Master in Photonics – "PHOTONICS BCN"
Master ERASMUS Mundus "EuroPhotonics"

MASTER THESIS PROPOSAL

Dates: April 2021 - September 2022

Laboratory: -
Institution: Quside
City, Country: Castelldefels (Barcelona), Spain

Title of the master thesis: FFT acceleration with integrated photonic circuits

Name of the master thesis supervisor and co-supervisor:
(for external proposals a co-supervisor from the Master program in needed)
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Keywords: Integrated Photonics, Photonic Computing, Hardware Acceleration

Summary of the subject (maximum 1 page):

Over the last 50 years, computing capabilities has undergone a tremendous speed up thanks to the exponential increase of transistor density dictated by Moore's law. However, its applicability is coming to an end, as transistor size is getting close to its physical limit.

Alternative technologies (so-called post-Moore technologies) have emerged to keep the computation capabilities growing. Among them, Optical Computing arises as one of the most promising research pathways.

In particular, optical computing can drastically improve arithmetic operations and Fourier Transform is one of the most useful and easy to implement.
Optical computing also responds to the need of a cleaner world, since optical components do not dissipate much energy, which is an intrinsic characteristic of electrical computation. Hence, advances in this field lead us to a more energy-efficient world.

However, what is most characteristic of light is its high speed and parallelization capabilities, due to the linear-interaction behavior of electromagnetic waves. Hence, advancing in this technology leads to algorithm speed improvement. In particular, the improvement of Fourier

Transform will directly benefit applications which rely on it, as data processing, communications, deep learning, and image processing, among others.

The thesis will focus on the development of a photonic computing platform capable of performing Fast Fourier Transforms. This platform has been implemented on a photonic integrated circuit by Quside. In particular, the thesis will focus on the measurement and analysis of the different building blocks of the photonic integrated circuit, including the development of the electronic hardware required to drive and control those building blocks. Focus will be put on the use of coherent detection techniques. Finally, the last part of the thesis will be devoted to the implementation of the FFT algorithm using the photonic circuit and the analysis of its performance.

Additional information (if needed):
* Required skills: Knowledge of optics and physics, Programming (Python/C++)
* Miscellaneous: English