Department of Mathematics,
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Math 218 - Seminars on Mathematics for Complex Biological Systems

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Stochastic Models of Neural Synaptic Plasticity

Abstract:

In neuroscience, learning and memory are usually associated to long-term changes of neuronal connectivity. Synaptic plasticity refers to the set of mechanisms driving the dynamics of neuronal connections, called synapses and represented by a scalar value, the synaptic weight. Spike-Timing Dependent Plasticity (STDP) is a biologically-based model representing the time evolution of the synaptic weight as a functional of the past spiking activity of adjacent neurons.

In this talk we present a new, general, mathematical framework to study synaptic plasticity associated to different STDP rules. The system composed of two neurons connected by a single synapse is investigated and a stochastic process describing its dynamical behavior is presented and analyzed. We show that a large number of STDP rules from neuroscience and physics can be represented by this formalism. Several aspects of these models are discussed and compared to canonical models of computational neuroscience. An important sub-class of plasticity kernels with a Markovian formulation is also defined and investigated via averaging principles.

Joint work with Gaetan Vignoud

Hosts: Li-Tien Cheng, Bo Li, and Ruth Williams

Thursday, January 14, 2021
2:00 PM
Contact Bo Li at bli@math.ucsd.edu for the Zoom info

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