of ground access to airports in measures of inter-urban accessibility

- The Ohio State University – work carried out in collaboration with the Center for Urban and Regional Analysis.

Using Naturalistic Driving Performance Data to Develop an Empirically Defined Model of Distracted Driving

- University of Michigan Risk Science Center, University of Michigan School of Public Health – financial support, collaboration.

A Study of the Usage Potential of a Proposed Expanded Commuter Rail Station at Chicago State University

- Chicago Metropolitan Agency for Planning – base street and transportation system maps

Other Collaborators and Contacts

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Civil Engineering and City and Regional Planning researchers and students collaborate on various project activities
- A faculty member at Tongji University (China) uses CTL data for education and research purposes at his institution. NEXTRANS researchers are collaborating with same individual on activities of value to the project

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Yu-ting Hsu, Professor, National Taiwan University – collaboration on a two-stage evacuation decision-making models.

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Supported by and extensive collaborations with Sustainable Mobility & Accessibility Research & Transportation (SMART) at the University of Michigan.
- Synergistic with a wider SMART project on the mobi platform, as well as on industry analysis and consumer uptake, all sponsored by Ford Motor Company.
- SMART is an advisor to and collaborates on a regular basis with international organizations: International Transport Forum of the OECD (Organization for Economic Co-operation and Development); World Business Council on Sustainable Development; World Economic Forum; Transportation Research Board; National Academy of Sciences; Global Clean Tech Cluster Association; Scottish Enterprise, Scotland; Tekes, Finland; Vinnova, Sweden; Chalmers University; ICT Viktoria, Sweden

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Supported by SMART at University of Michigan and has the benefit of the same collaborations as "Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions" above.

Methods for improving bicycle sharing system balance

- Ricardo Camargo and Fatima Lima (UFMG Brazil) – collaboration with visiting faculty and post doc.

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Civil Engineering and Geography researchers collaborate on project activities
- Michigan Tech Research Institute is a subcontractor and provides valuable services because of its close proximity to the border crossing facilities
- Data are obtained from international carriers, with focus on Canada-U.S. cross border trips.

Roadway Traffic Data Collection from Mobile Platforms

- Civil Engineering and Electrical Engineering researchers collaborate on various project activities

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- Collaboration with professor Kartik Ariyur from the School of Mechanical Engineering
- Indiana Department of Transportation - co-sponsor, future user of the developed product, potential future support to develop a prototype and to implement the method to engineering practice
- Consortium of 6 European universities within a research program InDev, lead - Lund University in Sweden, exchange of data and results
- International Laboratory of Transportation Safety, Tongji University, Shanghai, China

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Undergraduate students in civil engineering, environmental engineering, and computer science and one environmental engineering graduate student -- collaborated to develop the prototype unit and design the box for housing the unit on the CABS bus. Partnership with the OSU College of Public Health -- resulting in one proposal submission utilizing the technologies developed in this project.

Intermodal Infrastructure Investment Decisions and Linkage to Economic Competitiveness

- Ananth V. Iyer, Krannert School of Management, Purdue University

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- Civil Engineering and Statistics researchers and students collaborate on various project activities.

PART 4: IMPACT

Impact on the Development of the Principal Discipline(s) of the Program

Accessibility-Based Evaluation of Transportation and Land-Use Planning: From Laboratory to Practice/ Implementation of Access-Based Evaluation

- Improve feasibility of accessibility-based evaluation of land-use and transportation projects.

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Add to the body of knowledge on transit travel behavior and transit operations; motivate additional studies by the project research team and others; inspire improvements in decisions taken by transit planners and operators that allow better transit service at lower cost.

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Explicit consideration of people's information sharing preferences to understand information dissemination and propagation patterns.
- Better understanding of people's evacuation decision making process under the presence of heterogeneous information from different sources can help to improve strategies for evacuation information design and dissemination.

Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Foot prints

- Environmental Engineering: Students learned the transportation-climate change nexus by incorporating it into the Air Quality Engineering curriculum; in an environmental engineering program without any specific courses on transportation engineering, this grant helped to incorporate and train the students on the on-road transportation related pollution control.

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- New methodology outperformed the existing models for traffic signal timing optimization in the case study

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Novel methods not previously deployed in transportation economic planning as related to region system representation.
- Study of emerging industry sectors and related clean-tech clusters should be given greater attention in planning regional development, and specific policy development related to the promotion of regional industry clusters.
- Visualizations produced are a novel contribution aiming to produce new graphical products to inform the ways in which multiple disciplinary experts are able to understand sector development and agent composition structured geospatially and across time.

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Project model and methods are expected to improve the richness and quality of concrete bridge deterioration representation, estimation, and forecasting using regularly collected bridge inspection data, which in turn has the potential to improve the maintenance decision-making at state DOTs.

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Unique information on times trucks incur when crossing two of the busiest and highest valued freight border crossings in North America
- Evaluation of Heavy Vehicles on Capacity Analysis for Roundabout Design*
- Support to modify the passenger car equivalent for heavy vehicles at roundabouts published in the Highway Capacity Manual.

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- Quantitative safety estimates and predictions will become possible because the availability of real data to test various hypotheses and meet specifications.

Integration of ground access to airports in measures of inter-urban accessibility

- Developing mapping and spatial analysis results for continental US.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Successful results could lead to novel ways to monitor air quality and new contributions of existing transit bus platforms.

A Study of the Usage Potential of a Proposed Expanded Commuter Rail Station at Chicago State University

- Transportation GIS has been added as an area within our existing GIS program.

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- Improve the richness and quality of transit passenger OD flows representation and estimation using APC data, which in turn has the potential to improve the planning for and design of transit services in urban areas.

Modeling CO2 Emissions as a Function of Transportation, Land-Use, and Regulation Variables

- Improve the understanding of the nature of the contributions of passenger urban travel to greenhouse gas (GHG) emissions, which in turn has the potential to inform transportation related policy-making aimed at possibly reducing such emissions.

LIDAR based vehicle classification AND Segmenting, grouping and tracking vehicles in LIDAR data

- It is anticipated that the trajectory data set will have a large impact on the traffic flow theory community and that it will be widely used

Impact on other Disciplines

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Develop new theories and models in psychology to better understand travelers' choice behavior in a new travel environment with vehicle automation and connectivity technologies.

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Develop new models in behavioral psychology in relation to individual's information sharing behavior under emergency situations such as no-notice evacuations.

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Particular significance to industry development and economic development (especially jobs / workforce development in a changing, urbanizing, technology-driven landscape); novel approach to economic cluster mapping -- industry partners have expressed interest and demand for its application to other regional areas of study.

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Tools, realizable examples and a framework to assist in the uptake of access-based paradigms in planning transformations to transportation systems; producing new markets for New Mobility entrepreneurs, advancing economic opportunities. NGOs and community groups could utilize the result as a means to connect their service delivery.
- Interest from partners in the College of Engineering at U-M working in the sensor-based Smart City domain.

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Motivate researchers in statistics to develop new methods that address the complexities of the project's application in terms of the nature of the inspection data and the accuracy needs of the deterioration forecasting models.

Methods for improving bicycle sharing system balance

- Beneficial interaction between geographers and operations research specialists.

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Collaboration among Civil Engineering and Geography researchers help the different disciplines better understand the use of geo-spatial and sensing technologies in addressing practical transportation issues

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- Heuristic integration of data performed by computer scientists, such as in Google autonomous cars will be replaced by rigorous sensor integration with guarantees, likely using few and less expensive sensors.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Faculty in the OSU College of Public Health and professionals from the Columbus Public Health Department are interested in the sensor technology for applications related to pollutant exposure and the education of vulnerable populations (e.g., asthmatics).

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- Collaboration among Civil Engineering and Statistics researchers help Civil Engineering researchers better understand data analysis techniques and Statistics researchers gain experience by working in an applied setting.

Impact on Transportation Workforce Development

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Provide graduate students the opportunity to understand multiple dimensions of human factor studies in transportation including routing behavior, perception of information, distraction by information, and so on.
- Undergraduate/graduate students in transportation learn the practical use of microscopic traffic simulation (Aimsun) and bio sensors as associated tools of the experiments.

- Undergraduate students provided the opportunities to improve professional skills in transportation through research and internships in Driving Simulator Lab.

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Multiple undergraduate and graduate students regularly collect passenger flow information on CTL buses using manual methods and a Wi-Fi based sensing technology.
- Multiple graduate students regularly process and analyze automatically collected CTL data.
- Students in multiple classes use CTL data and CTL infrastructure for course assignments and projects.

Region V Transportation Workforce Assessment and Summit

- Building a network and a clearing house presence in the Midwest.

Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Footprints

- Summer transportation institute that is partially benefited through this grant helped the middle school and high school students understand the transportation industry, and helped the student enrollment to the institution for STEM majors.
- Minority students in the environmental engineering program are trained in software (MOVES and GREET) that transportation industry and regulating agencies use. This enhances their knowledge, thus the chances for the career in the transportation industry.
- One undergraduate student from Central State is spending summer at Purdue University where he is being mentored by Purdue faculty, graduate students.

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- Sharing the findings of the new methodology and its application for traffic signal timing optimization within the 30+ graduate students in the transportation engineering program at IIT. This has enhanced their understanding of developing effective means for urban traffic management

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Identification of emerging industry sectors and opportunities for entrepreneurial initiatives, identification of gaps in industry cluster assembly that point to both corporate opportunities, and specific workforce development needs.

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- New technology-based solutions and related skills needs and employment opportunities related to access and the development of new models of infrastructure delivery in metros, however, it is premature to claim these impacts.

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Civil Engineering student with a structures background will work with actual bridge inspection data and deterioration models and, as result, will become prepared to address the complexities associated with the infrastructure degradation and the decisions that support the necessary improvements over the long run.

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- One graduate student applied analytical geospatial skills to a new application area

Guaranteed LiDAR-aided Multi-object Tracking at Road Intersections

- Will facilitate data collection and several types of studies such as: pedestrian-vehicle interaction studies; traffic signals studies and intersection performance evaluation among others.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Four undergraduate students and one graduate student from non-transportation fields as well as one high school intern are engaging in a project that intersects transportation, environmental monitoring, and advanced technologies.

A Study of the Usage Potential of a Proposed Expanded Commuter Rail Station at Chicago State University

- Transportation GIS has been added to the curriculum in an advanced GIS course

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- One former Ph.D. student and currently research scientist works directly with APC data and applies data to solve a pertinent transportation flow estimation problem.

Modeling CO2 Emissions as a Function of Transportation, Land-Use, and Regulation Variables

- One former PhD student and one former MS student worked directly with urban transportation supply and demand, population density, CO2 emissions, and policy data to identify patterns and relationships pertinent to transportation policy-making.

Impact on physical, institutional, and information resources at the university or partner institutions

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- The Driving Simulator Lab setup is a state-of-the-art facility at the NEXTRANS Center, Purdue University. The advanced driving simulator has unique capability of replicating/mapping a large city network and creating ambient traffic via integration to microscopic traffic simulation software (AIMSUN). This is one of the most advanced driving simulator labs for understanding driver response to real-time information provision across many dimensions that have not been previously addressed in a research setting. It also has key implications for safety and effectiveness of information in the real world. With its advanced features, the driving simulator provides a robust and realistic driving experience for drivers. The driving simulator is connected to three high-performance computers, and other hardware components such as webcams, video capturing devices and high definition

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- The Ohio State University Campus Transit Lab is a unique living laboratory that is used for research, education, and outreach. This project makes a major contribution toward providing the physical and human resource infrastructure required to develop, sustain, and take advantage of the laboratory.
- CTL results in the amassing of large datasets relating to transit passenger flows, transit vehicle operations, passenger information systems, and transit user and non-user perceptions and attitudes towards transit services.

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- Creating a new body of knowledge in the area of intersection traffic signal timing design

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Sharing of database information between planning, engineering and business units at the University of Michigan, and several meetings to discuss methodological variations between disciplinary practices. Database organization, structure and access have been informed through these exchanges. We anticipate that new database structures related to clean-tech industry clusters will be produced, and that gaps in data acquisition will be identified.

Tracking bicyclists' route choices, case study

- Identify the needs of OSU bicyclists; generate information on origins, destination and routes of bicycling trips that could be utilized for making targeted investments; and identifying the priority areas that need such investments.

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Project activities rely on data resources at Ohio Department of Transportation and possibly other state DOTs. The experience with using these data and the corresponding interactions with state DOT technical staff may motivate improvements to inspection protocols that support the organizations' data resources and facilitate the adoption of the developed deterioration models and parameter updating methods in practice.
- The estimation results arrived at could contribute to improved maintenance decision making at Ohio DOT.

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Amassing of a large and unique dataset on truck times when conducting multiple activities at two major border crossings

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Using existing transit bus platforms at the university as platforms for air quality monitoring.

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- The estimation results arrived at could contribute to improved planning for and designing of transit services on campus.

Impact on Technology Transfer

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Provide government and public sector transportation agencies an assurance that they are targeting their limited funds toward technologies that are most likely to improve the nation's highway system and deliver maximum benefit to travelers.
- Help traffic information service providers and investment decision-makers in understanding the value of real-time information and traveler behavioral response to it. Help in deciding the content and amount of information necessary for travelers to make informed and effective routing decisions.
- The ability to explicitly quantify the human behavior dimension provides a broader set of performance measures to public/private sector stakeholders relative to the evolution of the traveler information services market.

Accessibility-Based Evaluation of Transportation and Land-Use Planning: From Laboratory to Practice/ Implementation of Access-Based Evaluation

- Website will put a powerful evaluation tool into the hands of practicing planners.

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- Amassed data are already leading to results of research and practical value that are communicated via presentations and publications and external projects.

Region V Transportation Workforce Assessment and Summit

- Webinar recording is on the MTWC.org website and is available to any user.

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Help transportation and emergency-control agencies in designing information strategies involving information dissemination through SNS during no-notice evacuations.
- Provide insights to SNS companies in deciding the content of emergency information to be disseminated on SNS to help their users (evacuees) make better decisions regarding the emergency.

Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Footprints

- Methodology in estimating transportation related GHGs and comparing the uses of different fuels.

Tracking bicyclists' route choices, case study

- Although the empirical results and data collection is based on a university campus, the methodology developed will be applicable elsewhere.

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Models and methods arrived at may also contribute to improved maintenance decision-making more broadly at state DOTs across the country.

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Efforts are ongoing to communicate results to prospective stakeholders

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- In the long term, the project would optimistically lead to operational use of the technology and procedures developed on a regular basis. Preliminary exploration of further use of the sensor technologies has already begun and may include other transit systems or exposure monitors for vulnerable populations.

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- Estimation results arrived at are also expected to contribute to improved planning for and designing of transit services more broadly in Columbus and other cities if the model and methods are adopted.

Impact on Society beyond Science and Technology

Driving Simulator Laboratory: Traveler Behavior Modeling and Interactive Experiments to Address Mobility and Safety Needs

- Help in developing a comprehensive understanding of the mechanism in which more benefits can be derived from real-time traffic information systems.
- Lead to direct benefits to the individual travelers, as it facilitates the design of personalized traffic information that can help commuters choose their routes based on their psychological benefits (which link to the quality of travel experience) in addition to travel time savings.
- Contribute to the development of better methods to provide information to travelers and enhance the quality and safety of the travel experience. The research accomplishments from this project can help in deciding the content and amount of information necessary for participants to make best route decisions.
- Improve public access to and awareness of the positive and negative impacts of real-time travel information.
- The driving simulator lab can be used as a platform to educate middle and high school students in various dimensions related to driver performance, behavior, and safety.

Research, Education and Outreach from Campus Transit Laboratory (CTL)

- The overall project is focused on improving transit services, increasing transit utilization, and enhancing transit efficiency, all of which lead to more socially, economically, and environmentally sustainable transportation systems.

Region V Transportation Workforce Assessment and Summit

- Long-range vision of having a highly connected transportation network to ensure a pipeline of workers that can meet the industry's needs.

Effects of Heterogeneous Information Characteristics and Sources on Evacuation Behavior

- Emphasizes the role of SNS as emerging information dissemination media for disaster or any other emergency situations.
- Lead to direct impacts on safety of the evacuees, as it contributes to the development of better information dissemination strategies on SNS.

Integrated Approach to Achieving Environmental Sustainability in Transportation: Coupling Energy Efficiency Solutions with Reductions in Environmental and Climate Footprints

- Helps the minority environmental engineering students and graduates who are underrepresented in the programs and the industry get opportunity to gain in knowledge, research experiences so that they will be competitive in the workforce.

Signal Timing Optimization for Large-Scale Urban Networks under Dynamic Traffic

- Implementation of new methodology for intersection signal timing design to achieve minimized vehicle delays could help improve traffic mobility in urban areas

Mapping New Mobility Business, Innovation, and Employment Opportunities in Michigan: Developing a Data-Driven Graphic Platform for Assessing and Advancing Industry Cluster Development and Entrepreneurship Opportunities in Urban Regions

- Impact on society – in order to transform transportation at the order of magnitude required for the current challenges and to take advantage of the emerging opportunities – social, technical, and demographic, an economic conversion is needed, not just an urban policy or transportation policy approach. The private sector is already and needs to in the future play an increasing role in the wicked problem of transportation in an urbanizing world. This project aims to produce data-based graphical analysis that enables this type of cross disciplinary / cross jurisdictional discourse.

Access-Enabling Architectures: New Hybrid Multi-modal Spatial Prototypes Towards Resource and Social Sustainability

- Impact end users in a range of direct and indirect ways. For participants engaged through the pilot process efforts in Chicago, we anticipate that direct opportunities across the various entities implicated in previous sections will be activated. However, as a pilot project, we are hopeful that the implications enabled through dissemination of the final work will reach multiple end users within the Region V area. As such, we envision a cascading set of impacts that will essentially result from the (i) novelty of the project initiative, (ii) range of stakeholders implicated through the project, and (iii) translational capacity of the proposed process and examples for future implementation and policy transformation opportunities.
- Within the scope of the proposed project, the transformational impact of this work promises to deliver on significant gaps (identified by colleagues such as Levine, Grengs, and Zielinski) and echoed by a range of civic and industry leaders in the SMART eco-system. These gaps are primarily in the uptake of accessibility-based perspectives in the planning of transportation systems and the related system-based solution sets. We recognize that many end users in the form of cities as clients, as well as related transportation planning agencies

and design professionals implicated in the delivery of the physical form of transit hubs, are not charged with, nor have available resources to think through, the synergistic and cost-effective opportunities latent within the system in pursuing the goal of accessibility.

Tracking bicyclists' route choices, case study

- Demonstrate how technology enabled new and innovative data collection methods can be used for collecting travel behavior data. It will demonstrate how these data can be used for modeling human behavior. The use of these data for future planning purposes and investment decisions will impact the quality of life for people and policy decisions. These have clear implications for creating livable communities and integration of different modes.

A Bayesian updating procedure for prediction of corrosion-induced cracking in pre-stressed concrete bridges using visual inspection data

- Improving the forecasting of concrete bridge deterioration to support proactive maintenance decision-making by agencies responsible for managing critical infrastructure assets leading to improved safety and reduced user costs for road transportation of passengers and goods, and a more cost-effective use of resources in achieving such results. Therefore, the overall impact is a more socially, economically, and environmentally sustainable transportation systems.

Methods for improving bicycle sharing system balance

- Improved operational understanding of bike share systems

Truck Activity and Wait Times at International Border Crossings and Documenting and determining distributions, trends, and relations in truck times at international border crossing facilities

- Improving freight flow across international borders, which is essential to international competitiveness

Guaranteed LIDAR-aided Multi-object Tracking at Road Intersections

- Make traffic modeling, estimation, prediction, and the meeting of safety specifications a matter of systematic scalable engineering rather than heuristics with large scale human intervention as it is today. Enable policy makers to design roads and signals on a quantitative basis to meet societal expectations.

Mobile air quality monitoring for local high-resolution characterization of vehicle-sourced criteria pollutants

- Improved air quality monitoring could lead to improved quality of life; for example, information on air pollutant concentrations with higher spatial resolution than currently available may prevent negative health effects in vulnerable populations (e.g., asthmatics, the elderly).

Intermodal Infrastructure Investment Decisions and Linkage to Economic Competitiveness

- Providing to the national-level policymakers a tool to develop policy and regulatory decisions

Transit Origin-Destination (OD) Flow Estimation Considering Temporal Variations based on APC Data

- Improving transit services, increasing transit utilization, and enhancing transit efficiency, all of which lead to more socially, economically, and environmentally sustainable transportation systems.

Modeling CO2 Emissions as a Function of Transportation, Land-Use, and Regulation Variables

- Supporting the motivation, development, and evaluation of passenger transportation, land-use, and environmental policies aimed at reducing greenhouse gas (GHG) emissions in urban areas

LIDAR based vehicle classification AND Segmenting, grouping and tracking vehicles in LIDAR data

- Right now the flows of people and goods over the road network are measured very sparsely- a few hundred permanent classifications per state, supplemented with many more short term counts at discrete locations, sampled once per multi-year cycle. In any event, all of these counts are at a (relatively) small number of fixed locations. The vehicle classification from the instrumented vehicle will bring classification to anywhere on the network, allowing for measurement of classified flows, etc.. Which in turn will lead to better management and planning of the roadway network to serve travelers and freight movements.
- Many aspects of surface transportation depend on models derived from traffic flow theory, e.g., traffic flow models and traffic simulation software. As such, the improved understanding of traffic flow that arises from the microscopic data should lead to improvements over a broad range of surface transportation, from short term traffic responsive controls like ramp metering to long term transportation planning applications.

Advancing Traffic Flow Theory Using Empirical Microscopic Data

- Traffic is inherently difficult to study due to the large number of vehicles interacting at high speeds over long distances. The nuances of these interactions are largely unknown, yet understanding the microscopic details of how people drive will lead to better roadway design and traffic controls. This work has already advanced our knowledge by demonstrating a previously unknown systematic dependency on the adjacent lane-

PART 5: CHANGES/PROBLEMS

No changes or problems to report.