SUCCESS STORY

TracEst
Traction Estimation → Wheel-Rail Friendly Transmission of Traction and Braking Forces

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: K2 COMET-Project

Type of project: TracEst, 36 months, multi-firm

Abbildung 1: ViF_DepR_Railway Systems @ Virtual Vehicle Research Center

PATENTED ONLINE-ESTIMATION OF THE TRACTION IN THE WHEEL-RAIL CONTACT

HOW THE TRACTION WAS IMPROVED BY 4.5% BY CHANGING THE CONTROL DEVICE STRATEGY

The traction coefficient characteristic within the wheel-rail contact has a high influence on the vehicle-track interaction in general. Especially with respect to drive train/vehicle dynamics, transmission of traction/braking forces, safety against derailment, running stability, ride comfort, and the development of wheel-rail wear and damage, this characteristic takes on a key role. Due to the still increasingly importance of prediction models during the development process of railway vehicles as well as during the operation of the vehicles (e.g., with respect to drive train control and maintenance), reliable wheel-rail creepforce models are of high interest.

The classical theory, which is implemented in almost all Multi Body System (MBS) software packages available on the market, assumes Coulomb's law of friction with a constant coefficient of friction. The disadvantage of this model approach is that it is not able to describe effects like falling traction at high creepages, dependency of the maximum traction coefficient on vehicle velocity and axle load etc. But these effects have a high influence on the overall dynamic behaviour of the system. Phenomenological approaches to describe them are available but they can only be parameterized for certain boundary conditions, e.g., operating conditions (loading, vehicle velocity, curving, etc.) and surface conditions (dry, wet, greased, friction modifier, etc.). If these

Federal Ministry Republic of Austria Transport, Innovation and Technology

Federal Ministry Republic of Austria Digital and Economic Affairs

Version 01/2019

conditions change, a new set of parameters must be found.

Therefore, a novel creepforce model has been developed. This Extended Creep Force (ECF) model can describe the main effects known from measurements. Furthermore, it can describe steady state and unsteady state effects. The ECF model shows a good quantitative agreement with the experimental results even if the boundary conditions change (without the need for re-parameterization) and is used to estimate the traction coefficient characteristic, based on as few as possible practically measureable quantities.

In addition to the traction estimation, the occurrence of drive-train oscillations was investigated depending on vehicle speed, friction, and control parameters to avoid unstable operating points. Hence, it was possible to define stable regions where these oscillations can be avoided.

Impact and effects

The traction estimation and the drive-train oscillation investigations were then used as basis for a creepage demand algorithm for use in a traction control device. To validate the algorithm, vehicle tests were performed at the Test Centre VUZ Velim in Czech Republic. There, the traction was measured for the standard and the modified control strategy. The results are shown in Figure 1.

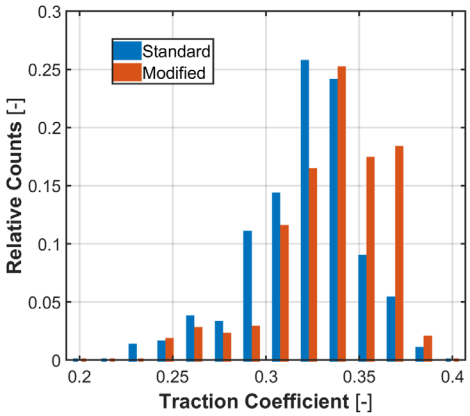

Figure 1: Traction coefficients during testing for the standard and the modified control strategy © Virtual Vehicle Research GmbH.

By modifying the control strategy, it was possible to increase the average traction significantly during the testing. These results were the basis for a patent that was issued in 2018.

Project coordination (Story)
DI Dr. Alexander Meierhofer
Researcher
Railway Systems

T +43 (0) 316 873 - 4046
Alexander.meierhofer@v2c2.at

Virtual Vehicle Research Center
Inffeldgasse 21a
8010 Graz
T +43 (0) 316 873 9001
info@v2c2.at
www.V2C2.at

Project partner

- L.B. Foster Rail Technologies, Canada
- Siemens Mobility GmbH, Austria
- Siemens Mobility GmbH, Germany
- Voestalpine GmbH, Austria
- ÖBB Infrastruktur AG, Austria
- SBB AG, Switzerland
- Institute of Applied Mechanics, Austria
- Institute of Automation and Control, Austria

This success story was provided by the consortium leader/centre management and by the mentioned project partners for the purpose of being published on the FFG website. Further information on COMET: www.ffg.at/comet

Federal Ministry
Republic of Austria
Transport, Innovation and Technology

Federal Ministry
Republic of Austria
Digital and Economic Affairs

Austrian Research Promotion Agency
Sensengasse 1, A-1090 Vienna
P +43 (0) 5 77 55 - 0
office@ffg.at
www.ffg.at