



STATISTICS DEPARTMENT COLLOQUIUM

MONDAY, MARCH 16, 2009

Talk: 4:00 PM – *Science Center 309*

Reception: 5:15 PM – *Science Center, 7th Floor*

“Point Process Filters Applied to the Analysis of Spiking Neural Systems”

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ABSTRACT

Although it is well known that neurons receive, process and transmit information via sequences of sudden stereotyped electrical events, called action potentials or spikes, most analyses of neural data ignore the highly localized nature of these events. In this talk, we discuss a point process modeling framework for neural systems that allows us to perform inference, assess goodness-of-fit, and estimate a state variable from neural spiking observations.

We develop a state space estimation and inference framework by constructing state models that describe the stochastic evolution of the signals to estimate, and conditional intensity models that define the probability distribution of observing a particular sequence of spike times for a neuron or ensemble. We can then develop discrete or continuous time expressions for the conditional density of the state given the observations using a recursive Bayesian framework combined with the Chapman-Kolmogorov equation or the forward Kolmogorov equation respectively. This allows us to derive a toolbox of estimation algorithms and adaptive filters to address questions of static and dynamic encoding and decoding. In our analysis of these filtering algorithms, we draw analogies to well-studied linear estimation algorithms for continuous valued processes, such as the Kalman filter and its discrete and continuous time extensions.

We will discuss the application of these modeling and estimation methods to neural data from a variety of systems including spatially specific firing activity in the rat hippocampus and movement related activity in primate motor cortex.