NEST Conference 2021

Workshop proposal:

Modeling and simulation of synaptic plasticity using NESTML and NEST Simulator

Charl Linssen^{1,2} <c.linssen@fz-juelich.de>, Pooja Babu¹ <p.babu@fz-juelich.de>, Jochen M. Eppler¹ <j.eppler@fz-juelich.de>, Abigail Morrison¹⁻³ <a.morrison@fz-juelich.de>

1. Simulation Lab Neuroscience, Jülich Supercomputer Centre, Institute for Advanced Simulation, Jülich-Aachen Research Alliance, Forschungszentrum Jülich GmbH

2. Institute for Neuroscience and Medicine INM-6 / INM-10, Jülich-Aachen Research Alliance, Institute for Advanced Simulation IAS-6, Forschungszentrum Jülich GmbH

3. Department of Computer Science 3 - Software Engineering, RWTH Aachen University, Aachen, Germany

Duration:

1 hour

Abstract

Spike-timing dependent plasticity (STDP) is a ubiquitous and diverse phenomenon in neural networks. We will review some of the empirical observations on STDP before looking at two mathematical formalisations in more detail, namely STDP with all-to-all and nearest-neighbour spike pairing, and the triplet STDP rule from [1]. These mathematical models are then expressed in the NESTML modelling language [2], and instantiated in a simple network which is simulated in NEST. We analyse how the parameters of the plasticity rule influence the evolution of synaptic strength during simulation.

All of the model definition, simulation and subsequent analysis will be controlled from a Jupyter (Python) notebook. Code will be provided for all models, and we invite interactive experimentation during and after the tutorial. Next to running NESTML on a local computer, participants will also have the opportunity to log into virtual machines courtesy of HBP/EBRAINS. These can be accessed worldwide in the browser, without any prior set-up or installation required.

[1] Pfister JP, Gerstner W (2006). The Journal of Neuroscience 26(38):9673-9682.

[2] NESTML https://nestml.readthedocs.org/