Date: **September 26th**

Time: **11:00 AM**

Location: **Ames 234**

Speaker: **Dr. Benjamin Shapiro**
University of Maryland at College Park

Title: **"Flow Control inside Micro-Fluidic Systems: Modeling, Sensing, and Feedback Control Design"**

Abstract

Micro-fluidic technology has the potential to allow hand-held devices with the functionality of existing biological and chemical laboratories, it can be used to create wearable or implantable drug delivery platforms, and it allows direct handling of biological materials such as cells, proteins, and DNA. In our research we have found that feedback control is sometimes required for robust micro-fluidic performance (as in the UCLA electro-wetting devices) and it allows new capabilities in other cases (as in our multi-particle steering system). This talk will address our efforts to integrate research in system design and feedback control with the rapid progress being made in micro-fluidic systems.

Results will be shown for two physical systems. The first is the Electro-Wetting-On-Dielectric (EWOD) system developed at UCLA by CJ Kim. Here a grid of electrodes is used to locally change surface tension forces on liquid droplets: by choosing the electrode firing sequence it is possible to move, split, join, and mix liquids in the droplets. I will describe our modeling, vision sensing, and control results for this system. In particular, I will show our algorithms for precision control of droplet splitting and joining, and I will describe how feedback can be used to correct for an unknown external environment.

The second system is a micro-fluidic “no-laser tweezer” system that can be used to steer many particles at once. I will show how we use flow control to create an underlying, time-varying fluid flow that carries all the particles at once along their desired trajectories, and I will describe the status of our experiments at Maryland and at NIST. Because the system does not require lasers and high quality optics with long optical path lengths, it is cheap and it can be miniaturized. This system is being used to steer cells for a “cell clinics” project at the University of Maryland.

I will close the talk by outlining some of the key motivations, benefits, bottlenecks, and remaining open challenges in integrating feedback control and micro-fluidic systems research.