Contribution ID: **8** Contribution code: **W-1** Type: **Workshop**

Using NESTML and NEAT to create massively parallel network simulations with dendritic subunits

Tuesday 17 June 2025 11:15 (1h 30m)

The brain is a massively parallel computer. In the human brain, 86 billion neurons convert synaptic inputs into action potential (AP) output. Moreover, even at the subcellular level, computations proceed in a massively parallel fashion, e.g. in each dendritic compartment. It is only natural, thus, to use the parallelisation and vectorisation capabilities of modern supercomputers to simulate the brain in a massively parallel fashion.
The NEural Simulation Tool (NEST) is the reference with regards to the massively parallel simulation of spiking network models. We have extended the scope of the NESTML modelling language to support vectorized multi-compartment models, with dendrites featuring user-specified dynamical processes. This allows users to define simple multi-compartmental neuron models through NEST's PyNest API, capturing key dendritic computations in large network models.
A new complementary tool in the NEST-Initiative, the NEuronal Analysis Toolkit (NEAT), then allows full biophysical models and simplifications thereof to be included in NEST network simulations. This tool provides high-level functionalities for defining biophysically realistic neuron models, and extensive toolchains to simplify these complex models. The resulting simplifications can be exported programmatically to NEST, and thus embedded in network simulations.
In this workshop, we will go over the mechanics of defining and compiling compartmental models using NESTML, of implementing simple compartmental layouts through the PyNEST API, and of creating biophysical models in NEAT, and embedding their simplifications in NEST network simulations. We will present this in the form of an interactive Jupyter notebook tutorial, which will subsequently become part of NEST's documentation.

Acknowledgements

References

Preferred form of presentation

Workshop

Topic area

Models and applications

Keywords

compartmental models, dendrites

Speaker time zone

UTC+2

I agree to the copyright and license terms

Yes

I agree to the declaration of honor

Yes

Primary authors: EWERT, Leander (IAS-6 Forschungszentrum Jülich); WYBO, Willem (Forschungszentrum Jülich)

Presenters: EWERT, Leander (IAS-6 Forschungszentrum Jülich); WYBO, Willem (Forschungszentrum Jülich)

Session Classification: Workshop