

# Sondervortrag

Am Montag, dem 31 Mai 2010, um 15:00 Uhr hält

**Prof. Benjamin Shapiro.**  
University of Maryland

einen Vortrag mit dem Titel

## **Flow Control of Microscopic and Nanoscale Objects: From Steering Live Swimming Cells to Manipulation of Quantum Dots to Nanometer Precision**

**Der Vortrag findet im OFFIS F02 statt.**

### **Abstract:**

Feedback control is ubiquitous in macro-scale engineered systems (from airplanes to operational amplifiers), and in living things (from the gross organ level down even to sub-cellular processes). It allows them to achieve high performance even in complex and uncertain environments by detecting and correcting for errors as they occur. The same need for feedback control also exists for engineered micro- and nano-scale systems: they too must perform well in uncertain and complex environments. We have developed methods to precisely manipulate objects by flow control -- these turn out to show both unexpected control flexibility as well as unexpected accuracy.

Our methods allow precise, robust, and gentle manipulation of cells on chips to micro-meter precision in hand-held devices. Capabilities include steering and trapping of single living cells, independently manipulating multiple cells at once, and control of swimming cells. By integrating our control methods with sub-pixel optical algorithms that can locate diffraction pattern centroids to much better than the wavelength of light, we have demonstrated nanometer precision control of single quantum dots, over a long 100 um working range with holding times exceeding an hour (the useable lifetime of the dots). Our methods are currently being extended to further control object rotation and to do control in the third (vertical) dimension, as will be demonstrated in simulations. Applications include basic-science biology studies, biological sample preparation (e.g. extracting circulating tumor cells from blood or bacteria from saliva or urine), and the fabrication of multi-dot quantum information systems. In this talk I will give a general overview of non-contact control. I will describe lessons learned about modeling, control design for different types of actuation (flow, electrokinetic, electrowetting, DEP, etc), will show experimental results, and will outline future directions from a control theory and devices perspective.

### **Biografie:**

Benjamin Shapiro received his bachelors degree from the Aerospace Engineering department at Georgia Tech, and his PhD from the Control and Dynamical Systems option at Caltech. He has been at the university of Maryland for 9 years. His research is focused on modeling, design, and control of micro-scale systems for chemical, biological, and now clinical applications. His primary appointment (as of January 2010) is with the Fischell department of Bio-Engineering, he has a joint appointment with the Institute for Systems Research, the Nano-center, and is affiliated with the Applied Math and Scientific Computation program. He is the recipient of a 2003 NSF CAREER award, has filed 16 patents (two of which were awarded 1st and 3rd places as inventions of the year at Maryland), and is a Fulbright scholar (to Germany). He was born in Jerusalem, Israel in 1973.

**Eingeladen von: Prof. Dr.-Ing. Sergej Fatikow**

*Weitere Kolloquiumstermine sind im WWW abrufbar.*