Car control algorithm for a formula student 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 car is composed of three main algorithms : track landmarks detection, car localization and landmarks mapping, and car control.

The estimation of the cone position position and their color detection is performed by the sensors fusion of a LiDAR and cameras.

The localization of the car and the mapping of the cones is performed by a Simultaneous Localization And Mapping (SLAM) algorithm. It works simultaneously with a Data Association process stating whether a detected cone by the sensors is a newly detected cone, or a cone already mapped in the virtual environment.

The car control algorithm provides the command the car needs to apply. The algorithm can be divided into two parts. The first part is a **Trajectory-Planning** algorithm that computes a reference trajectory, the middle of track, based on the virtual environment built. The second part is a **Model Predictive Contouring Control** (MPCC) that makes the trade off between maximising the speed on the track and following the reference trajectory, based on a theoretical model of the race car. The **MPCC** algorithm is providing commands, that are throttle, brake and steering wheel, to the car.

Thesis objective:

There are many different algorithms that provide controls for an autonomous car, e.g. https://www.sciencedirect.com/science/article/pii/S2405896319322566. Only one has been implemented for now.
The first part of the car control algorithm, **Trajectory-Planning** algorithm, is common to several autonomous software as it only computes a theoretical path. This thesis is about the second part, and you need to search, implement, and evaluate an algorithm providing **car commands** (throttle, brake steering) for a race car. The focus is on the second part. You start with the theoretical model of the race car and you need to provide an algorithm that is computing the controls to apply.

Here below are listed the different objectives of the thesis :

- Research part : Find a car control algorithm for an autonomous car to investigate, supported by strong motivations (memory usage, running time,...).
- Implementation part : Implement the chosen algorithm in the autonomous system.
- Evaluating part : Define well chosen criteria to test your control algorithm and the existing one, and compare both car control algorithms based on the same theoretical model of the race car. Report then the performances of your **car command** algorithm, according to the defined criteria, supported by complete explanations.

Profile:

- Interested in autonomous software

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

- Can work in iteratively
- Creative
- Teamplayer

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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