ZURICH UAS RACING

Development of Front Wing of a Formula student Car

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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 Bachelor-Thesis

Aerodynamics is a decisive factor for the performance of a Formula Student vehicle, directly influencing handling, efficiency, and lap time. Among all aerodynamic components, the front wing plays a critical role in generating front axle downforce, controlling the airflow to the undertray and sidepods, and ensuring aerodynamic balance with the rear of the car.

For the upcoming 2027 Formula Student season, a new ruleset will introduce design changes and additional constraints that significantly affect the aerodynamic package. To meet these requirements, this Bachelor Thesis focuses on the design, simulation, and validation of a new front wing that complies with the updated regulations while improving overall aerodynamic performance.

The project will combine CFD and FEM analyses to achieve an optimal balance between aerodynamic efficiency, structural rigidity, and adjustability, contributing directly to the development of the team's next-generation Formula Student car.

Goal

The goal of this project is to develop, simulate, and validate a front wing concept that fulfils the new Formula Student 2027 ruleset and integrates seamlessly into the vehicle's complete aerodynamic concept.

The design should aim to increase downforce and flow quality, particularly improving the aerodynamic interaction with the undertray, sidepods, and front wheels. In addition, the wing must satisfy requirements for structural stiffness, manufacturability, and adjustability, ensuring optimal on-track performance.

The results of this thesis will form a core part of the team's aerodynamic development process, providing validated data and design guidelines for the full aero package.

Objectives:

- **Regulation Review:** Analyse the 2027 Formula Student ruleset to define design boundaries and constraints relevant to front wing development.
- **Concept Development:** Generate and assess multiple front wing concepts regarding aerodynamic performance, manufacturability, and integration into the vehicle.
- **CFD Simulation:** Conduct computational fluid dynamics analyses to evaluate downforce, drag, and flow behaviour around the front wing, wheels, and sidepods.

- **Structural Analysis:** Perform FEM simulations to examine stiffness, strength, and deformation under aerodynamic loads.
- **Design Optimization:** Optimize the wing geometry and mounting system for aerodynamic efficiency, structural rigidity, and ease of adjustment.
- **Collaboration:** Work closely with the aerodynamics team to ensure smooth aerodynamic interaction with other vehicle components.
- **Documentation:** Summarize all findings, methodologies, and results, and provide detailed recommendations for manufacturing and integration into the new car.

If you are interested in this project thesis, we kindly ask you to get in touch with us:
David Margreth - Teamleader Mechanics, **Teams**: margrdav,
E-Mail: david.margreth@zurichuasracing.ch