
*Tuesday, January 17th, 2011
14h15, Room SV 2510*

Computational Neuroscience Seminar

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Spike Train Correlations Derived from Anatomical Microstructure

Spike train correlations reflect the structure of the network. Correlations are caused, for instance, by direct synaptic interaction and by shared input. In recent work, we considered the contributions of more indirect, multi-synaptic pathways by accounting for the connectivity motifs that arise in recurrent networks of arbitrary topology. Mathematical analysis using Hawkes processes allowed us to relate rates and correlations of spike trains to the fine-scale anatomical structure of the network. Numerical simulations demonstrate that the dynamic point process model also provides an excellent approximation to networks of LIF neurons, via linear response theory. Specifically, we considered power series expansions of firing rates and pairwise correlations, respectively, in terms of the kernel matrix encoding synaptic connectivity. Its components correspond directly to the relevant structural motifs of the network. Depending on the degree of recurrence, one can predict the influence of multi-synaptic pathways on activity dynamics, and thus identify those network motifs that make significant contributions to spike train correlations. This work demonstrates that the microstructure of neuronal networks in the brain exerts strong and specific influence on its activity dynamics. Interacting stochastic point processes represent an efficient tool to characterize the spiking dynamics of recurrent networks with arbitrary topology.

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