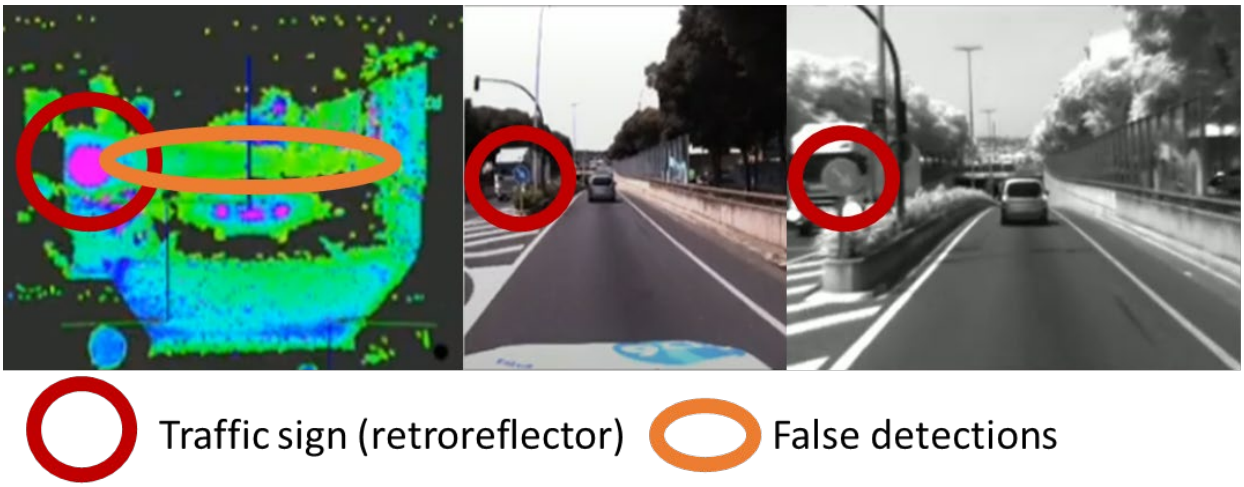
PROPOSAL FOR A MASTER THESIS

Dates: February 1st, 2025 – September 30th, 2025

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

Title of the master thesis:

ENHANCED LIDAR SELF-INMUNITY AGAINST RETROREFLECTORS



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Summary of the subject (maximum 1 page):

Light Detection And Ranging (LiDAR) devices are active sensors that use light for measuring distances. Similar to when cameras saturate and provide burnt images, LiDARs can eventually get blind by themselves if a huge amount of light reflects back towards the sensor. Consequently, there appear false detections in the 3D image as the figure shows. This saturation effect is primarily caused by retroreflector signals from sources such as traffic signs and car plates. Currently, the unique available solution in the literature is to temporalily shut down the sensor in the region where the retroreflector is detected. This is an intolerable failure mode for autonomous vehicles.

In the CD6, we have started the developement of a custom algorithm to avoid this risk in our proprietary LiDAR devices. The goal of this project is to study deeper the radiometric model when retroreflectors are present in the Field-of-View of a LiDAR and to improve the current software algorithms to overcome this hazardous fault mode.

You will join our research group, where you'll have support on the use of scanning lidars, computer vision, optical design and modelling, etc.

This thesis aims to enhance the LiDAR self-inmunity against retroreflectors. The focus will be on three key areas:

1) **Radiometric model:** Investigating the effects and relevance of light backpropagation from retroreflectors present in the Field-of-View of a LiDAR device.
2) **Experimental characterization:** Measuring and validating the developed model with in-field tests and in a real urban environment carried with our proprietary LiDAR devices mounted in a vehicle.
3) **Software development:** Improving our current detection and filtering algorithms to remove the false detections present in the 3D image (Point Cloud).

This project will tackle a real challenge and limitation to current LiDAR devices, becoming of high interest and impact for real-world applications like autonomous vehicles. Basic programming skills (fluent Matlab or Python) and basic knowledge of electronics and optical system design are desirable, but not strictly required.

Keywords: LiDAR, metrology, radiometry, autonomous vehicles, computer vision, deep learning

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.