Rapid advances in biology and nanotechnology require the development of robotics 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 seminar, 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.

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