Contribution ID: **10** Contribution code: **P-5** Type: **Poster & advertisement flash talk**

# Implementation and Validation of a Balanced Excitatory-Inhibitory Network in Loihi

*Tuesday 18 June 2024 14:25 (3 minutes)*

We implement a balanced excitatory/inhibitory network (EI) in Intel's neuromorphic hardware Loihi. A version of [1] has been used by researchers as a benchmark and validation for simulators in various software and hardware environments [2]. The implementation here has the same LIF neurons, but exponential decay synapses, and reduced size, which accommodate current software and hardware limitations of Loihi [3]. We implement the same network in NEST for validation.

The Loihi implementation was designed as in [4], by scaling and shifting the LIF models and their parameters in order to fit within Loihi's integer state arithmetic and limited-precision storage for parameters. For the network implementations here, we observe visually very similar firing patterns in both NEST and neuromorphic implementations. Network rate and correlation comparisons as in [5] yield similar numeric results, although not at the level of comparisons between standard simulations on varied architectures.

The NEST implementation of the EI network runs approximately in real time, ~20s/s biological time, scaling weakly with network size [2]. The Loihi simulation performs much faster, as expected for a specialized hardware simulator. It exhibits a similar weak scaling, running about 500x faster than a standard CPU implementation, and 25-50 times faster than biological real time. Power consumption was also much lower, at approximately constant 2W/chip, with up to 6 chips used for these simulations.

In conclusion, Loihi shows promise as an accelerator for biological neural network simulations. However more studies are needed to fully qualify its benefits and trade-offs of this platform.

## Acknowledgements

## References

[1] N. Brunel, JCNS, 8, 183–208, 2000
[2] J. Jordan et al., Front. Neuroinf., 12(2) 2018
[3] M. Davies et al., IEEE Micro, 38(1) 82–99, 2018.
[4] S. Dey and A. Dimitrov, Front. Neurosci., 16, 883360, 2022
[5] R. Gutzen et al., Front. Neuroinf. 12, 90, 2018.

## Preferred form of presentation

Workshop

## Keywords

neuromorphic, Loihi, balanced network, benchmark

## Topic area

Simulator technology and performance

## Speaker time zone

UTC+1

## I agree to the copyright and license terms

Yes

## I agree to the declaration of honor

Yes

**Primary author:** Dr DIMITROV, Alexander (Forschungszentrum Juelich)

**Co-authors:** TETZLAFF, Tom; KURTH, Anno (Institute of Neuroscience and Medicine (INM-6) and Institute for Advanced Simulation (IAS-6) and JARA-Institute Brain Structure-Function Relationships (INM-10), Jülich Research Centre, Jülich, Germany); MORRISON, Abigail (INM-6 Forschungszentrum Jülich); DIESMANN, Markus

**Presenter:** Dr DIMITROV, Alexander (Forschungszentrum Juelich)

**Session Classification:** Poster teasers