PHYSICAL MATHEMATICS SEMINAR

Collective stochastic oscillations and signal detection in tree networks of excitable elements

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ABSTRACT:

We study dynamics of stochastic excitable elements coupled on tree networks. In our setup the peripheral nodes receive independent random inputs which may induce large spiking events propagating through the branches of the tree. For strong enough coupling firing of peripheral nodes become synchronized, leading to global coherent oscillations in the network. This scenario may be relevant to generation of action potential in certain sensory neurons, which possess myelinated distal dendritic tree-like arbors and exhibit noisy periodic sequences of action potentials. A biophysical model of distal branches of a sensory neuron in which nodes of Ranvier at peripheral and branching points are coupled by myelinated cable segments is used along with a generic model of networked stochastic active rotators. We focus on the spiking statistics of the central node, which fires in response to independent noisy inputs at peripheral nodes. We show that, in the strong coupling regime, relevant to myelinated dendritic trees, the spike train statistics can be predicted from an equivalent excitable element with rescaled parameters according to the network topology. Furthermore, we show that by varying the network topology the statistics of network firing can be tuned to have a certain firing rate and variability, or to allow for an optimal discrimination of inputs applied at the peripheral nodes.

TUESDAY, NOVEMBER 7, 2017
2:30 PM
Building 2, Room 142

Reception following in Building 2, Room 290
(Math Dept. Common Room)

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