A random walk in neuroscience

Brent Doiron
University of Pittsburgh

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The dynamic of our nervous system is incredibly stochastic, with noisy fluctuations measured at scales ranging from sub-cellular to the entire brain. The field of mathematical neuroscience has provided many insights on brain dynamics and computation, but only recently has attention been given to the inherently stochastic nature of neural response. In this talk I will present a diffusion-based treatment of neural activity, relying on moment-based calculations and linear response approaches borrowed from non-equilibrium statistical mechanics. In the weakly coupled limit expressions are derived that capture the collective stochastic dynamic of populations of neurons, and how it depends on both external stimuli as well as cellular nonlinearities. These theories are applied to a wide spectrum of neural behavior; beginning with the stochastic synchronization of uncoupled cells, the responses of coupled networks to sensory inputs, the dynamics of working memory and decision making, and finally the differences between spontaneous and stimulated neural dynamics. These case studies show the rich, and often unexpected, phenomena that occur when coupled nonlinear systems are driven by stochastic forces.

The lecture will take place in Thackeray 704 at 4:00pm.
Refreshments will start at 3:30pm.