
Simulating the Izhikevich spiking neuron model using the Brian2 software

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Abstract

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1 Description of the problem

The study of spike-timing dynamics in the brain is of interest to neuroscientists and the artificial network community. Investigation of the relative timing of spikes of multiple neurons [1] and the role they play in temporal coding in the brain is an important issue. Similarly, spiking networks can serve as powerful supervised learning and memory representation tools with several potential applications in the machine learning domain [2].

The Izhikevich spiking neuron model [3] [4] is a two-dimensional system of ordinary differential equations.

The goal of the project is to implement the Izhikevich's model using the Brian2 Python library <https://brian2.readthedocs.io/en/stable/>.

2 Description of our approach

Interesting links:

<https://brian2.readthedocs.io/en/stable>

<https://brian2.readthedocs.io/en/stable/resources/tutorials>

<https://brian2.readthedocs.io/en/stable/examples>

<https://www.izhikevich.org/publications/spikes.htm>

<https://www.izhikevich.org/publications/whichmod.htm>

3 Implementation

4 Results

5 Conclusions

References

- [1] E. Izhikevich and G. Edelman. Large-scale model of mammalian thalamocortical systems. *Proceedings of the National Academy of Sciences*, 105:3593 – 3598, 2008.
- [2] H. Paugam-Moisy, R. Martinez, and S. Bengio. Delay learning and polychronization for reservoir computing. *Neurocomputing*, 71:1143–1158, 2008.
- [3] E. M. Izhikevich. Simple model of spiking neurons. *IEEE Transactions on Neural Networks*, 14(6):1569–1572, 2003.
- [4] E. M. Izhikevich. Which model to use for cortical spiking neurons? *IEEE Transactions on Neural Networks*, 15(5):1063–1070, 2004.