Control of the Scanning Tunneling Microscope for Atomically Precise Lithography, Spectroscopy and Imaging

Reza Moheimani
Department of Systems Engineering
University of Texas, Dallas

Abstract:
Since the invention of the scanning tunneling microscope in early 1980s we have seen little change in the STM's mechatronic system design and practically no change in its control system. In this talk I will discuss recent efforts in my group that aim to redesign the STM's feedback control system to enable new modes of lithography, imaging and spectroscopy. I will describe a key cause of instability in STM feedback control loop, and will propose a solution. I will then go on to describe recent progress in designing MEMS scanners with integrated tips for on-chip scanning tunneling microscopy. The ultimate goal is to enable multi-tip operation for both imaging and lithography.

Biography:
Reza Moheimani is a Professor and James Von Ehr Distinguished Chair in Science and Technology in the Department of Systems Engineering at the University of Texas at Dallas with appointments in Electrical and Computer Engineering and Mechanical Engineering Departments. He is an Adjunct Professor with the School of Engineering at University of Newcastle, Australia. He is the past Editor-in-Chief of Mechatronics, and a past associate editor of IEEE Transactions on Control Systems Technology, IEEE Transactions on Mechatronics and Control Engineering Practice. He received the Industrial Achievement Award (IFAC, 2023), Nyquist Lecture Award (ASME DSCD, 2022), Charles Stark Draper Innovative Practice Award (ASME DSCD, 2020), Nathaniel B. Nichols Medal (IFAC, 2014), IEEE Control Systems Technology Award (IEEE CSS, 2009) and IEEE Transactions on Control Systems Technology Outstanding Paper Award (IEEE CSS, 2007 and 2018). He is a Fellow of IEEE, IFAC, ASME and Institute of Physics (UK). Moheimani received the Ph.D. degree in Electrical Engineering from University of New South Wales, Australia in 1996. His current research interests include applications of control and estimation in high-precision mechatronic systems, high-speed scanning probe microscopy and atomically precise manufacturing.

*This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.
me.iastate.edu