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:

> COUNTERDRONE: AUTOMATED DETECTION STRATEGIES IN LIDAR SENSING FOR SMALL TARGETS.
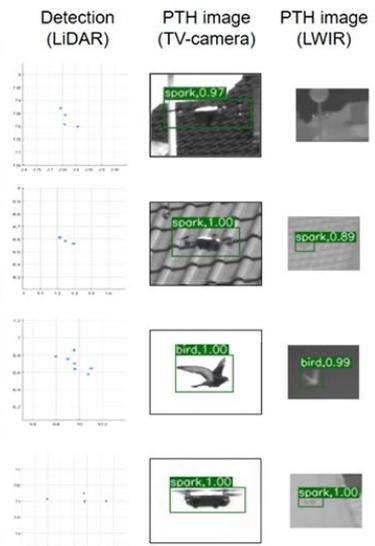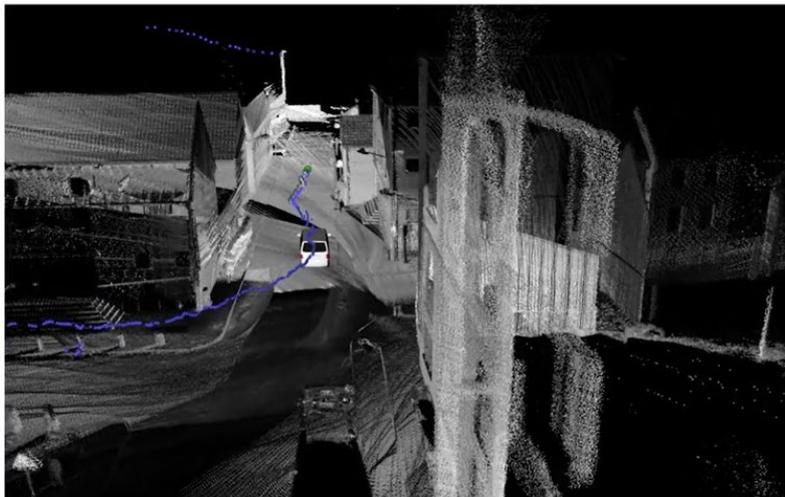

Distance = 5m

Distance = 15m

Distance = 25m

Name of the tutor of the master thesis: Santiago Royo
Email address: santiago.royo@upc.edu
Phone number: 34 93 7398904
Mail address: Rambla Sant Nebridi 10 E08222 Terrassa

Summary of the subject (maximum 1 page):

The increasing use of small Unmanned Aerial Vehicles (UAVs) or drones in civilian and defense applications raises concerns about airspace safety and privacy. Detecting and tracking such small targets requires high-resolution sensing and robust data processing methods. LiDAR (Light Detection and Ranging) sensors, known for their precise 3D spatial measurements, offer a promising solution for counterdrone applications. However, detecting drones in LiDAR data remains challenging due to their small size, fast motion, the sparse nature of point clouds at long ranges, and the presence of background clutter.

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

This thesis will focus on developing and evaluating advanced algorithms for the automatic detection and tracking of small drones using LiDAR data. The project will explore strategies that combine point cloud processing, statistical filtering, and computer vision techniques to improve target discrimination and robustness in dynamic environments.

The research will address four key areas:

1) **Technology background:** Understanding the principles of LiDAR sensing and the challenges of detecting small targets within large-scale 3D environments.
2) **State-of-the-art review:** Reviewing existing LiDAR-based detection and tracking strategies, including traditional signal processing and AI-based approaches.
3) **Algorithm development:** Implementing and testing point cloud processing algorithms for object segmentation, classification, and tracking of drones.
4) **Performance evaluation:** Assessing detection and tracking performance under different conditions (range, reflectivity, motion) and identifying trade-offs between accuracy and computational cost.

This thesis will contribute to the development of automated LiDAR-based counter-drone systems, providing a foundation for integrating intelligent sensing in future airspace monitoring platforms. The work will involve software development, 3D data analysis, and integration of computer vision concepts. Basic programming skills (fluent Matlab or Python) and basic knowledge of electronics and optical system design are desirable, but not strictly required.

Keywords: LiDAR, drone detection, point cloud processing, computer vision, object tracking, AI, Python

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 <u>confidential</u> 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.
<u>Early incorporation welcome</u>.