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Via Zoom

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Dynamics of Stochastic Integrate-and-Fire Networks

Gabriel Koch Ocker, Ph.D.

Abstract

The neural dynamics generating sensory, motor, and cognitive functions are commonly understood through field theories for neural population activity. Classic neural field theories are derived from highly simplified models of individual neurons, while biological neurons are highly complex cells. The hallmark neuronal nonlinearity is the action potential, a stereotyped pulse leading to neuron transmitter release and finishes with the neuron's membrane potential at an approximately constant reset value. Here, we develop a statistical field theory for networks of stochastic spiking neurons. We use this to investigate the mean field dynamics of the population activity and the impact of nonlinear spike emission and nonlinear spike resets on the population activity, and compare the roles of inhibitory interactions and single-neuron spike resets in stabilizing neural network activity.

Biosketch

Dr. Gabriel Koch Ocker is an Assistant Professor in the Department of Mathematics & Statistics at Boston University. He received his Ph.D. from the University of Pittsburgh.

Research Self-Statement

I work in theoretical neuroscience, studying structure-function relations in neuronal network models. How does neural activity encode sensory information and drive behavior? How does that connectivity shape activity, and what computations does that activity perform? Finally, how do neural circuits evolve, learn, and adapt to shape that activity? My group studies these types of question in models of neural circuits, often using tools drawn from dynamical systems, stochastic processes and statistical physics. We also test the predictions of these in neural data, working with experimental collaborators.

Arranged by Professors Kresimir Josic (Mathematics) and Joseph Francis (Biomedical Engineering)