Mechanical Engineering Seminar Series Presents:

Hydrodynamic, acoustic, and electrokinetic tools for particle manipulation in microfluidic devices

by Dr. Brian Kirby

10:30-11:45 am in 132 Fluor Daniel on Friday, Nov. 3.

We present results from several projects unified by microfluidic devices and their use in manipulating micro- and nanoparticles. We have developed the GEDI device for capturing circulating tumor cells; I will present the design principles behind this device as well as results from the TAXYNERGY trial, in which these devices were used to capture cancer patient cells and correlate cellular biomarkers with patient outcomes. We have also developed DEP-enhanced GEDI designs and I will shoe data illustrating how dielectrophoresis and electrorotation can be combined with GEDI to provide enhanced cell capture. As time has evolved, we have become more and more interested not just in cancer cells but in the vesicles they shed, and I will present acousto-phoretic devices that sort nanoscale lipid vesicles shed by cells to identify their content and provenance. Finally, micro- and nanoparticle suspensions are often monitored by nanoparticle tracking analysis, and I will show recent results highlighting how standard NTA particle size inference can lead to spurious size distributions in particle-particle correlations are not properly managed.

Bio

Brian J. Kirby currently directs the Micro/Nanofluidics Laboratory in the Sibley School of Mechanical and Aerospace Engineering at Cornell University. He joined the School in August 2004. Previous to that, he was a Senior Member of the Technical Staff in the Microfluidics Department at Sandia National Laboratories in Livermore, California, where he worked from 2001-2004 on microfluidic systems, with applications primarily to counterbioterrorism. From 1996-2001 he worked as a graduate student in the High Temperature Gasdynamics Laboratory at Stanford University, where he developed laser spectroscopy techniques for imaging gases in flames for combustion and aerothermopropulsion applications. From 1994-1996 he worked as a graduate student in the Variable Gravity Research Laboratory at the University of Michigan, studying multiphase heat transfer processes; at Hewlett-Packard Laboratories in Palo Alto, CA, studying fluid mechanics processes in hard drive stacks; and in the Gas Dynamics Research Laboratoriesin the Aerospace Engineering Department at the University of Michigan, studying soot formation processes in low-pressure diffusion flames. Professor Kirby has received a 2002 R&D Top 100 Invention award for work on microvalves for high pressure-fluid control, a 2004 JD Watson Investigator award for microdevices for protein production and analysis, and a 2006 Presidential Early Career Award for Scientists and Engineers (PECASE) award for nanoscale electrokinetics and bioagent detection. He has received the 2008 Mr. and Mrs. Robert F. Tucker Excellence in Teaching Award, the 2013 Robert '55 and Vanne '57 Cowie Excellence in Teaching Award, the 2015 James M. and Marsha D. McCormick Excellence in Advising Award, and the 2015 Cornell College of Engineering Research Excellence Award. Prof. Kirby has taught in various capacities in the Sibley School of Mechanical and Aerospace Engineering at Cornell, the Mechanical Engineering Department at Stanford, and the Chemical Engineering Department at the University of Michigan, and has authored a leading textbook on microscale and nanoscale fluid mechanics.