

How engineers will learn from motorcycle tires

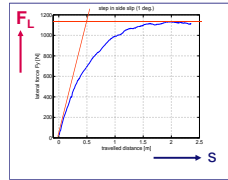
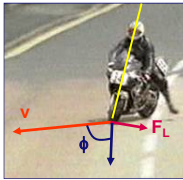


Dr. Koo J.J.M. Rijpkema
 TU/e – Department of Mathematics and Computer Science,
 j.j.m.rijpkema@tue.nl, tel. +40-247 3170/3130

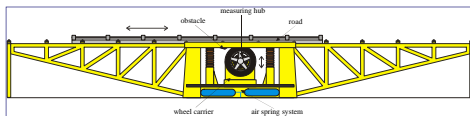


Introduction

For the controllability of a motorcycle the tire-road contact is crucial. With a rapid steering maneuver contact forces are generated dynamically:



Through a multidisciplinary project participants have to determine experimentally how the vertical load and tire pressure affect these contact forces. They have to plan, perform and analyze a number of experiments on a full scale experimental setup, the flat plank tire tester:



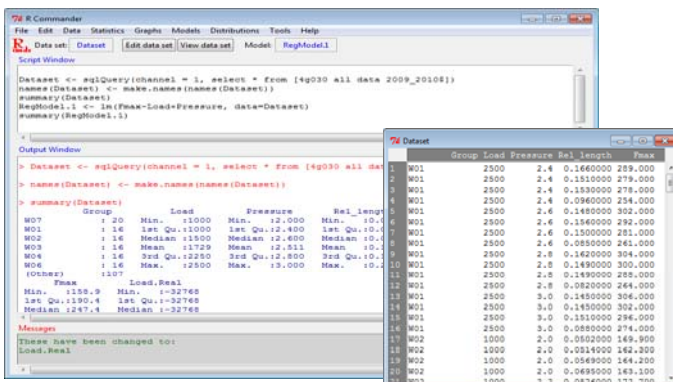
Results obtained have to be analyzed and compared with results from other groups. Finally, results of all groups are combined into a large predictive model, to be discussed in full detail.

Learning Objectives

- Learn how to design, execute and analyze (physical) experiments.
- Use adequate statistical techniques and software tools to analyze the experimental data.

Statistical Software

- As this project is the students' first introduction to computer aided statistical analysis, they primarily will use **R Commander** for editing, exploring and analyzing the experimental data:

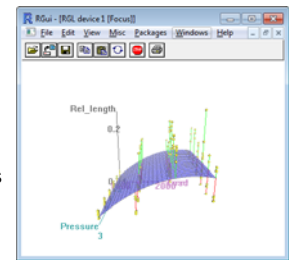


Assignments

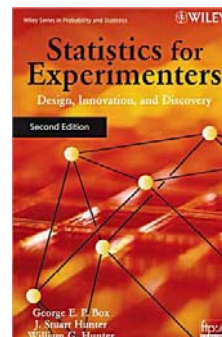
- Design and plan an adequate (physical) experiment and prepare an appropriate experimental protocol.
- Perform the experiment in the Automotive Lab:



- Analyze the data obtained:
 - Perform an Exploratory Data Analysis
 - Model the measured dynamic curves.
 - Estimate the relevant characteristics, such as relaxation length and maximum vertical force.
 - Build a model to predict these characteristics as a function of tire pressure and vertical load.
 - Use the model developed to achieve desired specifications for the tire-road contact (inverse prediction).



Next Steps...



- More advanced courses on Engineering Statistics and Design of Experiments.
- Use **R** for customized analyses!
- Use and "taylor" relevant packages, like:
 - BHH2,
 - DoE.base & DoE.wrapper,
 - rsm
 - R.matlab

References:

- Groemping, U. (2009). *Design of Experiments in R*. Presentation at User! 2009 in Rennes, France.
- Lenth, R.V. (2009). Response-Surface Methods in R, Using rsm. *Journal of Statistical Software* 32 (7), 1-17.
- Vikneswaran (2005). An R companion to "Experimental Design".