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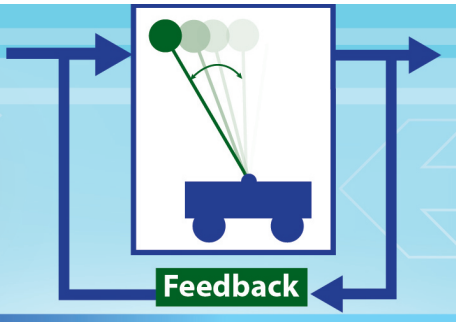

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High-speed Atomic Force Microscopy: Controls and Mechatronic Challenges

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3:30 – 4:30 pm • 1500 EECS

ABSTRACT: The Atomic Force Microscope (AFM) is one of the most remarkable scientific instruments of our time. Imaging in 3D with atomic resolution is one of the most unique features of the AFM. Unlike traditional light and scanning electron microscopes (SEMs) which create images of matter by measuring the intensity of reflected electromagnetic radiation, the sharp tip of an AFM micro-probe interacts with the sample surface enabling the AFM to create images by mechanically "feeling" the surface with its micro-probe. While the resolution of light microscopy is limited by the refraction of visible light, and SEMs on the diffraction of electron beams, the resolution of the AFM is directly related to the precision and accuracy of positioning the AFM probe relative to a sample surface. Additionally, the throughput of the AFM is limited by how fast the probe can be positioned over the specimen. Increasing the throughput of an AFM while maintaining its high accuracy amounts to a significant challenge. In this talk we report on recent efforts to develop video-rate atomic force microscopes for direct observation of dynamic processes at extremely high resolutions by combining innovative mechatronic design and high-performance control. In addition, we explain how these ideas lead to a compact on-chip AFM using MEMS fabrication techniques.

BIO: Reza Moheimani currently holds the James von Ehr Distinguished Chair in Science and Technology in Department of Mechanical Engineering at the University of Texas at Dallas. His current research interests include ultrahigh-precision mechatronic systems, with particular emphasis on dynamics and control at the nanometer scale, including applications of control and estimation in nanopositioning systems for high-speed scanning probe microscopy and nanomanufacturing, modeling and control of microcantilever-based devices, control of microactuators in microelectromechanical systems, and design, modeling and control of micromachined nanopositioners for on-chip scanning probe microscopy. Dr. Moheimani is a Fellow of IEEE, IFAC and the Institute of Physics, U.K. His research has been recognized with a number of awards, including IFAC Nathaniel B. Nichols Medal (2014), IFAC Mechatronic Systems Award (2013), IEEE Control Systems Technology Award (2009), IEEE Transactions on Control Systems Technology Outstanding Paper Award (2007) and several best student paper awards in various conferences. He is the Editor-in-Chief of Mechatronics and has served on the editorial boards of a number of other journals, including IEEE TRANSACTIONS ON MECHATRONICS, IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY, and Control Engineering Practice. He currently chairs the IFAC Technical Committee on Mechatronic Systems.

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