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Modeling dopamine-modulated STDP synapse with NESTML

Thursday 15 June 2023 15:00 (1h 30m)

NESTML is a domain-specific modeling language for neuron models and synaptic plasticity rules [1]. It is designed to support researchers in computational neuroscience by allowing them to specify models in a precise and intuitive way. These models can subsequently be used in dynamical simulations of small or large-scale spiking neural networks, by means of high performance simulation code generated by the NESTML toolchain. NESTML features a concise yet expressive syntax, inspired by Python, making it easy to write, understand, maintain and share models. There is direct language support for (spike) events, differential equations, convolutions, stochasticity, and arbitrary algorithms using imperative programming concepts, in addition to flexible event management using handler functions and prioritization.

In this workshop, we will model a plastic synapse in NESTML, which exhibits spike-timing dependent plasticity (STDP) that is additionally regulated by a neuromodulator. The synapse model will be used to create a network with balanced excitation and inhibition, where by identifying the neuromodulator with dopamine, we implement a biologically realistic version of reinforcement learning. This will be done by interacting with NESTML through a Jupyter notebook, where the model is created and the NESTML toolchain generates the corresponding code for NEST Simulator, making use of the scalable volume transmitter implemented in NEST [2].

Acknowledgements

References

[1] https://nestml.readthedocs.org/

[2] Potjans W, Morrison A, Diesmann M (2010). Enabling functional neural circuit simulations with distributed computing of neuromodulated plasticity. Frontiers in Computational Neuroscience, 4:141. DOI: https://doi.org/10.3389/fncom.2010.00141

Topic area

models and applications

Keywords

models, synpase, plasticity, nestml

Speaker time zone

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Preferred form of presentation

Workshop

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