McCormick

Northwestern Engineering

Engineering Sciences and Applied Mathematics

ESAM Seminar Series Presents:

Synchrony and Firing Rate in Neuronal Networks: An Exact Meanfield Approach

Presented by:

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Neurons primarily communicate via chemical synapses which are activated by temporally narrow all-or-none electrical events called action potentials. For this reason, networks of model neurons, which are capable of generating spikes, and which are connected via synapse-like interactions, are an essential computational tool for exploring brain function. Networks of real neurons also often display a high degree of recurrent synaptic connections as well as considerable heterogeneity in single cell parameters. Network models incorporating all of these defining features are generally not amenable to analysis given the high dimensionality and strong nonlinearities they imply. Rather, these network models are studied via numerical simulation. Given this, researchers often seek to characterize the dynamical properties of spiking networks by means of reduced models. These models are heuristic and generally treat the mean firing rate in the network as the variable of interest. As such, these models can, in principle, capture changes in firing rate, but not the degree of spike synchrony in the network.

In this talk, I will show how to derive an exact meanfield description for a spiking network, revealing that a firing-rate description is insufficient to describe the full dynamics. Rather, the mean firing rate is coupled dynamically to the subthreshold state of the neurons, which together fully describe rate dynamics and the degree of spike synchrony.

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Technological Institute M416

For further information see http://www.esam.northwestern.edu
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