

## Research Internship

### Unsupervised learning in brain-inspired neural networks for multimodal associations

#### Context

The biological brain is able to perform high performance calculations with a much higher efficiency than our most powerful computers with very low energy consumption.

Several models of artificial neural networks have been proposed in the literature to target unsupervised learning either with spiking or non-spiking neural networks [1-3]. In this project, we are interested in confronting both approaches and study how to combine them. We specifically follow a brain-inspired approach transposing classical classification tasks in a sensor-motor context [1]. The neural models explored and developed during this project will then be validated onto multimodal datasets [4].

#### Internship mission

The internship mission will be organized in several periods:

- Theoretical study of spiking neural networks and neuromorphic engineering in the scientific literature,
- Experiments of existing published models onto multimodal datasets,
- Development of new hybrid models,
- Experiment and analysis of the quality of the learning,
- Publication in an international conference.

#### References

- [1] Lyes Khacef, Benoît Miramond, Diego Barrientos, Andres Upegui: *Self-organizing neurons: toward brain-inspired unsupervised learning*. *IJCNN 2019*: 1-9
- [2] Sigaud, O. and Droniou, A. (2016). *Towards Deep Developmental Learning*. *IEEE Transactions on Cognitive and Developmental Systems*. Vol 8 No 2 Pages 99-114.
- [3] Hananel Hazan, Daniel J. Saunders, Darpan T. Sanghavi, Hava T. Siegelmann, Robert Kozma: *Unsupervised Learning with Self-Organizing Spiking Neural Networks*. *IJCNN*, 1-6, 2018
- [4] E Ceolini, G Taverni, L Khacef, M Payvand, E Donati, *Sensor fusion using EMG and vision for hand gesture classification in mobile applications*, arxiv, 2019

#### Practical information

Location : LEAT Lab, Sophia Antipolis  
Duration : 6 months from March/April 2020  
Grant : 529.20 € / month  
Profile : artificial neural networks, spiking neurons, sensors/actuators, robotics, Python

#### Contact

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