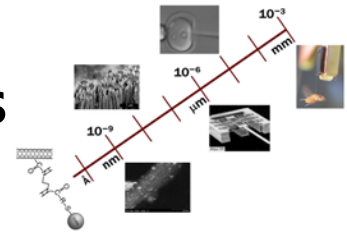


Undergraduate Research Topics



Lab: Advanced Micro and Nanosystems Lab

<http://amnl.mie.utoronto.ca>



Year: 2012

AMNL accepts strong undergraduate students from Engineering Science, Mechanical Engineering, Electrical and Computer Engineering, and Biomedical Engineering.

1. Topic: Software development in C++ for automated cell manipulation

Number of Students: 1 or 2 (EngSci/ECE/MIE)

Description: The student will develop C++ software to implement computer vision and control algorithms we invented. Strong skills in C++ programming are required. The software will control multiple pieces of hardware (e.g., microscopes, microrobots etc.) to manipulate biological cells. The student will also perform extensive cell experiments to evaluate system performance.

2. Topic: Development of electrical circuits for controlling microfluidic droplets and fluid pumping

Number of Students: 1 or 2 (EngSci)

Description: The student will develop PCB circuits for multiplexed high-voltage control of microfluidic droplets and microfluidic pressure. The student should have experience in developing electronic circuits and circuit integration. Previous experience with microcontroller circuits is also required.

3. Topic: Mechanical design of apparatuses for operation under microscopes

Number of Students: 1 (MIE)

Description: The student will design and construct a number of mechanical systems/mechanisms such as motorized stages, fixtures, sample holders etc. for use under optical microscopes. Prior experience in CAD design (e.g., in SolidWorks) is required.

4. Topic: CD-like cell manipulation devices

Number of Students: 1 (EngSci/MIE)

Description: The student will develop a system integrating motors and microdevices for manipulating cells using centrifugal forces. The student will conduct system analysis and system construction as well as testing the system with cells. The project will involve electronic control (e.g., motor's rotational speed), imaging, mechanics simulation, and cell mechanics experiments.

5. Topic: Software Development: Computer Vision and Image

Processing

Number of Students: 1 or 2 (EngSci/ECE/MIE)

Description: The student will develop algorithms and C++ programs to analyze biological cell images both on line and off line. The image processing/computer vision tasks will include real-time feature measurements (e.g., cell size); tracking of moving objects; and recognition of cellular structures. The student will also perform cell experiments to evaluate the performance of developed algorithms/C++ programs.

6. Topic: Nanowire surface functionalization for protein sensing

Number of Students: 1 or 2 (EngSci)

Description: The students must have a fundamental understanding of nanomaterials (e.g., carbon nanotubes, Si nanowires) and MEMS design and microfabrication. The student will design and microfabricate sensors (mechanical and bio/chemical) that integrate nanomaterials as active sensing elements. The sensors will be developed and applied to detecting proteins secreted by biological cells.

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- Mechanical and Industrial Engineering
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