Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

A novel 3D micron-scale DPTV (Defocused Particle Tracking Velocimetry) and its applications in microfluidic devices JOHN ROBERTS, QIAN LIAO, JOSEPH D. KIRTLAND, BRADLEY MORGENFELD, ABRAHAM STROOCK, MINGMING WU, School of Engineering, Cornell University — The rapid advancements in micro/nano biotechnology demand quantitative tools for characterizing microfluidic flows in lab-on-a-chip applications, validation of computational results for fully 3D flows in complex micro-devices, and efficient observation of cellular dynamics in 3D. We present a novel 3D micron-scale DPTV (defocused particle tracking velocimetry) that is capable of mapping out 3D Lagrangian, as well as 3D Eulerian velocity flow fields at sub-micron resolution and with one camera. The main part of the imaging system is an epi-fluorescent microscope (Olympus IX 51), and the seeding particles are fluorescent particles with diameter range 300nm - 10um. A software package has been developed for identifying (x,y,z,t) coordinates of the particles using the defocused images. Using the imaging system, we successfully mapped the pressure driven flow fields in microfluidic channels. In particular, we measured the Laglangian flow fields in a microfluidic channel with a herring bone pattern at the bottom, the later is used to enhance fluid mixing in lateral directions. The 3D particle tracks revealed the flow structure that has only been seen in numerical computation. This work is supported by the National Science Foundation (CTS - 0514443), the Nanobiotechnology Center at Cornell, and The New York State Center for Life Science Enterprise.

Mingming Wu
Sibley School of Mechanical and Aerospace

Date submitted: 11 Aug 2005 Electronic form version 1.4