

Progetto Laurea Magistrale Plus

(Students enrolled for the first time in the Academic Year 2021/22, undertaking the internship in the company in 2022/2023)

University info

Laurea degree: PHYSICS
University tutor / Thesis supervisor: Prof. Matteo Galli
Courses / Expertize of the university tutor: Integrated photonics for classical and quantum applications

Company info

Company name: CEA-Leti
Company Tutor(s): Benoit Charbonnier and Segolene Olivier
Role in the company of the tutor(s): R&D engineer in silicon photonics

Contents and info on project and internship

Project title: Development and experimental validation of optimization algorithms for programming silicon photonics integrated circuits for neural networks and quantum information
<u>Activity scenario and targets of the internship - Area/Department/office/lab (where the trainee will be involved):</u> Programmable photonic integrated circuits (PICs) are at the heart of many emerging field such as Lidars, Optical neural networks and quantum information. While the mathematical description of the integrated components is of no difficulty, accounting for fabrication tolerances and various crosstalks makes the description of the full circuit not feasible without adding in situ diagnosing ports, thus limiting the scaling of this technology. In order to overcome this difficulty, new numerical optimization and learning techniques allow from a given set of measurements to program the desired operation without prior knowledge of the exact description of each individual component. In this master thesis project, we propose to develop optimization algorithms in order to allow full and flexible programmability of a photonic circuit. In a first phase, the candidate will model a typical interferometer network accounting for fabrication variability. From this model, the candidate will simulate several sets of measurements for given inputs in order to be able to program efficiently the desired transfer function. Eventually machine-learning algorithm could be envisioned in order to optimize the calibration process. In a second phase, we expect the candidate to validate these numerical methods on PICs fabricated at CEA-LETI for integrated photonics IA as well as for quantum information applications. Depending on the outcome of these tests, the candidate will either elaborate on the first optimization algorithm or develop a generic PIC programming software.
<u>Background / Expertize of the student required for the internship:</u> Master studies including semiconductors, photonics and/or computer science and programming
<u>Potential thesis topics:</u> To be discussed, possible in principle
<u>Company location and place of work:</u> (Full address) CEA-Leti – Optics and Photonics Department – 17 rue des Martyrs – 38054 Grenoble - France
<u>Time length of the internship:</u> 10 months (4.5 months + 6 months separated by 1.5 month)
<u>Benefits provided by the company</u> (at least reimbursement of 500€ per month): Reimbursement of >=500€ per month in Grenoble
<u>Specific company requests:</u> Strongly motivated students with good exam scores, team working and flexibility skills to work in a multi-disciplinary environment (photonic circuit design and optimization, pre-industrial clean room fabrication, optical characterization)
<u>Other comments:</u> The student will get a pratical insight of the various theoretical and experimental aspects of integrated silicon photonics technology in one of the largest technological R&D institutes in Europe.