Fluctuating hydrodynamics of microparticles in biological fluids: modeling, simulation and analysis

Dr. Scott McKinley

October 1, 2014

Abstract:

Recent progress in advanced microscopy reveals that foreign microparticles in biological fluids exhibit anomalous diffusive behavior. Intrinsic to particle trajectories are time and length scale correlations that challenge conventional probability frameworks.

This talk will consist of two parts. In the first part we will look at microparticle tracking data (joint work with David Hill and Greg Forest among others), looking in particular at the statistical signals that endorse using fractional Brownian motion as our base model. In the second part I will present the Landau-Lifshitz formulation of thermally fluctuating viscous fluids with an eye toward describing particle-particle interactions. The stochastic PDEs associated with these models pose numerous computational and analytical challenges though. I will give one example of analytical work (joint with Jonathan Mattingly and Natesh Pillai) in which we establish geometric ergodicity of a bead-spring pair with stochastic Stokes forcing. The method employs control theoretic arguments, Lyapunov functions and hypoelliptic diffusion theory to prove exponential convergence via a Harris chain argument.