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Made-to-Order spiking neuron model for a variety of cortical neurons

Information is transmitted within the brain through various types of neurons that respond differently to the same input. The Hodgkin−Huxley model has been revised by including ionic channels that account for typical neuronal firing phenomena. However, estimating parameters of the Hodgkin−Huxley models from experimental data is a notoriously difficult. Furthermore, the computational costs of these models are high, which hinders performing a simulation of massively interconnected neural networks.

Here we introduce a computationally fast spiking neuron model [1] that is capable of accurately predicting a rich variety of spike responses. We also developed a procedure for optimizing model parameters. The key features of the new model are a non-resetting leaky integrator and an adaptive threshold equipped with fast (10 ms) and slow (200 ms) time constants. The model can be easily tailored to various cortical neurons, including regular-spiking, intrinsic-bursting, and fast-spiking neurons, by simply adjusting three parameters. Both the high flexibility and low computational cost would help to model the real brain reliably and examine how network properties may be influenced by the distributed characteristics of component neurons.

References

[1] R. Kobayashi, Y. Tsubo, S. Shinomoto, *Made-to-order spiking neuron model equipped with a multi-timescale adaptive threshold.* Front. Comput. Neurosci. **3** 9.