

Robotic Systems for Cell Surgery and Nanomanufacturing

by

Professor Yu SUN

Department of Mechanical and Industrial Engineering
University of Toronto
Canada



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Abstract

Rapid advances in biology and nanotechnology require the development of technologies for automated manipulation of cells and nanomaterials. Tasks such as single-cell surgery and the manoeuvring of individual nanowires pose interesting research challenges in micro-nanorobotic manipulation. For instance, relevant forces of object interactions (e.g., van der Waals force; electrostatic force) occurring in micro-nanomanipulation must be carefully characterized. Three-dimensional position information must be accurately obtained from two-dimensional image feedback of optical and electron microscopy. New visual servo control approaches are required to tackle nonlinearity and imprecisely modeled kinematics of micro-nanomanipulators.

In this talk, I will first introduce our robotic cell manipulation technologies. Hardware platforms and techniques such as cell immobilization, vision-based contact detection, and visual servo control will be discussed. System performance and applications to molecule testing and clinical cell surgery will be presented. I will then move from microrobotic manipulation to nanomanipulation under scanning electron microscopes (SEM). Through the development of novel systems/devices and nanorobotic manipulation techniques, we are in process of realizing a multi-functional 'nano-factory' for tackling a portfolio of problems, such as manipulation and characterization of individual nanomaterials; probing and characterization of nanoelectronic structures; manufacturing of nano-scaled devices; and manipulation of sub-cellular structures.

Biography of the Speaker

Yu Sun is a Professor in the Department of Mechanical and Industrial Engineering, with joint appointments in the Institute of Biomaterials and Biomedical Engineering and the Department of Electrical and Computer Engineering at the University of Toronto. He obtained his Ph.D. in mechanical engineering from the University of Minnesota in 2003 and did his postdoctoral research at the Swiss Federal Institute of Technology (ETH-Zürich). He is presently a McLean Senior Faculty Fellow at the University of Toronto and the Canada Research Chair in Micro and Nano Engineering Systems.

During 2012 and 2013, he directed the University's Nanofabrication Center that hosts 50\$Million micro-nanofabrication equipment. He has served and serves on the editorial boards of a number of journals (e.g., several IEEE Transactions, J. Micromechanics Microengineering, Scientific Reports, and Microsystems& Nanoengineering). Among his awards were the McLean Award in 2009, the IEEE Robotics and Automation Society Early Career Award in 2010, and an NSERC E.W.R. Steacie Memorial Fellowship in 2013. He was elected Fellow of ASME (American Society of Mechanical Engineers), IEEE (Institute of Electrical and Electronics Engineers), and CAE (Canadian Academy of Engineering) for his work on micro-nano devices and robotic systems.