State estimation for a small ground vehicle using heterogeneous sensor measurements

TECHNISCHE UNIVERSITÄT DARMSTADT

Project Seminar (2-3 students)

In robot applications like automated driving, an accurate and robust estimation of the current robot state is essential. Usually, measurements from a variety of sensors are available, which need to be combined to provide more accurate estimates, as well as estimates of states that can't be measured directly.

In this project seminar, a state estimator for a CogniTeam Hamster within the new Lab at CCPS should be realized. The CogniTeam Hamster is a small 4-wheel ground robot equipped with proprioceptive sensors (3-axis 9-DoF IMU and wheel encoder), as well as a depth camera and a LiDaR for environment sensing. The Lab is equipped with an OptiTrack motion tracking system, which can be used for validation, as well as an additional input to the estimator.

"Hamster"

Tracking camera

The goals are:

- Implement position estimators (e.g., Kalman filter, Moving Horizon Estimation) that only use proprioceptive sensors and evaluate their performance with the tracking system.
- Improve the estimator by incorporating global position data from the tracking system. The new estimator needs to deal with variable time delays of the data from the different measurement sources.
- The estimator should be robust against short outages of the tracking system data (e.g. due to occlusion of the robot from the tracking cameras).

Good C++ or Python coding skills are required. Adherence to coding conventions and best practices is part of the assignment and grading criteria. Experience using Linux/ROS is helpful.

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