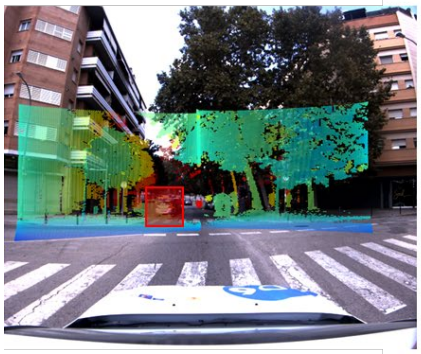
PROPOSAL FOR A MASTER THESIS

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:

AUTO-SELF SENSOR FUSION CALIBRATION FOR A DATA COLLECTION VEHICLE



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Summary of the subject (maximum 1 page):
Autonomous vehicles rely on a wide variety of sensors to perceive their surroundings, including cameras, LiDAR, RaDAR, and other advanced modes. Accurate sensor calibration is critical for fusing multimodal data into congruent understanding of the environment. This master thesis will focus on developing an on-line self calibration method for multiple sensors with different modes that ensures proper alignment while the vehicle is in operation. The developed algorithms are going to be tested in real and diverse scenarios using the multimodal data acquisition vehicle developed by the CD6 team. This thesis will contribute to improving sensor fusion in autonomous systems, leading to a better perception security and safety.

The project is therefore focused on updating the data fusion parameters of the multimodal device available in the center while in operation.

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

This thesis aims to develop an on-line (while operating) self-calibrating method for a data collection vehicle. The focus will be on four key areas:

1) **Sensor Fusion Background:** Understanding the algebraic principles and parameters related with data fusion (both spatial and temporal) is crucial to develop the on-line calibration procedure.
2) **Probabilistic Models:** Exploring probabilistic models to estimate and predict the misalignments that may eventually occur during operation as a random process.
3) **Feature Extraction:** Detecting common key features available in all the modes that can be used to compare and to determine the data fusion parameters.
4) **Robustness:** Developing a robust method that considers the in-factory calibration as the general data fusion set of parameters but has flexibility to tune them according to the on-line calibration to enhance data fusion accuracy in operation.

This project will provide a key capability to the currently available multimodal devices in the center which are calibrated once, improving the data fusion precision over all the operating time. In particular, this project will be of high interest for our current data collection vehicle which is equiped with a complex sensor suite. Basic programming skills (fluent Matlab or Python) and basic knowledge of electronics and optical system design are desirable, but not strictly required.

Keywords: integration, data fusion, autonomous vehicles, Python, computer vision, datasets

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 in 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.