ZURICH UAS RACING

Research, Simulation, and Testing of Aramid and Carbon Fiber Composites for Formula Student Vehicle Applications

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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

Lightweight composite materials are essential for achieving high performance and efficiency in Formula Student race cars. In particular, carbon fibre and aramid fibre (Kevlar) composites enable a superior combination of stiffness, strength, and energy absorption, making them ideal for critical components such as the monocoque, aerodynamic structures, and accumulator housing.

To fully leverage these advantages, a deep understanding of how different layups, core materials, and manufacturing processes influence mechanical properties is required. This Bachelor Thesis therefore focuses on the investigation, simulation, manufacturing, and experimental testing of aramid and carbon fibre composites.

The results will provide valuable insights into the relationship between material configuration, process, and structural performance, forming a key foundation for future use of composite materials in the team's chassis and aerodynamics development.

Goal

The goal of this project is to evaluate and compare different composite materials and processes, focusing on aramid and carbon fiber laminates, to determine the most effective configurations for Formula Student applications such as the monocoque and accumulator structure.

Through a combination of literature research, FEM simulations, and experimental validation, the thesis will deliver reliable material data, validated simulation models, and practical process recommendations. This work directly supports the team's long-term goal of developing a full carbon monocoque and improving impact-resistant, lightweight composite structures.

Objectives:

- **Research:** Analyse existing composite materials and manufacturing methods, including prepreg, vacuum infusion, and hand layup processes.
- **Material Selection:** Review materials currently used within the Zurich UAS Racing Team and evaluate alternatives available on the market.
- **Simulation:** Perform FEM simulations of aramid and carbon composite layups with different fibre orientations, core materials, and resin systems.
- **Manufacturing:** Produce composite test samples using selected processes (e.g., prepreg, infusion, or sandwich structures).

- **Testing:** Conduct mechanical tests such as three-point bending, shear punch, and tensile tests to determine stiffness, strength, and failure modes.
- **Validation and Evaluation:** Compare simulation and experimental results to verify material models; assess process quality and identify the most suitable process for future composite components.
- **Documentation:** Summarize all findings, methods, and results; provide design and process recommendations for future Formula Student applications.

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