BMC Neuroscience

Poster presentation

Open Access

Resonant responses to variance modulation in stochastic integrate-and-fire neurons

Joanna Pressley*[1] and Todd W Troyer[1,2,3]

Address: [1]Applied Mathematics and Scientific Computation Program, University of Maryland, College Park, MD, 20742, USA, [2]Neuroscience and Cognitive Science Program, University of Maryland, College Park, MD 20742, USA and [3]Department of Psychology, University of Maryland, College Park, MD 20742, USA

Email: Joanna Pressley* - pressley@math.umd.edu

* Corresponding author

from Sixteenth Annual Computational Neuroscience Meeting: CNS*2007
Toronto, Canada. 7–12 July 2007

Published: 6 July 2007

BMC Neuroscience 2007, **8**(Suppl 2):P44 doi:10.1186/1471-2202-8-S2-P44

In the stochastic integrate-and-fire (SIF) model, the distribution of membrane potentials is subject to drift, due to the mean input current, and diffusion, due to input variance; the firing rate is determined as the instantaneous probability of crossing threshold. Previous research has shown that when the drift term dominates, the SIF acts like a neural resonator, amplifying fluctuations in the mean input at multiples of the neuron's steady-state firing frequency. Here we show that the SIF also displays two distinct resonances to fluctuations in the input variance. Similar to the resonance for mean input fluctuations, the first "drift resonance" occurs near the steady-state firing frequency and is found only in the drift dominated (regular firing) regime. However, the peak of this resonance occurs at frequencies slightly higher than the steady-state firing frequency. The second "variance resonance" differs significantly from the drift resonance and predominates in the variance dominated (random firing) regime. This resonance has a broader frequency range and peaks at frequencies an order of magnitude greater than the underlying steady-state firing frequency of the neuron. Because oscillatory input that synchronously activates excitatory and inhibitory neurons is expected to generate disynaptic input modulations of the variance and not necessarily the mean, the variance resonance may play a significant role in modulating oscillatory activity in circuits with a balance of excitation and inhibition.