



PHOTONICS - EUROPHOTONICS MASTER COURSE

PROPOSAL FOR A MASTER THESIS

Dates: February 1st, 2023 – September 31st, 2023

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

Title of the master thesis:

Radar+lidar data fusion for Autonomous vehicles in turbid media using deep neural networks



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Summary of the subject:

Which is the problem?

Turbid media scatter light in many directions, damping the visibility through them. Consequently, the performance of imaging sensors such as cameras and LiDAR (Light Detection And Ranging) devices is severely harmed, even to the extent of failing to provide reliable data because of veiling or hazing artefacts on images and false alarms. Radar, on tis side, is unaffected by fog but does not achieve the level of spatial resolution desirable as they produce a very limited number of data points.

The current disruption of autonomous vehicles (AVs) and robotics has led Computer Vision (CV) researchers to focus on data fuson architectures to minimize the damaging effects of imaging through turbid media or adverse weather conditions. In such networks, the complementarities of the imaging modes are critical. Several manufacturers are currently trying to fuse lidar and radar architectures to improve sensing in AVs.

This TFM proposal is linked to a cutting-edge research project carried in the CD6 with the spinoff Beamagine that proposes a <u>multimodal sensor based on 3D LiDAR in conjunction with</u> <u>radar imaging</u> for improving the imaging performance through turbid media. The aim of this TFM is to explore and train DNN for improving perception and reducing the turbid media haze effect and increasing the detection performance by using the available imaging modes.

What will you do?

During the first weeks, you will be introduced to the multimodal sensor fusion device with technical staff of CD6 (teammates) whilst you will explore and learn about DNN focused on data fusion. Radar and lidar devices are available at CD6 which may be sued for tests of the technology. Your tasks will involve to explore state of the art data fusion architectures, setting up data acquisition strategies involving lidar and radar, generate the datasets and evaluate the improvement of performance of a radar+lidar perception arrrangement

You will have to make decisions on different technical aspects such as code performance, generated output, efficiency, ... getting confidence and experience in working in real-world applications and getting involved in technical teams. It must be highlighted that you will be co-working with the team so you can get support from them when needed.

Is this TFM for you?

This is a Thesis mostly related to programming. If you are willing to work with state-of-the-art tech-challenges and seeing your progress applied in a real-world application whilst working with a good and enriching environment, this TFM is for you.

Keywords: LiDAR, 3D imaging, LiDAR calibration, Image processing, radar. Data fusion **Additional information:**

* Amount of the monthly allowance. Depending on value of candidate

* Recommended skills:

Interest in application-driven experimental work for solving real-world problems. Basic concepts in image processing and neural networks Programming (MatLab, Python and the DNN packages, C++ appreciated) 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.

A solid research project with several PhDs related.

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.