SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

OPTIMAL DESIGN OF MICROFLUIDIC MICROSPHERE-TRAP ARRAYS

PhD Preliminary Research Examination

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Abstract: Microsphere array devices are powerful for detecting and analyzing biological targets, such as DNA, RNA, protein, etc. Implementing the microsphere array system by microfluidic techniques offers a gentle liquid environment for biological samples, reduces reagent cost and hybridization assay time, integrates high-throughput sample processing steps, and provides the potential for mass production of devices at low cost. Therefore, these devices have great promising applications in life science research and diagnostics.

We consider a microsphere-trap array device by employing microfluidic techniques and a hydrodynamic trapping mechanism. We design a novel geometric structure of the trap arrays in the device, and develop a comprehensive and robust framework to optimize the values of the geometric parameters to maximize the microsphere arrays' packing density. We also simultaneously optimize multiple criteria, such as efficiently immobilizing a single microsphere in each trap, effectively eliminating fluidic errors such as channel clogging and multiple microspheres in a single trap, minimizing errors in subsequent imaging experiments, and easily recovering targets. We use finite element fluidic dynamic simulations to validate the trapping mechanism of the device and to study the effects of the optimization geometric parameters. We further perform microsphere-trapping experiments using the optimized device and an un-optimized device. These experiments demonstrate easy control of the transportation and manipulation of the microspheres in the optimized device. They also show that the optimized device greatly outperforms the un-optimized one. The design and optimization framework lays the foundation for the future goal of developing a modular, reliable, efficient, and inexpensive lab-on-a-chip system.

DATE: Monday, February 18, 2013
TIME: 10:10 a.m.
PLACE: Green Hall, Room 0120

Thesis advisor:
Dr. Arye Nehorai

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

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