Contribution ID: **2** Contribution code: **K-4** Type: **Keynote**

Full-scale point neuron models of mouse and human hippocampal microcircuits

Tuesday 17 June 2025 09:15 (45 minutes)

The mathematical modeling of extended brain microcircuits is becoming an effective tool to simulate the neurophysiological correlates of brain activity while opening new perspectives in understanding the mechanisms underlying brain dysfunctions. The generation of realistic networks is however experiencing limitations due to the strategy adopted to build network connectivity and also to the computational cost associated with biophysically detailed neuronal models.

We have recently developed a method to generate neuronal network scaffolds associating geometrical probability volumes with pre- and postsynaptic neurites. In this talk, I will show that the proposed approach allows to generate neuronal networks with realistic connectivity properties without the explicit use of 3D morphological reconstructions to be adopted for highly efficient simulation through point-like neuron models. The method has been benchmarked both on the mouse and human hippocampus CA1 region and its efficiency at different spatial scales has been explored. The abstract geometric reconstruction of axonal and dendritic occupancy, by effectively reflecting morphological and anatomical constraints, could be integrated into structured simulators generating entire circuits of different brain areas.

Acknowledgements

References

Gandolfi D, Mapelli J, Solinas S.M.G. et al. A realistic morpho-anatomical connection strategy for modelling full-scale point-neuron microcircuits. Sci Rep. 2022 Aug 16;12(1):13864. doi: 10.1038/s41598-022-18024-y. Erratum in: Sci Rep. 2022 Nov 17;12(1):19792. PMID: 35974119; PMCID: PMC9381785.

Gandolfi, D., Mapelli, J., Solinas, S.M.G. et al. Full-scale scaffold model of the human hippocampus CA1 area. Nat Comput Sci 3, 264–276 (2023). https://doi.org/10.1038/s43588-023-00417-2.

Preferred form of presentation

Talk (& optional poster)

Topic area

Models and applications

Keywords

hippocampus, network connectivity, synaptic plasticity

Speaker time zone

UTC+1

I agree to the copyright and license terms

Yes

I agree to the declaration of honor

Yes

Primary authors: GANDOLFI, Daniela (University of Modena and Reggio Emilia); Dr BOIANI, Giulia Maria (University of Modena and Reggio Emilia); Prof. MAPELLI, Jonathan (University of Modena and Reggio Emilia); Dr TARTARINI, Lorenzo (University of Modena and Reggio Emilia); Dr MIGLIORE, Michele (National Research Council, Italy); Dr SOLINAS, Sergio (University of Sassari)

Presenter: GANDOLFI, Daniela (University of Modena and Reggio Emilia)

Session Classification: Keynote