MASTER'S THESIS

The non-linear firing pattern of stochastic neuronal models

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The Non-Linear Firing Pattern of Stochastic Neuronal Models

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Abstract

During the last two years 1998-2000, the inhibition boosted firing (IBF) phenomenon have been reported in the neuronal model like the FitzHugh-Nagumo model and the Hodgkin-Huxley model. That is, the increase of inhibitory input would increase the firing rate of a neuron. Such phenomenon is impossible in deterministic dynamical systems. It can also happen in the stochastic neuronal model like integrate-and-fire model and the IF-FHN model. We extend the IF-FHN model in two respects: (a) with the diffusion coefficient (infinitesimal variance) is in a space-dependent form. (b) with the sinusoidal signals input to the neuron. For model (a), the closed integral form of mean firing time is obtained. For model (b), the analysis is mainly by simulation. In either model we have the existence of the critical input frequency so that the efferent firing rate is equal when the neuron receives purely excitatory inputs or exactly balanced inhibitory and excitatory inputs. Several properties are discussed. Our results suggest that the increasing inhibitory inputs boosting neuron firing is a universal phenomenon. This might give a new insight to the neuroscience.

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