WORKSHOP
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Exact mean and variance of neuronal subthreshold voltage fluctuations driven by shot noise

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Abstract

Neurons are subject to a vast number of synaptic inputs from as many as tens of thousands of other cells. These inputs consist of spikes changing the conductivity of the target cell, i.e. they enter the neural dynamics as multiplicative shot noise. Up to now, only for simplified models like current-based (additive-noise) point neurons or models with Gaussian white noise input, exact solutions are available. We will present a method to calculate the exact time-dependent mean and variance for the voltage of a point neuron with conductance-based Poissonian shot noise and a passive membrane. The exact solutions show novel features (for instance, maxima of the moments vs time) and are in excellent agreement with numerical simulations. The theoretical analysis of subthreshold membrane fluctuations may contribute to a better comprehension of neural noise in general. It may also help devising schemes for the extraction of synaptic parameters or network parameters from voltage recordings.

This is a joint work with Lars Wolff.