The Foundation of the DLR RailwayDynamics Library: the Wheel-Rail-Contact

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The formulation of the wheel-rail contact is a crucial issue in simulations considering the running dynamics of railway vehicles. Therefore a modeling environment that is dedicated to railway vehicle dynamics such as the new DLR RaiwayDynamics Library relies on an efficient representation of the kinematics and forces or torques, respectively, that appear at the wheel-rail interface. In order to give an impression on the geometry and the physics Fig. 1 presents a wheel-rail contact patch and the associated normal stress distribution.

A number of different formulations have been developed since the underlying rolling contact problem was firstly discussed in literature in 1876 [1]. The paper overviews these wheel-rail contact formulations in order to motivate the model, that has been chosen for implementation, namely a quasielastic ellipitical single point contact [2] with tangential force law according to *Polach* [3]. This model is then presented in detail.

Finally, the DLR RailwayDynamics Library is used to model and simulate the behavior of an experimental scaled M 1:5 running gear operating on the DLR roller rig, see Fig. 2. The simulations results are compared and validated with measurements.

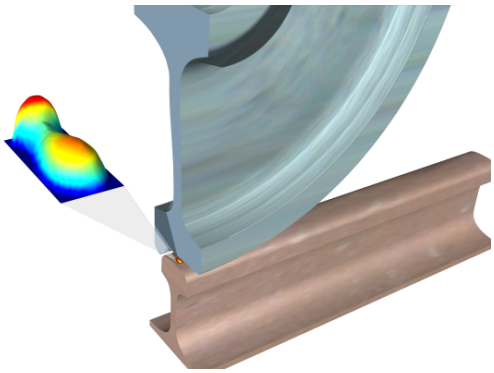

Figure 1: Examplary wheel-rail contact patch and the associated normal stress distribution

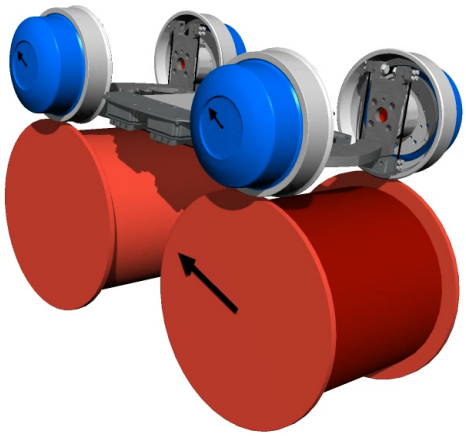

Figure 2: An animation of DLR's M 1:5 roller rig with experimental running gear

References

[1] K. Knothe. History of wheel/rail contact mechanics: from Redtenbacher to Kalker. *Vehicle System Dynamics*, 46(1-2):9–26, 2008.

[2] H. Netter, G. Schupp, W. Rulka, and K. Schroeder. New aspects of contact modelling and validation within multibody system simulation of railway vehicles. *Vehicle System Dynamics*, 29(S1):246–269, 1998.

[3] O. Polach. A fast wheel-rail forces calculation computer code. *Vehicle System Dynamics*, 33:728–739, 2000.