Sensor Fusion and SLAM optimization for an autonomous electric race car

We are looking for motivated master students Engineering Technology

Project description:

Formula Electric Belgium (**FEB**) is a team of highly motivated engineering students that build an electric formula student race car. Just like Formula 1 the team builds a brand-new car each year to compete in multiple international competitions during the race season. Formula Student is the largest international engineering and design competition in the world. The competition is characterized by combustion vehicles, electric vehicles and since recently also autonomous vehicles. Formula Electric Belgium strives towards innovations and the raw performance of technologies. It is for this reason that the team will focus on the autonomous/electric race cars. Research and development applications will be made by postgraduate students in collaboration with thesis students from the KU Leuven and bachelor students from Thomas More.

Thesis description:

An autonomous software for a driverless electric race car is composed of three algorithms: **Track Landmarks Detection**, **Car Localization and Landmarks Mapping**, and **Car Control**. The first two blocks perform a sensor fusion to simultaneously localize the car on the track and map the track landmarks. The Car control block aims to simultaneously keep the car within the track limits and maximizing the speed.

This year, we developed a Track Landmarks Detection algorithm and a **SLAM** (Simultaneous Localization and Mapping) algorithm using two sensors: a **LiDAR** and **INS/GNSS** device. The performances of these two algorithms are evaluated based on two criteria: the **position accuracy** and the **reliability**. In normal conditions, the fusion of the LiDAR and INS/GNSS device provide an accurate tracking of the car position and track landmarks. However, a failure of one of these two sensors will lead to an immediate loss of the tracking, which is not an option.

Combining and improving both accuracy and reliability can be reached by adding **redundancy** in the sensing process, **diversifying** the sensing process, and enhancing the **sensor fusion**. Targeting these improvements will be the core of this thesis.

Thesis objective:

This thesis aims to improve the overall performances of an operational algorithm by optimizing the existing resources and by bringing upgrades.

Here is a non-exhaustive list of tracks to investigate:

- Sensor position and mounting optimization
- Sensor fusion of 2 LiDAR's
- Sensor fusion of Camera and LiDAR
- Sensor fusion of INS/GNSS and Ground Speed sensor
- Include the physical constraints of the car motion (eg. by measuring the wheel-speed and steering angle)
- 'Doppler effect' observed when the car is in motion

The results will be validated with tests in real conditions.

Profile:

- Interested in Signal Processing and SLAM algorithms. A background in these fields is preferred.
- **Creative/Innovative**
- Teamplayer

Are you interested? Please send your resume with accompanying motivation to:
recruitment@formulaelectric.be
Diestsesteenweg 692, 3010 Kessel-Lo

- C++, Python, Matlab

What do you gain?

- A unique engineering– and team experience where hard work and team atmosphere are central.
- Work with innovative technologies in a realistic environment/application.
- Create added value for your curriculum and the team

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