Thursday, December 12th, 2013
EPFL, Lausanne, Room AAC 132
Swiss Computational Neuroscience Seminar

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16h15 – 17h45

Features of spontaneous activity and signal transmission in models of stochastic neurons

Neurons in the brain generate action potentials (spikes) either spontaneously or in response to stimuli that carry information. Both aspects of neural activity can be modeled and studied analytically in the framework of stochastic integrate-and-fire models.
In the first part of my talk I review recent results on the spike train statistics of the spontaneous activity taking into account various complications such as colored noise (arising from the synaptic filter, stochastic oscillations in the input, short-term synaptic plasticity, presynaptic bursting, etc) or adaptation currents. I will show analytical results for the interspike-interval statistics (distribution and serial correlation coefficient) and discuss their application to experimental data (electro-sensory neurons of paddlefish, auditory receptor cells in locust). Specifically, I will focus on how colored noise and/or (stochastic) adaptation may lead to distinct patterns of interval correlations. The analytical results can be used to infer or at least to constrain values of physiological parameters from spike train statistics.
In the second part of my talk I will discuss a simple aspect of signal transmission: Does a neuron transmit more information about slow or about fast components of a stimulus? Using the so-called lower-bound estimate, I show that standard integrate-and-fire models transmit most information about low-frequency bands, i.e. they act as a low-pass filter on information. However, by certain cellular mechanisms (heterogeneous synaptic plasticity, resonating subthreshold dynamics) or mechanisms at the population level (presynaptic synchronous spiking), neurons can be turned into high-pass or band-pass filters of information. I also briefly discuss a frequency-resolved measure of information transmission by means of which the notion of information filtering can be generalized and previous predictions based on the lower bound can be tested.

Hosted by:

Prof. Alexandre Pouget	Prof. Walter Senn	Prof. Wulfram Gerstner	Prof. Richard Hahnloser
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