

Innovative MEMS Design & Process

Fifth Workshop for MEMS Consortium

When: **14th June 2011, 10.00 a.m. to 2.30 p.m.**

Where: **Institute of Microelectronics, Singapore**

11 Science Park Road Singapore Science Park II Singapore 117685

Prof. Farrokh Ayazi

Director of Center for MEMS and Microsystems Technologies, Georgia Institute of Technology, Founder and CTO, Qualtré, Inc.

Abstract: “Multi-DOF MEMS for Position, Navigation and Timing”

The motion and position of an object in space can be accurately mapped through the use of a ten degrees-of-freedom (10-DOF) sensor microsystem comprising a three-axis accelerometer, a three-axis gyroscope, a three-axis magnetometer and a barometer. Six-DOF inertial measurement units (IMU) consisting of accelerometers and gyroscopes are being deployed in a myriad of consumer, automotive and industrial applications such as gaming, image stabilization in digital cameras, user interfaces, electronic stability control in automobiles, and robotics. Packaging represents a major challenge to the implementation of small form factor MEMS-based IMUs with high accuracy and stability. This talk presents an overview of multi degrees-of-freedom (DOF) inertial MEMS in applications ranging from gaming to dead reckoning. Approaches to the implementation of high-performance inertial measurement units (IMU) are examined, focusing on challenges related to tri-axial gyroscope implementation. Benefits and tradeoffs of homogeneous multi-axis sensors are reviewed and contrasted with advances in single-chip integrated IMUs.

Biography



Farrokh Ayazi is a professor in the School of Electrical and Computer Engineering and director of the Center for MEMS and Microsystems Technologies (CMMT) at Georgia Tech. He received the B.S. degree in electrical engineering from the University of Tehran, Iran, in 1994 and the M.S. and Ph.D. degrees in electrical engineering from the University of Michigan, Ann Arbor, in 1997 and 2000, respectively. His main research interest lies in the area of Integrated Micro-Electro-Mechanical Systems (Integrated MEMS), focusing on resonators, inertial sensors, and mixed-signal interface circuits for MEMS and Sensors. He is also an editor for the IEEE/ASME Journal of Micro-Electro-Mechanical Systems and served on the technical program committee of several IEEE conferences such as ISSCC, IEDM, and IFCS. Dr. Ayazi is the Co-Founder and Chief Technology Officer of Qualtré Inc., a spin-out from his research Laboratory that commercializes multi-axis Bulk Acoustic Wave (BAW) silicon gyroscopes and six-degrees-of-freedom inertial sensors for consumer electronics and personal navigation systems.

Prof. Amit Lal

Principal Investigator of SonicMEMS Laboratory, Cornell University

Abstract: “High Intensity Microscale Piezoelectric Actuators: Applications to Ultrasonics for Medicine, Microfluidics, and Energy Harvesting Devices”

This talk will present the technology of high-intensity silicon-based ultrasonic actuators, which are bulk and surface micro-machined from silicon wafers. Silicon offers high particle velocity owing to its high peak strain and speed of sound. This enables resonators made of silicon to be operated at very high peak particle velocities, 5-8 times that possible with metal based high-intensity ultrasonic resonators. In addition to material property advantage, silicon micromachining enables fabrication of high aspect ratio structures with low flexural stiffness and high quality factors, enabling very high motion even at CMOS compatible drive voltages. Furthermore, micromachining enables the integration of strain-gauges, electrodes for bio-potential measurement, and piezoelectric material integration. These three advantages of high peak particle velocities, low drive voltages, and integrated sensors enables new applications of ultrasonic actuators. Applications such as zero-insertion force micro probes for penetrating tough tissue, measurement of tissue structure using penetrating probes, integrated viscosity sensing, blood-separations, and electromechanical neural probes will also be covered. In addition, the combination of piezoelectric elements with silicon resonators enables energy harvesting from the same actuators.

Biography



Prof. Lal obtained his B.S degree in Electrical Engineering from Caltech in 1990. He obtained his Ph.D. in Electrical Engineering from University of California, Berkeley. He conducted his doctoral research at the Berkeley Sensors and Actuators Center in the area of ultrasonic MEMS. He leads the SonicMEMS laboratory, which has active efforts in ultrasonic MEMS, radioisotope MEMS, neural probe micro-technology, and chip-scale particle accelerators. Most recently, he served as a Program Manager at DARPA in the Microsystems Technology Office, from 2005-2009. At DARPA he managed ten and started six new programs in the area of navigation, low-energy computation, bio-robotics, and atomic microsystems. He is the recipient of the NSF CAREER award, and with his students several best paper awards at the IEEE Ultrasonics and Frequency Control Symposium, and IEEE NEMS conferences. He is also a recipient of the Department of Defense Exceptional Service Award, and a Best Program Manager Award for his work at DARPA.