ZURICH UAS RACING

Enhancement of a Driverless System for a Formula Student Vehicle

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Formula Student (FS)

The internationally highly regarded engineering competition Formula Student (FS) challenges teams of students to design and build a formula racing car and compete against other universities in various disciplines. The various competitions offer an exceptional opportunity for students to apply their academic knowledge in a practical setting.

Introduction Project-Thesis

Zurich UAS Racing is developing its first race-ready, autonomously driving Formula Student Driverless (DV) race car for the 2026 season. To ensure competitiveness, the project focuses on integrating essential components of the driverless system—including perception, localization, trajectory planning, and control—into a cohesive and robust software pipeline. This integration is crucial for achieving reliable and high-performance autonomous behavior in the demanding environment of Formula Student competitions.

The main goal of this thesis is to implement a fully functional driverless module for a Formula Student race car. This includes the integration of key subsystems such as Simultaneous Localization and Mapping (SLAM), trajectory generation, perception, and mission planning. The ultimate objective is to establish a complete, tested, and competition-ready driverless software pipeline capable of autonomous racing.

Goal

Depending on the chosen area of contribution, the project work may focus on one of the following core domains:

Perception Pipeline Integration

- Sensor data acquisition and synchronization (LiDAR, camera, GPS, IMU).
- Cone detection and classification algorithms.
- Data preprocessing and object tracking.

SLAM and Localization

- Implementation and tuning of SLAM algorithms suitable for dynamic environments.
- Sensor fusion for robust real-time localization.
- Mapping and loop closure strategies.

Trajectory Generation and Motion Planning

- Real-time trajectory planning based on perception and localization input.
- Collision-free path generation with optimization for speed and smoothness.
- Integration with vehicle dynamics constraints.

Mission Planner and State Machine

- Design of the high-level mission planner for race phases (start, exploration, lap).
- Development of a state machine to manage behavior and fail-safes.
- Interface with other modules for coordination and control logic.

Objectives

- **Working implementation** of the selected module (perception, SLAM, planning, or mission control).
- **Integration** with the overall driverless pipeline.
- **Documentation** of design decisions, implementation, and validation results.

If you are interested in this project thesis, we kindly ask you to get in touch with us:

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