



Education and Culture DG

ERASMUS MUNDUS



PHOTONICS - EUROPHOTONICS MASTER COURSE

PROPOSAL FOR A MASTER THESIS

Dates: February 1st, 2023 – September 30th, 2023

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

Title of the master thesis:

Benchmarking Fusion Deep Neural Networks Using a Custom Multimodal Dataset for Autonomous Driving



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):

Our research group has developed a fully working multimodal data acquisition prototype for autonomous driving under adverse weather conditions. The prototype's sensor suite comprises three visible cameras, one short-wave infrared (SWIR) camera, one thermal camera, one polarimetric camera, and a custom-made solid-state LiDAR as its core. With it, the team has gathered data in diverse scenarios and adverse weather conditions, including nighttime, heavy rain, dense fog, and even snow scenarios. A full annotated data set has been developed.

The project, thus, is oriented to the development of a benchmarking framework for object detection algorithms using our group's custom multimodal dataset for autonomous driving. A thorough state-of-the-art review of object detection methods will be performed, followed by the selection of representative models (e.g., YOLO, CenterPoint, PointPillars, BEVFusion) for evaluation, focusing on a comparison between early/late fusion strategies. The student will design both the software workflow (data preprocessing, training pipelines, evaluation metrics, result visualization) and the experimental protocol to ensure fair and reproducible benchmarking.

You will join our research group, where you'll have support on the use of scanning lidars, design deep learning pipelines, multimodal sensor calibration, etc.

The interested student will work in a combination of experiment design and evaluation tasks, from a very much engineering-oriented point of view, with the goals of

- 1) Review the state-of-the-art in object detection for autonomous driving and explore the most promising solutions with early/mid/late fusion strategies.
- 2) Adapt benchmarking frameworks to include our own data set.
- 3) Train and evaluate different algorithms with custom pipelines and metrics.
- 4) Exporting the best performing models for real-time testing on the data acquisition prototype.

Keywords: Autonomous driving, deep learning, Python, benchmarking, datasets, real-time inference

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.

Programming (C++ desirable, Python proficiency)

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.