

Design and Development of a Damper Test Rig for the Formula Student Electric 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 Bachelor-Thesis

The damper system has a decisive influence on the handling, comfort, and stability of a Formula Student vehicle. Its behaviour determines how the car responds to road irregularities and load transfers, directly affecting lap time and driver confidence.

Accurate knowledge of the frequency- and velocity-dependent damping characteristics is essential for realistic simulation models and for the later optimization of suspension setup on track. To achieve this, a dedicated damper test rig must be developed that enables controlled, repeatable, and precise measurement of damper performance.

This thesis therefore focuses on the conceptual design and realization of a damper test bench that will serve as a long-term development tool for vehicle dynamics simulation and suspension tuning within the Formula Student Electric Vehicle project.

Goal

The goal of this project is to develop and build a functional damper test rig to experimentally determine the damping characteristics of the Formula Student Electric Vehicle. The resulting data will enable the parameterization and validation of vehicle dynamics and suspension models, providing a solid foundation for future simulation and on-track optimization.

Objectives:

- **Concept Research:** Analyse existing damper test rig concepts (hydraulic, mechanical, electromechanical).
- **System Design:** Develop a mechanical and mechatronic concept capable of exciting the damper with defined velocities and frequencies.
- **Component Design:** Design essential components including the damper mount, guide system, load measurement, and actuation unit.
- **Sensor Integration:** Select and integrate appropriate sensors for displacement, velocity, force, and temperature measurement.
- **Measurement and Evaluation Routine:** Develop data acquisition and processing routines to determine damper maps and frequency response functions.
- **Testing:** Conduct initial functional or calibration tests to validate the setup.

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

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