Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Mechanisms of adaptation to stimulus statistics in neuronal systems[1] MICHAEL FAMULARE, University of Washington, Physics, BARRY WARK, REBECCA MEASE, UW, Neurobiology and Behavior, ADRIENNE FAIRHALL, UW, Physiology and Biophysics — In transforming sensory data into voltage signals, the strategies employed by neurons and neural systems have been shown to be adaptive: as the statistical properties of the environment change, the mapping from input to output also changes, often in such a way as to maximize information transmission. In large part, neuronal dynamics arise from voltage-dependent configuration changes in ion-selective conducting channel proteins, and so neurons are inherently nonlinear when viewed as electrical devices. By expressing different mixes of channels, isolated neurons can express a large variety of particular input/output relations. We show how the mechanisms by which neurons implement adaptive coding arise from the intrinsic neuronal nonlinearities, and we study the conditions under which the adaptation is optimal. We focus specifically on the timescales over which adaptation occurs and the functional changes to the input/output relationships that result. The timescale for adaptation to changes in stimulus statistics is limited by statistical considerations. We show that treating adaptation to changing stimulus statistics as an estimation problem predicts experimentally observed properties of adaptation timescales.

[1]funded by the McKnight Foundation and NSF #0928251.

Michael Famulare
University of Washington, Physics

Date submitted: 29 Nov 2009 Electronic form version 1.4