Abstract:

This presentation focuses on design principles for nanofabrication tools and instruments, with an emphasis on precision motion control. We present broad subject area topics and analyses coupled with specific case studies and an overview of solutions given in the literature. In addition, we give an overview of approaches for teaching these subjects at MIT.

As an example, magnetic suspensions are increasingly used in precision motion systems such as photolithographic scanners used to manufacture integrated circuits. The governing physics and control of such suspensions at the nanometer level will be presented. We will also discuss advanced actuation and control of precision machine elements such as fast tool servos for diamond turning machines. Additionally, applications of precision motion control in atomic force microscopes will be discussed.

Finally, we will present some of our approaches for teaching the principles of precision mechatronics at MIT, at both the undergraduate and graduate levels. The picture below shows the hardware of our macro-scale atomic force microscope used for teaching precision mechatronics.

Bio:

David L. Trumper joined the MIT Department of Mechanical Engineering in August 1993, and holds the rank of Professor. He received the B.S., M.S., and Ph.D. degrees from MIT in Electrical engineering and Computer Science, in 1980, 1984, and 1990, respectively. Following the Bachelor's degree, Professor Trumper worked two years for the Hewlett-Packard Co. After finishing the Master's degree, he worked for two years for the Waters Chromatography Division of Millipore. Upon completing the Ph.D. degree, for three years he was an Assistant Professor in the Electrical Engineering Department at the University of North Carolina at Charlotte, working within the precision engineering group. Professor Trumper's research centers on the design of precision mechatronic systems, with a focus on the design of novel mechanisms, actuators, sensors, and control systems. He has conducted research in topics including precision motion control, high-performance manufacturing equipment, novel measurement instruments, and high-precision magnetic suspensions and bearings. He is a member of the IEEE, ASME, and ASPE (past-President).