Subdiffusions in Microrheological experiments

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The widespread availability of high quality light microscopy combined with high speed digital camera recording and automated tracking tools has allowed for experiments which track single particles passively diffusing in complex fluids (Microrheology).

In a Newtonian fluid, the mean squared displacement (MSD), i.e., the second moment of a particle's position, grows linearly in time, a situation called diffusion. However, for other viscoelastic materials such as biological fluids, one may observe a MSD that grows slower than linearly, also called subdiffusion. Detecting subdiffusion in a statistically sound manner can be biologically relevant. For example, knowing that a virus or other parasite in a complex biological fluid such as lung mucus diffuses out relatively slowly can have important clinical ramifications.

In this talk, we look into the problem of modeling the behavior of particles with time varying diffusion rates. In particular, the true long term diffusion rate is still an open question in the Microrheology literature, so we propose the use of the Local Whittle Estimator to estimate and test for subdiffusivity in data from human lung mucous. Moreover, we propose a fast wavelet-based simulation method for the velocity process of the particle, which will allow us to study the finite-sample properties of the Local Whittle Estimator.