

HUMBOLDT-UNIVERSITÄT ZU BERLIN

BERNSTEIN CENTRE FOR COMPUTATIONAL
NEUROSCIENCE

BERNSTEIN CENTER FOR COMPUTATIONAL NEUROSCIENCE
HUMBOLDT-UNIVERSITÄT ZU BERLIN
PHILIPPSTR. 13 HOUSE 6

PHONE: 030/2093-9110
FAX: 030/2093-6771
WEBPAGE: [HTTP://WWW.BCCN-BERLIN.DE/](http://www.bccn-berlin.de/)

Models of Neural Systems I, WS 2008/09 Project Assignment

Modelling ion channels

Hodgkin-Huxley formalism accurately describes voltage-dependent conductances of large number of channels. However, in order to simulate single channels we need a model of their different conformational states and transitions between them. In this project you will implement a simple model of multi-state ion channels, simulate them using Monte-Carlo method and compare them with conductance equations proposed by Hodgkin and Huxley.

Problems

1. Implement a single delayed-rectifier K^+ channel according to the Figure 5.12 in Dayan and Abbott [1]. Compare the obtained channel current to the prediction of Hodgkin-Huxley model. Increase the number of channels and see how the correspondence between both models changes. Plot the mean squared deviation between the current produced by model channels and the Hodgkin-Huxley current as a function of N over the range $1 < N < 100$, matching the amplitude of the Hodgkin-Huxley model so that the mean currents are the same.
2. Implement Na^+ channel model from Figure 5.13 of Dayan and Abbott [1]. Compare such a channel model and Hodgkin-Huxley prediction for different numbers of channels. Can you see any differences between them? Where do they come from?
3. Simulate Hodgkin-Huxley neuron model with stochastic channels. Plot the distribution of interspike intervals for constant current injection. Check how the distribution changes with an increasing number of channels. For computational efficiency consider implementing improved simulation methods (see for example [2]).

References

- [1] P Dayan, LF Abbott, "Theoretical neuroscience", MIT Press 2001

- [2] JA White, JT Rubinstein, AR Kay, “Channel noise in neurons”, Trends Neurosci. 23: 131-137 (2000)

CONTACT

ROBERT SCHMIDT (ITB, R. 2316) PHONE: 2093-8926 EMAIL: R.SCHMIDT@BIOLOGIE.HU-BERLIN.DE
BARTOSZ TELENCZUK (ITB, R. 1309) PHONE: 2093-8838 EMAIL: B.TELENCZUK@BIOLOGIE.HU-BERLIN.DE