Print this Page

Presentation Abstract

Program#/Poster#: 99.20/UU7

Presentation Title: An energy efficient neuron model with excitatory and inhibitory inputs

Location: WCC Hall A-C

Presentation time: Saturday, Nov 15, 2014, 1:00 PM - 5:00 PM

Presenter at Poster: Sat, Nov. 15, 2014, 4:00 PM - 5:00 PM

Topic: ++G.06.b. Network models

Authors: ***J. XING**[1,2], T. BERGER[1], T. J. SEJNOWSKI[2];
[1]Dept. of Electrical and Computer Engin., Univ. of Virginia, Charlottesville, VA;
[2]Salk Inst. for Biol. Studies, La Jolla, CA

Abstract: Neural information processing within neural microcircuitry is determined by the balance between excitation and inhibition (E/I balance). Toward understanding it better from an information-energy efficiency standpoint, we earlier calculated the maximum Shannon mutual information transfer per unit of energy expenditure of an idealized integrate-and-fire (IIF) neuron all of whose synapses are excitatory but have differing weights. Since it is well known from neuroscientific experiments that the postsynaptic potential (PSP) accumulation in real neurons is not monotonically increasing but behaves like a diffusion process that possesses both local decrease and local increase, in this paper we extend the IIF model to a biophysically more realistic one in which synaptic weights not only are assumed unequal but also can be inhibitory. Such inhibitory signals are also widely considered essential for keeping signal processing in the brain from becoming unstable. Based on information theory and stationary processes, we have derived the formula for the long-term average mutual information rate. We also establish that the probability density function (pdf) of interspike interval (ISI) duration

induced by the bits per joule (bpj) maximizing pdf of the combined excitatory and inhibitory postsynaptic potentials (EPSPs/IPSPs) remains a delayed gamma distribution as in the IIF model with only excitatory synapses. The bpj optimizing input density, in the case of inhibitory as well as excitatory unequal weights, still satisfies an inhomogeneous Cauchy-Euler equation with variable coefficients.

Disclosures:	**J. Xing:** None. **T. Berger:** B. Contracted Research/Research Grant (principal investigator for a drug study, collaborator or consultant and pending and current grants). If you are a PI for a drug study, report that research relationship even if those funds come to an institution.; US National Science Foundation under Grant No. CCF-1162449. **T.J. Sejnowski:** None.
Keyword (s):	INFORMATION THEORY
	INHIBITION
	ENERGY EFFICIENCY
Support:	NSF Grant CCF-1162449