

ARTIFICIAL INTELLIGENCE

Ateneo/DET - Silicon photonics microrings for AI processing units

Funded By	Dipartimento di Elettronica e Telecomunicazioni [Piva/CF:00518460019]
Supervisor	GIOANNINI MARIANGELA - mariangela.gioannini@polito.it
Contact	GIOANNINI MARIANGELA - mariangela.gioannini@polito.it RIMOLDI CRISTINA - cristina.rimoldi@polito.it
Context of the research activity	This interdisciplinary research project focuses on the intersection of photonics and artificial intelligence (AI). It aims to develop active optical components integrated into photonic circuits for AI applications.
Objectives	This project locates and the intersection between photonics and AI. AI technologies, as for example deep learning, requires units capable of processing and transferring data at high speed and low energy consumption. In this frame photonics is a key enabling technology to generate, manipulate and transfer data in the form of optical signals with significant reduction of the power consumption and increase of the data rate. Most of the data processing is carried out at the optical level in photonic integrated circuits. These circuits in silicon are fabricated in the same CMOS foundry of electronic integrated circuits and it is also possible to integrate in the same package or in the same chip both electronic and optical processing and control. The PhD project will be carried out in strong collaboration with STMicroelectronics, that is working since many years on the development of photonic integrated circuits in silicon photonic platform. Here the aim is the development, together with STM, of active optical components integrated into photonic chips for AI applications. The components and circuits will be modelled and designed in the group of Politecnico di Torino and STM (Castelletto site in Italy); fabricated in STM (Crolles site in France) and tested both in STM and Politecnico di Torino experimental labs. This research project therefore covers different aspects: theory and modelling, design, fabrication and testing. The PhD students will be involved in all these steps and will spend time in STM in both Castelletto (Italy) and Crolles (France) sites. In details, the research activity will cover: -Design, fabrication and testing of silicon photonics high speed low power

consumption optical modulators based on micro-ring resonators

- Explore theoretically and experimentally how silicon micro-rings and modulators can be employed in reservoir computing
- Employ machine learning techniques in the design process

Skills and competencies for the development of the activity

It is required strong background in electronic and optoelectronic devices and microelectronics. Good knowledge of Matlab and student level experimental lab experience in a photonic laboratory (ie: familiar with lab instrumentations such as oscilloscopes, signal generation, optical spectrum analysers, optical fibers etc.).