Spécialité de Master «Optique, Matière, Paris»

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 09/11/2018

Responsable du stage / *internship supervisor*:

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Nom du Laboratoire / *laboratory name*: C2N

Code d'identification : UMR9001 Organisme : CNRS/U-PSud/UPSaclay

Site Internet / *web site*: https://www.c2n.universite-paris-saclay.fr/fr/

Adresse / *address:* Avenue de la Vauve, 91120 Palaiseau

Lieu du stage / *internship place*: Palaiseau

Titre du stage / *internship title*: **Analog computing with brain-inspired micropillar lasers**

Résumé / *summary*

Artificial neural networks, which are at the heart of recent progress in analog computation and machine learning, are becoming increasingly important for our future digital societies. We propose to study coupled spiking photonic nodes in order to implement simple photonic artificial neural networks. Each node is materialized by a micropillar laser with integrated saturable absorber, whose neuromimetic properties have already been explored in the team. In neurons, information is coded with spikes (electrical pulses) which are excited in an all-or-none fashion provided input stimuli to the neuron soma exceed a given threshold. This generic property is called excitability and has been demonstrated in micropillar lasers. Though, the optical spikes emitted by these latter are more than one millions times shorter in duration than biological action potentials. Hence, photonic neurons could in principle be interesting to build ultrafast artificial neural networks. The computing capability of optical neurons are enforced by the property of temporal summation also already demonstrated by us in micropillar lasers, and which provides universal computation capability. The internship will consist in participating to the research lead in the group on the implementation of brain-inspired, photonic analog computing. The work combines optical experiments, some modelling and possibly some technology if the C2N clean-room facility, recently relocated to Palaiseau, is operational.

References :

Pulse train interaction and control in a microcavity laser with delayed optical feedback S. Terrien, B. Krauskopf, N. G. Broderick, R. Braive, G. Beaudoin, I. Sagnes, S. Barbay, **Opt. Lett. 43**, 3013 (2018)

Spike latency and response properties of an excitable micropillar laser F. Selmi, R. Braive, G. Beaudoin, I. Sagnes, R. Kuszelewicz, T. Erneux, S. Barbay, **Phys. Rev. E 94**, 042219 (2016)

Temporal summation in a neuromimetic micropillar laser F. Selmi, R. Braive, G. Beaudoin, I. Sagnes, R. Kuszelewicz, S. Barbay, **Opt. Lett. 40**, 5690 (2015)

Relative Refractory Period in an Excitable Semiconductor Laser F. Selmi, R. Braive, G. Beaudoin, I. Sagnes, R. Kuszelewicz, S. Barbay, **Phys. Rev. Lett. 112**, 183902 (2014)

F. Selmi, Thèse de doctorat, *Réponse excitable et propriétés neuromimétiques de micropiliers lasers à absorbant saturable*, 2015.

Site web : https://toniq.c2n.universite-paris-saclay.fr/fr/activites/smila/neuromimetic-photonics/

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/ *financial support for the PhD***: EDOM, Project (under evaluation)**

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**

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