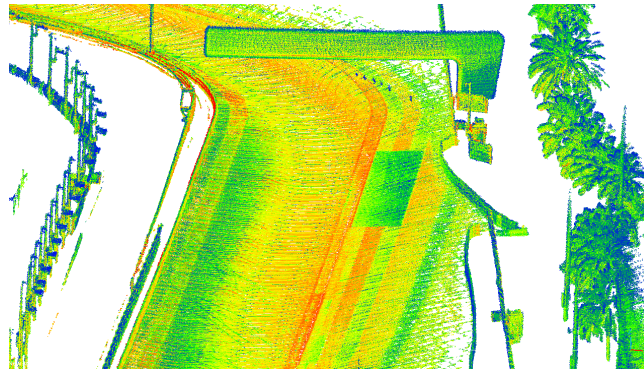


Know Your Surroundings: Influence of Semantic Map Components on LiDAR Localization for Racecars

Masters Thesis



The TUM Autonomous Motorsport team made history by winning the Abu Dhabi Autonomous Racing League (A2RL) in 2024 at the Yas Marina Circuit. A2RL is a premier competition where teams develop software for identical autonomous vehicles, competing at speeds exceeding 200 km/h. A critical aspect of this challenge is localization and mapping, especially in GNSS-denied environments, requiring the use of sensors like LiDAR, cameras, and RaDAR for accurate and reliable positioning.

This thesis aims to further improve the LiDAR-based localization pipeline by investigating the influence of different parts of the environment on the localization performance. Therefore, the existing 3D point cloud map needs to be semantically segmented, to classify single segments in the environment. In the next step, the influence of these segments on the overall localization is to be investigated regarding accuracy, robustness and runtime. To this end, an existing, deterministic simulation pipeline may be used. The goal is to identify which environmental features are most critical for accurate LiDAR-based localization, resulting in map optimization strategies for increased localization efficiency.

The following work packages are included in the study work to be assigned:

- Literature research on map-based LiDAR localization and semantic segmentation of LiDAR data
- Classification of existing open-source algorithms for point cloud segmentation
- Semantic segmentation of the existing point cloud map and simulative investigation of the influence of single semantic instances
- Development of a strategy for optimization of the point cloud map and integration into the TUM Autonomous Motorsport software stack
- Documentation and visualization of the results

Qualifications

You should be able to independently familiarize yourself with the topic and the tools and have a structured way of working. You should be motivated to work in a fast-paced environment and eager to collaborate with a highly motivated team of students and Ph.D. candidates. Ideally, you have programming experience in Python and C++ and know the ROS2 framework and Docker.

Contact

If you are interested in this project, send your CV, transcript and a short motivation to:

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