Univ. Grenoble Alpes
Université de l'innovation

MIAI @ Grenoble Alpes
Multidisciplinary Institute in Artificial Intelligence

MIAI PhD

SECTOR**:** Higher Education Institution

LOCATION: France, Grenoble

RESEARCHER PROFILE:
□ *First stage researcher,*

INSTITUTION: Univ. Grenoble Alpes, University of Innovation

One of the major research-intensive French universities, Univ. Grenoble Alpes[1] enjoys an international reputation in many scientific fields, as confirmed by international rankings. It benefits from the implementation of major European instruments (ESRF, ILL, EMBL, IRAM, EMFL*). The dynamic ecosystem, grounded on a close interaction between research, education and companies, has earned Grenoble to be ranked as the 5th most innovative city in the world. Surrounded by mountains, the campus benefits from a natural environment and a high quality of life and work environment. With 7000 foreign students and the annual visit of more than 8000 researchers from all over the world, Univ. Grenoble Alps is an internationally engaged university.

A personalized Welcome Center for international students, PhDs and researchers facilitates your arrival and installation.

In 2016, Univ. Grenoble Alpes was labeled «Initiative of Excellence ". This label aims at the emergence of around ten French world class research universities. By joining Univ. Grenoble Alpes, you have the opportunity to conduct world-class research, and to contribute to the social and economic challenges of the 21st century ("sustainable planet and society", "health, well-being and technology", "understanding and supporting innovation: culture, technology, organizations" "Digital technology").

* ESRF (European Synchrotron Radiation Facility), ILL (Institut Laue-Langevin), IRAM (International Institute for Radio Astronomy), EMBL (European Molecular Biology Laboratory), EMFL (European Magnetic Field Laboratory)

Key figures:

- + 50,000 students including 7,000 international students
- 3,700 PhD students, 45% international
- 5,500 faculty members
- 180 different nationalities
- 1st city in France where it feels good to study and 5th city where it feels good to work
- ISSO: International Students & Scholars Office affiliated to EURAXESS

[1] https://edu.univ-grenoble-alpes.fr/en/

MANDATORY REFERENCES:

PROJECT TITLE: *MIAI @ Grenoble Alpes*
SUBJECT TITLE: Spiking Neural Networks On Line Learning Strategies
RESEARCH FIELD: Engineering > Electrical engineering, Technology > Nanotechnology
SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): CEA/LETI - DACLE/SCSN/LISAN team and TIMA Laboratory, Amfors team
DOCTORAL SCHOOL'S: EEATS
SUPERVISOR'S NAME: VATAJELU Ioana/VALENTIAN Alexandre/ANGHEL Lorena

SUBJECT DESCRIPTION:

- Development of on-line supervised and unsupervised learning algorithms adapted to spiking neural networks

Hardware implementation of neural networks is considered strategic research and development topic for several large hardware-oriented companies such as Nvidia, IBM, Intel, as well as software-oriented companies such as Amazon, Facebook, Microsoft. In the past years, there has been an increasing interest in Spiking Neural Networks (SNN) as potential very low energy solutions for complex computation or pattern recognition tasks. Leading projects in neuromorphic engineering brought neuroscience and machine learning domains closer together, leading to powerful brain-inspired chips able to simulate numerous spiking neurons in new types of computer architectures (SyNAPSE, TrueNorth, SpiNNaker, etc.).
The main issues considered in SNNs implementations is the **power consumption reduction**, that will be achieved by the right combination of learning algorithms, large scale power efficient accelerators developed in a Non-von Neuman style and the utilization of emerging technologies. Therefore, research communities have to jointly consider circuit robust design, architecture constraints and simplified, hardware-oriented learning algorithms. In fact, the real switch from classic Deep Neural Network to Spiking Neural Network would really be reached when other properties of bio-inspired neural networks such as unsupervised and distributed learning could be efficiently implemented. In that respect, one of the key scientific challenges is to design a scalable and flexible SNN architecture that can adapt to different learning algorithms, to handle not only inference tasks but also the learning ones (online, supervised, unsupervised, probabilistic, etc.).

This PhD thesis subject is tightly coupled with another PHD targeting the design and verification of spiking neural network accelerators. (Title: "**Design and verification of a Spiking Neural Network accelerators with Resistive RAM synapses**").

The PhD student will join a multi-disciplinary team of machine learners, circuit designers and technologists, working on industrial, health and automotive Edge AI applications.
The PhD student will have access to state-of-the-art research facilities, enabling work from system design and validation to tape-out circuits in advanced technology nodes.
The research work will consist in:

- Proposing efficient implementation of unsupervised on-line learning and long-term learning in addition to classic, supervised learning algorithms. Algorithms such as Spike timing dependent plasticity (STDP), Spike Count base learning rule (modified back-propagation), STDP-based unsupervised pre-training followed by supervised fine-tuning, Rewarded STDP will be implemented and validated with high level languages (Python based, Tensor flow, ONNX, etc) for a specific industrial application.
- Assessing scalable architectures key parameters, e.g. latency, network bandwidth, memory capacity based on modular ensemble network
- Learning Algorithm adaptation to the Spiking Neural Network input signal shape and connectivity requirements
- Optimizing and evaluating Information coding sparsity - temporal or probabilistic coding will be considered as an additional mean to reduce the power consumption.

The obtained circuits will be employed in embedded applications, in the industrial, health and automotive sectors.

Expected skills

Technical: Embedded System Design and Validation (design, System level and HDL modeling languages, CAD tools), Python/C/C++ and scripting, Signal Processing.
Knowledge about system level and digital front-end design and validation, assembly language, machine learning algorithms, data science, etc.

Personal: Determination, perseverance, trustworthiness, autonomy, adaptability, initiative, good communication skills

Languages: English: at least B2 equivalent, excellent reading and writing level, good speaking level. Fluency in French is a plus but it is not mandatory.

ELIGIBILITY CRITERIA
Applicants must hold a Master's degree (or be about to earn one) or have a university degree equivalent to a European Master's (5-year duration).

Applicants will have to send an application letter in English and attach:

- Their last diploma and transcript of last 2 years scores.
- Their CV focusing on the technical topics developed and implemented in projects and labs
- A short presentation of their scientific project (2 to 3 pages max)
- Letters of recommendation are welcome.

Address to send application: alexandre.valentian@cea.fr; lorena.anghel@grenoble-inp.fr