Tilo Schwalger

Effects of noisy adaptation on neural spiking statistics

Adaptation and noise are key features of almost any neuron and have a profound impact on signal processing by neurons. This processing might crucially depend on the nature of neural variability. In the first part of my talk, I analytically study a perfect integrate-and-fire neuron with adaptation and either white noise driving or noise resulting from fluctuations in the slow adaptation mechanism. The latter "adaptation noise" could, for instance, arise from channel noise associated to the slow adaption current. Surprisingly, we find a large difference in the statistics of interspike intervals (ISI): in the case of adaptation noise, the stochastic adaptation current can be mapped to an effective colored noise driving giving rise to long-range positive ISI correlations and a pronounced peak of the ISI density. In contrast, when variability stems from white noise one observes anticorrelations and a less pronounced peak. These results suggest that insight into the major source of noise in certain neurons might be gained from the ISI statistics.

In the second part, I study ISI correlations in an excitable system with adaptation, where spikes are driven by fluctuations. To this end, I propose a spiking neuron model with discrete adaptation states which allows for an exact calculation of the ISI correlation coefficient.