

SEMINAR NOTICE

Department of Electrical and Systems Engineering

Multifunctional Nanoelectromechanical Devices and Systems: From Single-Biomolecule Sensing to Information Processing and Very Large Scale Integration

Philip Feng

Kavli Nanoscience Institute
California Institute of Technology

Abstract: Nanoscale devices with mechanical degrees of freedom offer compelling characteristics that make them not only interesting tools for fundamental studies, but also intriguing candidates for technological applications. In particular, nanoelectromechanical systems (NEMS) *vibrating* in their *resonant* modes provide promising opportunities and advantages for developing novel sensors and transducers, in previously inaccessible regimes.

This presentation describes my research efforts, interests, and plans in *NEMS engineering*, with a central theme of how to advance today's very primitive nanostructures into functional devices and integrated systems with high performance. I will first briefly overview the fundamentals of NEMS devices, as enabled by state-of-the-art nanofabrication techniques (both top-down and bottom-up). I will then focus on two specific application areas. One is to demonstrate that engineering of NEMS resonators and signal transduction, in very-high and ultra-high frequency (VHF/UHF) ranges, has enabled single-biomolecule sensing in real time, and the prototyping of NEMS-based mass spectrometry for future proteomics. The second area is the nascent radio-frequency (RF) NEMS signal processing and frequency control, where initial studies on self-sustained NEMS oscillators, phase noise, and synchronization will be presented. Next, I will briefly introduce ongoing research and highlight some latest research milestones such as engineering *multifunctional* NEMS toward very large scale integration (VLSI). Finally, I shall discuss the tremendous opportunities opened up by such explorations that transcend boundaries of traditional disciplines. I will show my perspectives of fundamental and technological research, opportunities of novel devices for applications in biomedical and photonic systems, as well as integrations with mainstream RF MEMS and CMOS technologies.

The above efforts and plans would help establish a solid technological foundation toward enabling future practical integrated systems with embedded multifunctional nanodevices, which may have strong impact upon a number of important applications, ranging from new tools for biology and healthcare to advanced information processing and communications.

Wednesday, May 6, 2009

10:00 a.m.

Bryan Hall 305

Host: R. Martin Arthur

Short Bio: Philip Feng is a senior staff scientist at Caltech, where he also serves as a co-principal investigator. He obtained his Ph.D. from Caltech for developing ultra-high-frequency nanoelectromechanical systems (NEMS) with low-noise technologies. He has since been leading a team of engineers and applied physicists to advance device and system technologies for sensing, signal processing and computing. He has delivered invited lectures at several peer-reviewed international conferences, and served as a frequent reviewer for more than a dozen multidisciplinary and IEEE journals.