

# SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

## DESIGN AND IMPLEMENTATION OF POSITION-ENCODED MICROFLUIDIC MICROSPHERE-TRAP ARRAYS

DISSERTATION DEFENSE

by

**Xiaoxiao Xu**

PhD Candidate

Preston M. Green Department of Electrical and Systems Engineering  
Washington University in St. Louis

**Abstract:** Microarray devices are useful for detecting and analyzing biological targets, such as DNAs, RNAs, proteins, etc. Applications of microarrays range from fundamental research to clinical diagnostics and drug discovery. In this presentation, we consider a microsphere array device with predetermined positions of the microspheres. We implement it by employing microfluidic technology and a hydrodynamic trapping mechanism. We call the device position-encoded microfluidic microsphere-trap arrays. We design a novel geometric structure for this device, and develop a comprehensive and robust framework to optimize the values of its geometric parameters that maximize the microsphere arrays' packing density. We also simultaneously optimize multiple criteria, such as high microsphere trapping efficiency and low fluidic and imaging errors. We use finite element simulations to investigate the hydrodynamic trapping of the microspheres. We further perform microsphere-trapping experiments using the optimized device and an un-optimized device. The experimental results demonstrate easy control of the microspheres' transportation and manipulation in the optimized device. They also show that the optimized device greatly outperforms the un-optimized device. We finally extend our optimization framework to build a device that enables simultaneous, efficient, and accurate screening of multiple biological targets in a single microfluidic channel, by immobilizing different-sized microspheres at different regions. Different biomolecules captured on the surfaces of the different-sized microspheres can thus be detected simultaneously by the microspheres' positions. Our device is promising as a cost-effective and point-of-care lab-on-a-chip system.

DATE: Friday, April 18, 2014  
TIME: 10:10 a.m.  
PLACE: Green Hall, Room 0120

Dissertation advisor:  
Dr. Arye Nehorai

This seminar is in partial fulfillment  
of the Doctor of Philosophy degree