



## Master in Photonics – “PHOTONICS BCN” Master ERASMUS Mundus “EuroPhotonics”

### MASTER THESIS PROPOSAL

Starting full time from April 2024

Presentation at the end of July or beginning of September 2024

**Laboratory:** D4-S107, Optical Communications Laboratory  
**Institution:** UPC and collaboration with company Capgemini  
**City, Country:** Barcelona, Spain

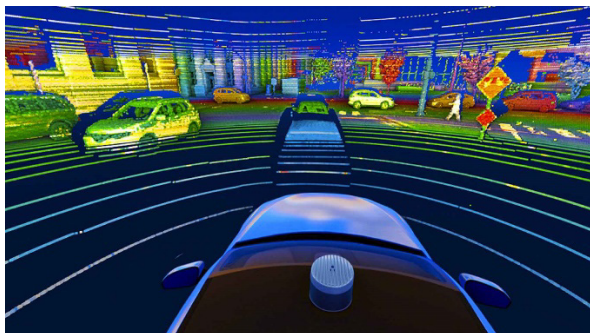
**Title of the master thesis:** Design of LIDAR (Laser Imaging, Detection, And Ranging) for future Autonomous Vehicles

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**Phone number:** +34 934 017348

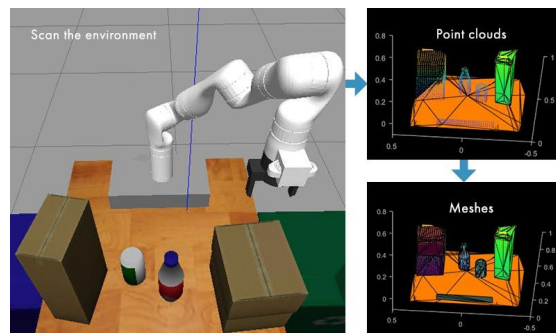
**Keywords:** Photonics, Laser, AI, Autonomous Vehicles

### Summary of the subject (maximum 1 page):

LIDAR is based on scanning an object or a surface with a laser or set of lasers. It is nowadays used in thousands of applications requiring high-resolution maps, as surveying, geodesy, archaeology, geography, geology, geomorphology, seismology, forestry, atmospheric physics, etc. [1]. Recently it is being used for navigation of autonomous cars, and even for the helicopter Ingenuity recording the terrain of Mars [2]. Figures A and B provide some example of LIDAR perception and LIDAR object identification using AI techniques.

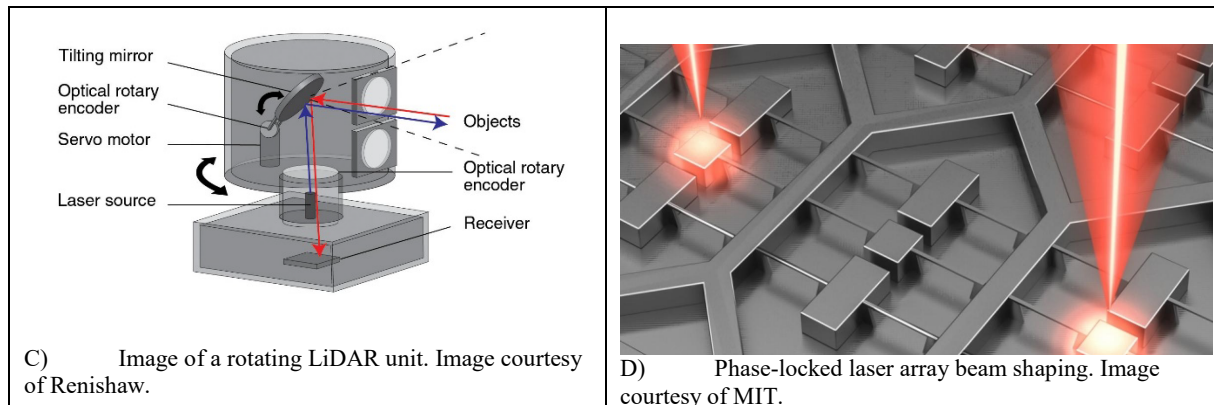


A) Providing perception to Autonomous Vehicles by Laser Imaging, Detection, And Ranging (LIDAR)



B) LIDAR scanning and AI object identification for Collaborative Robotic perception

The main problem of nowadays LIDAR is the cost, because commercial LIDAR are based in expensive micromechanical systems as in Figure C.



This Master Thesis propose the design of much more compact and cheap photonic integrated LIDARs as also proposed by MIT in Figure D. To do that you will count with:

- Step-by-step tutorial to follow to design your prototype
- Commercial design and simulation suite to check the performance of your design

Even more, a prototype of your design could be later fabricated by:

- External support from company Capgemini
- Open source Silicon photonics Process Design Kit (PDK) in collaboration with the University of British Columbia (Vancouver, Canada)

- 1) Knowledge of the Master Photonics' subject: 2301116 - SEMPHO - Semiconductor Photonics: Applications and Technology

([https://photonics.masters.upc.edu/ca/media/contents/academic\\_year\\_2023-24/course\\_contents/semiconductor-photonics.pdf](https://photonics.masters.upc.edu/ca/media/contents/academic_year_2023-24/course_contents/semiconductor-photonics.pdf)) -> Recommended

- 2) **Possibility to start as “Initiation to Research Grants (INIREC - UPC)”** ([Initiation to Research Grants \(INIREC\) — Research, Development and Innovation. RDI — UPC. Polytechnic University of Catalonia](#)), before the Master Thesis, with 5h/week to 15h/week dedication, receiving 183 to 550 € per month, depending on the availability and previous experience/kills of the student.

## References:

[1]: Cracknell, Arthur P.; Hayes, Ladson (2007) [1991]. “*Introduction to Remote Sensing*” (2 ed.). London: Taylor and Francis. ISBN 978-0-8493-9255-9. OCLC 70765252.



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[2]: "*How NASA Designed a Helicopter That Could Fly Autonomously on Mars*". IEEE Spectrum. 17 February 2021. Archived from the original on 19 February 2021. Retrieved 19 February 2021.