PURDUE
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School of Mechanical Engineering

MECHANICAL ENGINEERING GRADUATE SEMINAR

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PRISM
NNSA Center for Prediction of Reliability, Integrity and Survivability of Microsystems

SEPTEMBER 6TH, 2012 4:30 p.m. room 1061

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"Reconfigurable and Self-Healing MEMS"

Abstract

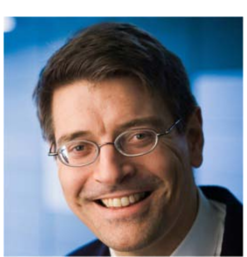
The "More than Moore" trend in the microelectronics industry builds upon a traditional focus on improving mixed analog-digital systems-on-chip. The industry now has an increasing interest in the expansion of "More than Moore" into mixed-physics microsystem integration with CMOS. The growing commercial success of integrated microelectromechanical systems (MEMS), particularly in inertial sensors, is providing an even greater impetus for extending the integration paradigm to other applications. Predictions of large growth cast for CMOS systems with embedded MEMS-enabled sensing and actuation functions cater to evolving applications in mobile communications, sensed infrastructure, and health care. Two specific application areas inspiring research within my group include reconfigurable RF communications and "near-zero invasive" implantable microsystems.

Emerging features in future integrated microsystems include attributes of reconfigurability, selfconfigurability and "self healing" in the presence of manufacturing and environmental variability. These are general attributes that hold promise of providing high manufacturing yield, resiliency and redundancy for critical applications. Reconfigurable RF transceivers are one class of such systems, where RF MEMS switches, tunable passives and resonator filters promise to play a distinctive role. Self-healing techniques are of particular interest in making manufacturable resonator filters. Operation at or above 5 GHz requires sub-micron features that are prone to variation that increases in severity. A technique called statistical element selection embraces the variation by selecting specific resonators from a nominally equal array to build self-healing filters.

A second topic I will touch upon is our work on reliable ultra-compliant neural probes. In contrast to the electronic nature of RF MEMS self healing, these probes exhibit a literal self healing within live tissue. Very fine meandered platinum wires with parylene insulation insert into brain tissue via a stiff biodissolvable needle. The intent is that the tissue heals around the wiring with minimal microglial (i.e., scar) formation, creating reliable single-unit recording electrodes that incorporate intimately with the brain tissue. Histology results from needle insertions provide initial validation of the approach. Ultimately, such probes will contain hundreds of electrodes with distributed CMOS electronics to provide the degrees of freedom necessary to drive complex brain-machine interfaces.

Short Bio: Gary K. Fedder is Director of the Institute of Complex Engineered Systems, Howard M. Wilkoff Professor of Electrical and Computer Engineering and Professor in The Robotics Institute at Carnegie Mellon University. He received his B.S. and M.S. degrees in electrical engineering from MIT in 1982 and 1984, respectively, and his Ph.D. degree from U. C. Berkeley in 1994. From 1984 to 1989, he worked at Hewlett-Packard on circuit design and printed-circuit modeling. He is an IEEE Fellow and received the 1994 AIME Electronic Materials Society Ross Tucker Award, the 1996 Carnegie Institute of Technology G.T. Ladd Award, and the 1996 NSF CAREER Award. He currently serves on the editorial boards for IEEE/ASME *Journal of Microelectromechanical Systems*, IoP *Journal of Micromechanics and Microengineering* and IET *Micro & Nano Letters* and as co-editor of the Wiley-VCH *Advanced Micro- and Nanosystems* book series. He has contributed to over 200 research publications and holds several patents in the MEMS area. His research interests include microsensor and microactuator design and modeling, integrated MEMS manufactured in CMOS processes and structured design methodologies for MEMS.

Reception 4:00 p.m. Gatewood ME 2137



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