Master QLMN (Quantum, Light, Materials and Nano Sciences)

Proposition de stage / Internship proposal

Date de la proposition : 3/1/2023

Responsable du stage / *internship supervisor*:

Nom / *name*: Prénom/ *first name* :
ROZENBERG Marcelo
Tél : 0651578940 Courriel / *mail*:marcelo.rozenberg@universite-paris-saclay.fr

Nom du Laboratoire / *laboratory name*:

Etablissement / *institution* :LPS (Orsay) Code d'identification : UMR85012
Site Internet / *web site*: https://www.lps.u-psud.fr/en/home-english/
Adresse / *address:*
Lieu du stage / *internship place*: LPS

Titre du stage / *internship title*: Implementation of Spiking Neural Networks in Solid State

Résumé / *summary*

The information age we live in is supported on a physical under-layer of electronic hardware, which originates in condensed matter physics research. The end of Moore's law demands the development of new paradigms. In this context neuromorphic systems emerge as a novel possibility for the direct implementation in hardware of Artificial Intelligence systems, such as Neural Networks.
Recently, we have developed a new and extremely simple electronic artificial spiking neuron [1,2] based on the new concept of *memristive* behavior. This innovation is allowing us to implement *neural networks* of biological relevance [3,4], and to study fundamental questions of Neuroscience, such as the encoding and propagation of information in the spiking activity in the brain.
In this Stage we propose to implement and investigate the dynamical behavior of spiking neural network models following the recent developments described in the articles mentioned above. More specifically, we would like to focus on the correlations that emerge in the spiking activity of small number of neurons that are coupled via excitatory and inhibitory synaptic connections. The type of neural networks that we aim to implement are basic functional units, which may implement desired spike sequences, such as central pattern generators; or implement neurocomputations, such as the *winner-take-all*. This project is related to our ongoing work on Ring Attractor Neural Networks and Brain-Machine Interfaces.
During the stage, the student will become familiar with basic concepts of Neuromorphic Computation, dynamical behavior of Spiking Neural Networks, numerical simulation of electronic circuits, and hands-on building of electronic circuits.

This project may be followed by a thesis (depending on requested funding).
https://devicematerialscommunity.nature.com/posts/53252-an-out-of-the-shelf-ultra-compact-leaky-integrate-and-fire-artificial-neuron

[1] Scientific Reports, **9**,11123 (2019)
[2] Frontiers in Neurosciences **14**, 421 (2020)
[3] Frontiers in Neurosciences **15**, 102 (2021)
[4] Physical Review Applied **16**, 034030 (2021)

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : yes**
Si oui, financement de thèse envisagé ou acquis / *financial support for the PhD* **? requested**

Financement acquis / *Secured funding*		Nature du financement */Type of funding*	
Financement demandé / *Requested funding*	*x*	Nature du financement */Type of funding*	*ANR*