PHOTONICS - EUROPHOTONICS MASTER COURSE

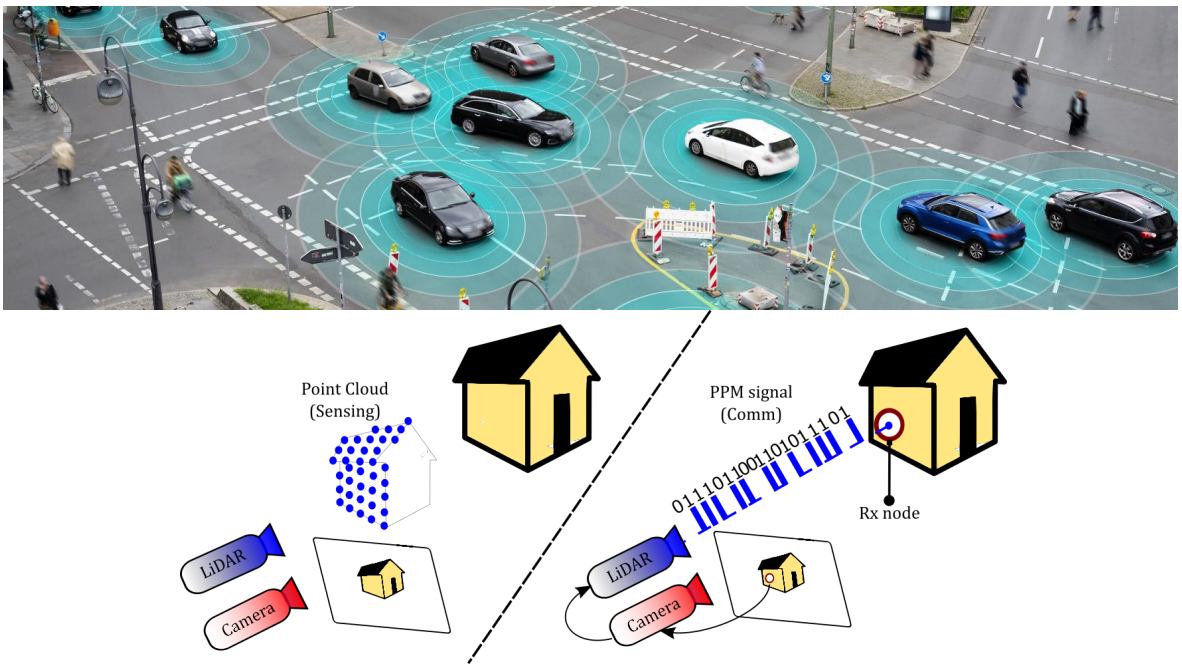
PROPOSAL FOR A MASTER THESIS

Dates: February 1st, 2026 – September 30th, 2026

Laboratory: Centre for Sensors, Instrumentation and systems Development (UPC-CD6)
City, Country: Terrassa, Spain

Title of the master thesis:

OPTICAL PULSE MODULATION FOR A FSO 6G-COMMUNICATION LINK BASED ON JCAS LIDAR TECHNOLOGY



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Summary of the subject (maximum 1 page):

The sixth generation (6G) of wireless communication technology is touted as an enabler of our digital age. Novel critical technologies like autonomous driving will be enhanced with 6G. Particularly, Optical Wireless Communications (OWC) and sensing technologies for situational awareness are crucial technologies to ensure safety on our roads. Currently, Autonomous Vehicles (AV) rely in multiple sensors to collect information from their environment and, within them, Light Detection And Ranging (LiDAR) devices are key. LiDAR sensors use light beams to measure the distance to a target, providing dense 3D geometric information with more resolution than conventional RaDAR devices. Given that LiDAR devices emit light, they can also be used for communicating information via OWC rather than only sensing. This is known as Joint Communication And Sensing (JCAS) and it is one of the key enablers in future 6G.

This master thesis will focus on developing OWC suitable with the pulsed modulation intrinsic in our LiDAR devices, demonstrating the JCAS concept by sending information from the LiDAR (Bob) to a remote receiver (Alice). The developed protocols will be tested in our JCAS LiDAR device and different communication performance metrics like the bitrate (capacity), Bit-Error-Rate (BER), latency (speed) and Range will be evaluated.

The project is therefore focused on providing communication capabilites to a real JCAS LiDAR prototype already available in the center.

You will join our research group, where you'll have support on the use of scanning pulsed lidars, signal acquisition and processing, programming, optical design and modelling, etc.

The focus will be on four key areas:

1) **LiDAR background:** Understanding the principle of operation (Time-of-Flight) and the key parameters of LiDAR devices that yield different trade-offs.
2) **Pulsed Communication Protocols:** Exploring strategies and protocols to communicate information based on pulsed light and constrained to our JCAS LiDAR specifications.
3) **Communications Signal Processing:** Proposing and developing signal processing algorithms to encode and decode the information sent via the JCAS LiDAR OWC link.
4) **Experimental Validation:** Performing experimental laboratory testing to demonstrate the novel communications capabilities and protocols, focused on obtaining the most relevant key performance indicators of communications like the bitrate, BER, latency.

This project will contribute to the foundation for JCAS LiDAR devices and 6G providing novel communication capabilities to the LiDAR devices developed within the CD6 enter. In particular, this project is part of an European Research project whose goal is to enhance road safety by connecting vehicles and making their collected information instantaneously available to all traffic participants. Thus, you'll be involved in top-level international research.

Basic programming skills (fluent Matlab or Python) and basic knowledge of communications and optical system design are desirable, but not strictly required.

Keywords: LiDAR, OWC, Autonomous Vehicles, 6G, communications, optics

Additional information :
* Amount of the monthly allowance (if it is the case):
To be discussed depending on the value of candidate.

* Required skills:
Interest in application-driven experimental work for solving real-world problems.
Basic concepts in optical metrology and optical engineering
Programming (C++ desirable, Python or Matlab minimum) and use of scientific software packages.
Search of resources, both scientific and technical
Self-motivated, objective-driven, capable of autonomous working within a multidisciplinary team.

* Miscellaneous:
This thesis contents will be considered confidential due to its closeness to market.
International team with several years of experience in the topic proposed.
Multidisciplinary environment with electronics and mechanics workshops, and specialists and technicians in metrology, optics, mechatronics, and electronics.
Possibility of joining the Centre for a PhD/Project Manager career in case of common interest.
Early incorporation welcome.