MASTER 2 Computational Neurosciences

Internship proposal 2025-2026

(internship from January to June 2026)

Host laboratory: Lyon Neuroscience Research Center CRNL. Inserm U1028 - CNRS UMR5292 - UCBL. Centre Hospitalier Le Vinatier - Bâtiment 462 - Neurocampus. 95 boulevard Pinel. 69675 Bron Cedex

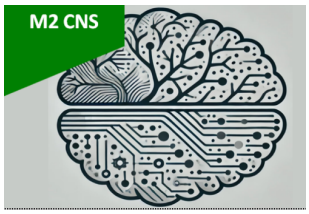
Host team : Cophy Team, https://www.crnl.fr/fr/equipe/cophy

Internship supervisors : Matteo DI VOLO, Chair Professeur Junior Université Lyon 1, matteo.di-volo@univ-lyon1.fr; Mathilde BONNEFOND, Researcher Inserm, mathilde.bonnefond@inserm.fr

Project title : A modeling approach to investigate **t**he role of Alpha rhythms in visual processing

Project summary : The objective of this internship is shed light on the biophysical origin of the spatio-temporal structure of alpha oscillations (10Hz) and to determine whether they help selecting information the visual system, as suggested in the literature based on experimental findings. In order to answer these questions we will develop biologically grounded spiking neural network (SNN), exhibiting similar constraints as the visual system, e.g. the convergence of information that creates bottleneck issues. In contrast to traditional artificial neural networks, this model generates dynamic patterns of activity due to recurrent interactions between neurons in the visual hierarchy and nonlinear proprieties of biophysical neurons. These network models will be exposed to an attention tasks which will involve the "attentional" selection of one stimulus out of two presented. Importantly, the readout of the network will be evaluated in the last node, incorporating the complex time-dependent emergent dynamics of the SNN. This readout will represent the optimal linear combination of neurons' firing activity over time, aiming to maximize the separability between the two stimuli. Once calibrated the model, we will causally manipulate its structure, i.e. connectivity and cellular composition, to predict the impact of biophysical proprieties of the visual system for emerging alpha oscillations for attentional capacities.

Please send your proposal to matteo.divolo@univ-lyon1.fr for publication on the Master of Neuroscience website.



Related publications :

1. Bonnefond M, Jensen O. (2024) The role of oscillations in resisting distractions. Trends in Cognitive Sciences, ISSN 1364-6613, https://doi.org/10.1016/j.tics.2024.11.004.
2. di Volo, M., Romagnoni, A., Capone, C. & Destexhe, A. (2019) Biologically Realistic Mean-Field Models of Conductance-Based Networks of Spiking Neurons with Adaptation. *Neural Computation* **31**, 653–680
3. Douchamps, V., di Volo, M., Torcini, A., Battaglia, D., & Goutagny, R. (2024). Gamma oscillatory complexity conveys behavioral information in hippocampal networks. *Nature Communications*, *15*(1), 1849.
4. Schwalger T, Deger M, Gerstner W (2017) Towards a theory of cortical columns: From spiking neurons to interacting neural populations of finite size. PLoS Comput Biol 13(4): e1005507.
5. Yamazaki K, Vo-Ho V-K, Bulsara D, Le N. (2022) Spiking Neural Networks and Their Applications: A Review. *Brain Sciences*. ; 12(7):863. https://doi.org/10.3390/brainsci12070863

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