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Institut d'Electronique, de Microélectronique et de Nanotechnologie
UMR CNRS 8520

Master nanosciences-nanotechnologies specialty ETECH

Internship 2022-2023

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Title : CONNECTing artificial and biological neurons : Towards Neurobiohybrid Systems

Abstract :

Our team works on a multidisciplinary project that brings together the expertise of three different scientific fields: Electronic, Neuroscience and Biomems. The project aims at designing, manufacturing and characterizing neuro-bio-hybrid systems allowing to interface artificial and living neurons in order to develop new therapies for neurodegenerative diseases (e.g. AMD: age-related macular degeneration - Parkinson).

Neuro-inspired information processing or "neuromorphic engineering" is an emerging field that aims at developing artificial systems inspired by the physical properties of living neural networks. Using knowledge from information processing, nanoelectronics and neuroscience, it is possible to design artificial neural networks and synapses capable of learning, which are at the basis of the current revolution in artificial intelligence. In parallel, neurosystem engineering that aims at studying neural systems, enhancing or replacing neuronal function with engineered devices such as biosensors, multielectrode arrays or even neural prostheses has also considerably progressed in the past years. The convergence of these disciplines and the particularity of artificial neurons that have the same electrical signature as living ones open vast perspectives for the development of "biomimetic" hardware solutions for therapeutic purposes.

Our project aims at bridging neuromorphic and neurosystem engineering fields by developing a new class of systems called 'Neurobiohybrid systems' which enable the bidirectional communication between neuroinspired artifacts and living neurons. Today, neuro-biohybrid systems are the subject of intense research worldwide with the objective of providing new tools to replace or restore neural functions and/or to better understand brain function. In this context, the long-term vision of the project is to make implantable a neuromorphic device with learning capabilities allowing in real time a bidirectional analog communication using the same language between artificial neurons and living neurons of the central nervous system.

In this context, we are looking for a motivated student. Following the student background, different subjects could be envisaged. For example, working to develop the electronic bench or working on the cell culture and characterization. Proven experience with programming instruments to automatize data acquisition will be an advantage. Additional knowledge in neuron culture, neurosystem engineering or on artificial neurons will be appreciated.