ME DEPARTMENTAL SEMINAR

Friday, February 24, 2006
1:00pm – 2:00pm
2233 GG BROWN

Dr. Gloria Wiens
University of Florida

"Incorporating Passive Control Techniques and Piezoresistive Sensing In MEMS Devices for Micromanipulation and Micromanufacturing"

Abstract:

Research in addressing the instabilities and need for high precision performance in electrostatic actuators and micro mirrors is resulting in new MEMS devices incorporating both passive and active control techniques for high precision performance. Electrostatic actuators suffer from an instability known as 'pull-in' that occurs when the electrostatic force exceeds the mechanical restoring force of the device. This instability, while advantageous for digital designs in which only two stable positions are required, is a limitation for devices that require continuous motion over the full actuation range. Another phenomenon associated with this instability is that once the mirror has pulled-in, it will not return from this position until the actuating voltage has been reduced below a threshold voltage, resulting in hysteresis. Through modeling of the behavior of electrostatic instability and hysteresis, mechanical nonlinearities are being exploited for improved performance in the new designs.

In addition to controlling the mirror across the instability point, on-chip piezoresistive sensing is being integrated into MEMS devices for the realization of feedback control design for high precision micro manipulation. This work is also extended to address the need for the ability to sense interactions in force-guided assembly of small devices and in material handling and fixturing of components in micromanufacturing. The development of a multiple DOF, surfaced micromachined piezoresistive force transducer is based on a compliant platform design with integrated piezoresistive sensing elements fabricated in a modified SUMMiT process. This presentation presents the latest developments of the above collaborative research with University of Florida and Sandia National Laboratories.

Gloria J. Wiens received her B.S. and M.S. in Mechanical Engineering from Kansas State University in 1980 and 1982, respectively, and her Ph.D. from The University of Michigan in 1986. Prior to becoming a professor at the University of Florida in 1994, Dr. Wiens was faculty member in the Department of Mechanical and Industrial Engineering, State University of New York, Binghamton (1986-1987) and in Mechanical Engineering at Auburn University (1987-1994). Her current research interests are on physics-based modeling and control of cooperative and/or reconfigurable robotic systems; design, analysis and control of Micro-Electro-Mechanical System (MEMS) devices and dynamic fixturing systems with applications in micro-manipulation and manufacturing. Professor Wiens' research efforts have culminated in the development of the Space, Automation, and Manufacturing Mechanisms (SAMM) Laboratory and the Autonomous and Multi-Agent Systems (AMAS) Program. Her research has been supported by NSF, SNL, NASA, DARPA, AFOSR and industry.