

# Investigation and Parameterization of a Tire Model (Pacejka Magic Formula) for the 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 Bachelor-Thesis

Accurate tire modelling is one of the most critical aspects of vehicle dynamics simulation. The behaviour of the tire directly influences handling, stability, and overall vehicle performance, making it a key component in control systems development such as traction control or torque vectoring. The Pacejka "Magic Formula" is a semi-empirical model widely used in motorsport and automotive engineering to describe tire forces as a function of slip, load, and other operating conditions. For Formula Student vehicles, a properly parameterized model enables realistic simulation of cornering and acceleration dynamics, providing valuable insights into car setup and performance optimization.

This thesis aims to develop, parameterize, and implement a Pacejka tire model specifically for the team's Formula Student vehicle, based on available tire data such as the FSAE Tire Test Consortium dataset.

## Goal

The goal of this project is to create or adapt a tire model based on the Pacejka Magic Formula for use in the team's vehicle dynamics simulations. The model should be parameterized using relevant tire data and validated to ensure realistic force generation behaviour under varying load and pressure conditions.

## Objektives:

- **Literature Review:** Study and understand the theoretical background of the Pacejka "Magic Formula" tire model.
- **Data Analysis:** Use published Formula Student tire data (e.g., FSAE Tire Test Consortium) for model parameterization.
- **Model Implementation:** Implement the model in MATLAB or Python for use in vehicle dynamics simulations.
- **Parameter Study:** Investigate the influence of parameters such as vertical load, inflation pressure, and slip angle on lateral and longitudinal forces.
- **Validation and Evaluation:** Compare simulated tire behaviour with available experimental data to assess accuracy.
- **Documentation:** Provide complete documentation of model development, parameterization process, results, and recommendations for future use.

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

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