2025-2026

Internship proposal (Master 2 or final internship)

In-Materia Reservoir Computing: The Potential of Metal Oxide Semiconductor Nanowire Networks

Context

Contemporary computing, based on the von Neumann architecture, has reached its energy and material limits. Each computation involves numerous data transfers between memory and processor, accounting for 80% of a computer's energy consumption. As artificial intelligence becomes ubiquitous, it is urgent to imagine more efficient approaches where computation is no longer abstract but emerges from the material itself. This internship topic lies within this perspective, focusing on networks of metal oxide semiconductor nanowires—self-organized architectures that are disordered yet dynamically coherent, capable of performing physical information processing: in-materia computing.

We hypothesize that these networks possess two remarkable properties: first, that their nanometric junctions exhibit natural memristivity, embedding memory directly in the material's dynamics; and second, that they display nonlinear behavior. By exploiting this dual nature, it becomes possible to make computation emerge directly from the physical dynamics of the system.

This paradigm shift represents a true rupture: it is no longer about simulating intelligence but letting it emerge from matter itself. Through an interdisciplinary approach combining materials science (LMGP), advanced electrical characterization (CROMA), and neuromorphic electronics (TIMA), this internship aims to explore how disordered networks of oxide nanowires can serve as the foundation for embodied, energy-efficient, and self-organized computing. These systems pave the way for ultra-low-power computational devices inspired by the brain.

Internship Objectives

- Set up a measurement platform for studying nanowire networks used as physical reservoirs.
- Characterize the electrical and dynamic response of the network under various excitations (voltage, frequency, temperature).
- Analyze correlations between input and output signals to evaluate the system's nonlinear transformation capabilities.
- Explore the potential of these networks for simple computational tasks.

Internship Benefits

The internship will provide exposure to the emerging concepts of *in-materia* neuromorphic computing, hands-on experience with measurements on nanostructured systems, and an opportunity to explore the intersection of physics, artificial intelligence, and low-carbon electronics.

Required Skills

Candidates should be currently pursuing a Master's degree, final year of engineering school or equivalent in a field related to materials science, microelectronic technologies, semiconductor device physics, electrical characterization, or modeling. Please explicitly mention these skills in your application.
The position requires teamwork ability, strong experimental skills, and an interest in signal processing. Outstanding academic performance and excellent proficiency in written and spoken academic English are highly valued.

Application Instructions

A complete application must include:

Motivation letter and relevance of application: a brief cover letter describing how the candidate's background and goals align with the position, including how it supports their future career plans. The candidate should clearly describe how their academic path and expertise are relevant and can contribute added value to the project described above
CV: academic and professional background, detailing relevant experiences, particularly in research. Include any information demonstrating your interest in research. Provide the names and contact details of one or two academic or professional references who can attest to your professional skills and ability to work in a team. At least one reference should be a research supervisor.

Our team welcomes applications from candidates of diverse backgrounds and experiences. We view diversity as a strength and an asset.

Depending on the motivation and skills of the selected candidate, the internship may lead to a PhD opportunity.

Laboratory: LMGP collaboration with CROMA and TIMA
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Start date: from February
Required documents: Motivation letter, CV, current and previous academic transcripts (including rank if possible), and recommendation letters.