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Multiscale Analysis of Hybrid Processes and Reduction of Stochastic Neuron Models

We introduce a method for systematically reducing the dimension of biophysically realistic neuron
models with stochastic ion channels exploiting time-scales separation. Based on a combination of sin-
gular perturbation methods for kinetic Markov schemes with some recent mathematical developments
of the averaging method, the techniques are general and applicable to a large class of models. As
an example, we derive and analyze reductions of the stochastic Hodgkin-Huxley model.The bifurcation analysis of the reduced models with
the number of channels as a parameter provides insight into some features of noisy discharge patterns,
such as the bimodality of interspike intervals distribution.