

Concept and Development of Test Benches for Gearbox and Motor 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

Testing and validation are essential to ensure the reliability, efficiency, and performance of a Formula Student powertrain. Both the gearbox and electric motors are critical components that directly influence the car's acceleration, drivability, and overall system robustness.

To achieve high confidence in design and simulation results, these components must be tested under realistic operating conditions. This requires the development or adaptation of dedicated test benches capable of replicating load conditions and capturing detailed performance data.

This Bachelor Thesis therefore focuses on the conceptual design, modification, and realization of test benches for the gearbox and electric motors of the Formula Student Electric Vehicle. The project plays a key role in building a foundation for future powertrain validation and optimization, ensuring that the vehicle's performance on track is predictable, safe, and efficient.

Goal

The goal of this project is to develop and implement test bench solutions for the gearbox and electric motors of the Formula Student Electric Vehicle. These setups should enable controlled testing, accurate measurement, and systematic evaluation of drivetrain performance and durability. The results of this work will provide a validated basis for powertrain optimization, simulation model calibration, and further controller development, forming an essential step in the team's long-term testing and validation strategy.

Objectives:

- **Research and Analysis:** Research existing test bench concepts for electric motors and gearboxes used in industry and Formula Student.
- **Concept Development:** Create a detailed concept for both the gearbox and motor test benches, defining requirements for load application, measurement accuracy, and safety.
- **Design and Construction:** Design or adapt existing setups to meet Formula Student-specific requirements (mounting interfaces, torque range, rotational speed, and cooling).
- **Instrumentation and Control:** Select appropriate sensors and data acquisition hardware for torque, speed, temperature, and efficiency measurement.
- **Testing and Validation:** Perform initial tests to verify setup functionality, measure gearbox efficiency and motor characteristics, and analyse results.
- **Documentation:** Provide complete documentation of concept, design, test procedures, and evaluation results, including recommendations for future use or expansion.

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

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