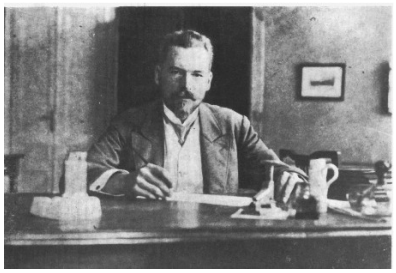

Contribution ID: **65** Type: **Invited Talk**

Linear and nonlinear fluctuation-response relations in non-equilibrium systems - spiking neurons, stochastic oscillators, and particles in an active bath

Monday, 25 September 2023 11:00 (40 minutes)

The fluctuations and the response of stochastic systems are not independent but related by fluctuation-dissipation theorems or, equivalently, fluctuation-response relations (FRRs). Originally introduced for systems in thermodynamic equilibrium, generalizations of such relations for non-equilibrium situations have been discussed since the 1970's and are particularly appealing for biological systems. FRRs are useful to (i) prove that a system is outside of equilibrium, (ii) prove that it does not follow Markovian dynamics, (iii) extract parameters and statistics of intrinsic noise sources, (iv) derive analytically statistics of nonlinear stochastic models. In my talk I report progress on several FRRs in systems far from equilibrium.
I discuss a nonlinear FRR for systems that can be perturbed by a step stimulus, which can be used as an efficient test of Markovianity. I present a universal description for stochastic oscillators, that results in a simple FRR in terms of a new complex-valued transform of the original oscillator variables. Most importantly, I derive a new class of FRRs for spiking neurons that relate the pronounced fluctuations of spontaneous neural firing to their average response to sensory stimuli, i.e. to the processing of sensory information that is the raison d'etre of neural systems.

Refs.
B. Lindner Fluctuation-dissipation relations for spiking neurons. Phys. Rev. Lett. 129, 198101 (2022)
A. Perez-Cervera, B. Gutkin, P. J. Thomas, and B. Lindner A Universal Description of Stochastic Oscillators. PNAS, accepted (2023)
K. Engbring, D. Boriskovsky, Y. Roichman, and B. Lindner A nonlinear fluctuation-dissipation test for Markovian systems Phys. Rev. X, 13, 021034 (2023)

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