Fritz-Haber-Institut der Max-Planck-Gesellschaft, Humboldt-Universität zu Berlin, Max-Delbrück-Centrum für Molekulare Medizin, Otto-von-Guericke-Universität Magdeburg, Physikalisch-Technische Bundesanstalt, Technische Universität Berlin, Universität Potsdam

Berlin Center for Studies of Complex Chemical Systems

Seminar

Complex Nonlinear Processes in Chemistry and Biology

Honorary Chairman: G. Ertl
Organizers: M. Bär, C. Beta, H. Engel, M. Falcke, M. J. B. Hauser, J. Kurths, A. S. Mikhailov, P. Plath, L. Schimansky-Geier, and H. Stark

Friday, October 30, 2015, at 16:00
Address: Richard-Willstätter-Haus, Faradayweg 10, 14195 Berlin, U-Bahnhof Thielplatz (U3)

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Correlated fluctuations in neural systems

Nerve cells (neurons) are subject to various sources of noise that result in a pronounced stochasticity of their spike trains. These fluctuations often show temporal correlations both in the neural periphery and in the recurrent networks of the brain. Many theoretical investigations neglect these correlations and approximate fluctuations by white Gaussian noise. In my talk, I review some recent analytical results for integrate-and-fire models driven by colored noise with arbitrary temporal correlations. The formulas for the interspike-interval density and correlation coefficient of a simple perfect integrate-and-fire neuron model are used to quantitatively explain the spike statistics of two types of neurons: auditory receptor cells in locust and electro-afferent cells in paddlefish. The theory also explains features of the spike statistics of neurons in recurrent networks driven by non-Poissonian spike trains. Moreover, it predicts a transition from short- to long-correlated network fluctuations as the overall coupling strength between neurons is increased. A smoothed version of such a transition can be observed in numerical simulations of biophysically more realistic network models.

1) B. Dummer, S. Wieland, and B. *Lindner Self-consistent determination of the spike-train power spectrum in a neural network with sparse connectivity*, Front. Comp. Neurosci. **8**, 104 (2014)

2) T. Schwalger, F. Droste, and B. Lindner *Statistical structure of neural spiking under non-Poissonian or other non-white stimulation*, J. Comp. Neurosci. **39**, 29 (2015)

3) S. Wieland, D. Bernardi, T. Schwalger, and B. Lindner *Slow fluctuations in recurrent networks of spiking neurons*, Phys. Rev. E (accepted, 2015)