PhD position in collaborative ANR project:

Learning in spiking photonic neural networks

In the frame of the ANR project “Analog Computation with Photonic Spiking Nodes” (ANACONDA), we are searching for a motivated PhD candidate with expertise in free space optics and interest in neural networks / artificial intelligence. ANACONDA is the first national project investigating the realization of spiking photonic neural networks consisting of 100s of photonic neurons, and the implementation of machine learning and computational neuroscience methods for optical learning hardware. The field of artificial intelligence and photonic neural networks is currently experiencing significant attention, and the members of the ANACONDA consortium (Dr. Brunner, Dr. Barbay, Dr. Thorpe) are the leading experts in France in this area.

The PhD project will be shared between the FEMTO-ST CNRS institute in Besancon (supervision Dr. Brunner, https://members.femto-st.fr/daniel-brunner) and the CERCO CNRS institute (supervision Prof. Thorpe, http://tmbi.fr/simon-thorpe). Work in Besancon will take the center stage and consists of the physical realization of a spiking electro-optical neural network and a trainable optical learning mechanism [1-3]. Work will be accompanied with significant secondments at CERCO, where the student will be trained in powerful neuro-inspired learning concepts [4]. These techniques are then to be physically implemented with the optical system in Besancon. Finally, the student will be involved in the interfacing of the optical learning hardware with an array of excitable spiking lasers developed at the C2N (Paris, Dr. Barbay, https://toniq.c2n.universite-paris-saclay.fr/fr/membres/sylvain-barbay/).

The project is funded by the French national research agency (ANR) and takes place in world-leading laboratories. Education and training in leading edge optical and neural network techniques are a set of skills which currently are in high demand and would equip the student for life after the PhD. During their PhD, the student will attend international conferences and workshops and have the opportunity to network with collaborating institutions. Candidates should have excellent knowledge of and experience with free-space optics and programming. Additional expertise with spatial light modulators would be an advantage.

Interested candidates please contact us via email:

- Daniel Brunner: daniel.brunner@femto-st.fr
- Simon Thorpe: simon.thorpe@cnrs.fr

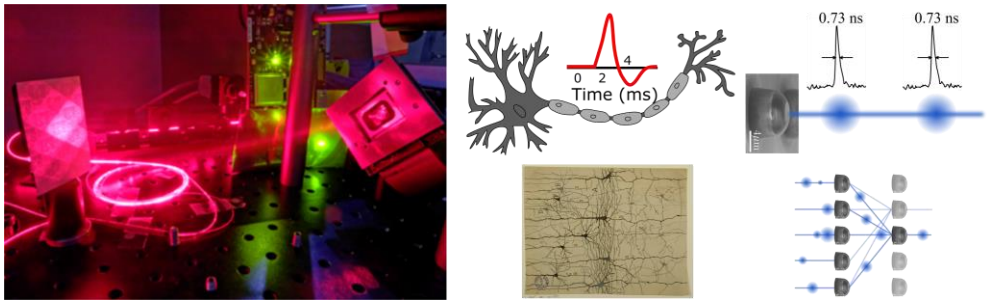

Figure 1. Photonic neural network and the optically realized optical learning hardware. The experiment was realized at FEMTO-ST in 2018. The right panel shows an illustration of the neuro-inspired learning rules to be realized optically during ANACONDA.

[1] Brunner, D.; et al.; “Parallel photonic information processing at GByte/s data rates using transient states,” Nature Communications 4, 1364 (2013). **[2]** Bueno, J.; et al. ; "Reinforcement learning in a large-scale photonic recurrent neural network," Optica 5, 756 (2018).**[3]** Penkovsky, B.; et al.; "Coupled nonlinear delay systems as deep convolutional neural networks," Physical Review Letters 123, 054101 (2019). **[4]** Thunell, E.; Thorpe, S.; “Regularity is not a key factor for encoding repetition in rapid image streams,” Scientific Reports volume 9, 6872 (2019).