

## **Call for applications – PhD candidate**

Lyon Institute of Nanotechnology  
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### **ROBUSTNESS AND RELIABILITY IN PHOTONIC NEURAL NETWORKS**

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Today, the exponential growth in the amount of data (e.g., generated by IoT devices) calls for innovative computing approaches that can circumvent the electrical I/O bottleneck and increase computing performance of next-generation systems. Many efforts are currently ongoing to explore and demonstrate novel unconventional (non-Von-Neumann) computing architectures. Specifically, brain-inspired (neuromorphic) hardware architectures can deliver several orders of magnitude superior performance in terms of energy efficiency, computation density, speed and latency compared to classical CPU and GPU-based computing solutions. Several applications ranging from 5G technology and IoT processing to autonomous driving and robotics would greatly benefit from such solutions.

The focus of this work will be to develop neuromorphic architectures leveraging emerging technologies suitable for the implementation of these novel computing paradigms. Among the myriad of technologies under investigation, integrated photonics is regarded as one of the best candidates because of its large potential in terms of multiplexing (parallelization), high-speed operation and speed-of-light propagation as well as low power consumption and large number of physical degrees to manipulate/encode the information (amplitude, polarization, phase, etc.). Besides, integrated photonics benefits from CMOS-compatible fabrication for volume scaling and ease of market take-up.

In the framework of a research project funded by the French National Research Agency (ANR) and by the University of Lyon, the Heterogeneous Systems Design group at INL aims to explore the limitations in terms of robustness and reliability of photonic neural networks. In this context we are currently looking for a (m/f) **PhD student** for a **3-year** contract.

#### **Job description**

This thesis aims to explore the robustness and reliability of photonic neural networks (neuromorphic architectures) and to propose solutions at a device/system level to enhance their performance for real scenarios deployment.

This will involve (i) selecting key photonic neuromorphic architectures, (ii) carrying out their behavioral and system-level modeling, (iii) assess their performance in terms of robustness and reliability by exploiting techniques well-known in the reliability community, and (iv) propose novel device/system designs and strategies to build more robust and reliable architectures.

The work will involve behavioral and system-level modeling of photonic devices and neuromorphic architectures, robustness and reliability analysis of the selected architectures, and the proposal of novel design/system-level solutions.

#### **Profile**

You have or are about to obtain an MSc in Electronic or Physical Engineering / Computer Engineer / Computer Science with strong experience in at least one of the following areas: analog / digital / photonic integrated circuit design, multi-disciplinary or system-level modelling. Good programming skills (python, C++) are required. Previous experience in Neural Networks is a plus (e.g., knowledge of major NN frameworks such as Pytorch and Tensorflow). Excellent written and verbal communication skills in English. Fluency in French is also a plus but is not mandatory.

#### **About INL**

INL is a 250-strong research institute based in Lyon, France, carrying out fundamental and applied research in electronics, semiconductor materials, photonics and biotechnologies. The Heterogeneous Systems Design group is a leader in the area of advanced nanoelectronic design, with research projects and collaborations at both national and European level. Recent highlights include the development of high-performance design strategies for complex 3D integrated circuits, ferroelectric logic in memory, VNWFFET-based logic and silicon photonic networks on chip.

#### **Send CV and statement of purpose (in English or French) to**

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