BALÁZS UJFALUSSY

Institute of Experimental Medicine
Biological Computation Research Group

Address: Szigony u. 43., H-1083 Budapest, Hungary

RESEARCH AREA

We are using mathematical models and computational analysis to study the neuronal basis of memory and navigation. Our goal is to understand how basic biophysical mechanisms in a specific neuronal system (the hippocampus) give rise to higher order cognitive processes. What is the effect of nonlinear dendritic processing of inputs on the dynamics of the network and thus how they influence the learning and recall of memories and ultimately the behavior of the animal? We answer similar questions using computational models in close collaborate with experimental colleagues. During the research, models are also used in a different way: during learning the neuronal network of the brain develops a model of the environment that the animal can use to interpret the incoming sensory information or to predict possible future consequences of its actions. Describing or analysing both of these models requires computational tools. We are looking for students passionate for understanding the nervous system but also interested in mathematics and programming.

TECHNIQUES AVAILABLE IN THE LAB

- simulation of detailed single neuron models in Neuron and Python
- data analysis and programming in python
- building and using probabilistic generative models
- analysing in vivo Ca-imaging and electrophysiology data
- analysis of behavioural experiments in mice
- programming virtual reality for animal experiments

SELECTED PUBLICATIONS

Ujfalussy, B.B., Orbán, G. (2021) Sampling motion trajectories during hippocampal theta sequences. **BioRxiv 2021.12.14.472575.**

Ujfalussy, B.B., Makara, J.K., (2020) Impact of functional synapse clusters on neuronal response selectivity. **Nature Comm 11:** 1-14.

Vágó, L., **Ujfalussy, B.B.** (2018) Robust and efficient coding with grid cells. **PLoS Computational Biology 14:** e1005922.

Ujfalussy, B.B., Makara, J.K., Lengyel, M., Branco, T. (2018) Global and multiplexed dendritic com- putations under in vivo-like conditions. **Neuron 100:** 579-592.

Ujfalussy, B.B., Branco, T., Makara J.K., Lengyel M. (2015) Dendritic nonlinearities are tuned for efficient spike-based computations in cortical circuits. **eLife 4:** e10056.