Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Steering and Trapping Multiple Particles by Feedback Flow Control: Theory and Experiments MIKE ARMANI, SATEJ CHAUDHARY, ROLAND PROBST, BENJAMIN SHAPIRO — On the macro scale, feedback control is routinely applied to improve performance and enable new tasks in complex and uncertain systems operating in noisy environments. Our lab has focused on applying feedback control ideas to systems on the micro scale. We show how to combine micro-fluidics and feedback control to independently steer multiple particles with micrometer accuracy in two spatial dimensions. The particles are steered by creating a spatially and temporally varying fluid flow that carries all the particles from where they are to where they should be at each time step. Our control loop comprises sensing, computation, and actuation to steer particles along user-input trajectories, to hold particles in place, or both. Particle locations are identified in real-time by an optical system and sent to a control algorithm that then determines the electrode voltages necessary to create a flow field to carry all the particles to their next desired locations. The process repeats at the next time instant. We have demonstrated flow steering of multiple particles at once both in simulations and in experiments. The steering algorithm is robust to uncertainty and works even when conditions of the particles (size, surface charge), conditions of the buffer (pH, temperature, electro-chemistry, impurities), and attributes of the devices (errors in fabrication geometry, parasitic pressure flows driven by surface tension) vary and/or are unknown.

Benjamin Shapiro

Date submitted: 13 Dec 2005 Electronic form version 1.4