Master thesis project at Chalmers Division of Dynamics for 1 – 2 students

Railway wheel tread damage – identification and consequences:

Advanced numerical analyses and in-field measurements

The proposed thesis project aims at assessing damage in railway wheels and axles. It builds on in-field measured data that are combined with numerical simulations using the FE software ABAQUS and an in-house software for predicting wheel–rail impact loads.

Railway wheels with damage on the running surface (tread) generate repeated impacts in the wheel–rail contact that may lead to fatigue failure of wheelsets and track, and in the worst-case scenario a train derailment. Examples of tread damage are flats (due to sliding of the wheel on the rail) and clusters of broken out wheel material due to rolling contact fatigue (see figure). The wheel–rail contact loads depend on the form and shape of the damage, train speed, and on the characteristics of the dynamic vehicle–track system. Contact forces are regularly detected using so-called wheel impact load detectors (WILD) that are distributed along the track within the railway network. A detector triggers an alarm if the measured load exceeds a pre-defined limit load. One key issue is if a measured load can be translated to a (probable) form and severity of tread damage. How can detection be improved to avoid false alarms and what are realistic alarm limits?

In the first part of this thesis work, data from different detectors will be compared. For a given wheel with a specific damage, what is the influence of train speed and do different detectors measure the same magnitude? Is it possible to detect a wheel with an early stage of damage before the detector triggers an alarm that will stop traffic? An important aim is to increase the confidence and understanding of data registered by these detectors.

In the second part, the influence of increased load levels on the risk of wheelset failure will be determined using finite element models to be developed in the commercial FE-software ABAQUS. An in-house software RAVEN that is based on structural dynamics models of the wheelset and track will be applied to predict impact loads that are compared to corresponding loads measured in WILD. Stresses in the wheelset (see figure) and the risk for failure due to fatigue will be determined to guide the selection of WILD alarm limits.

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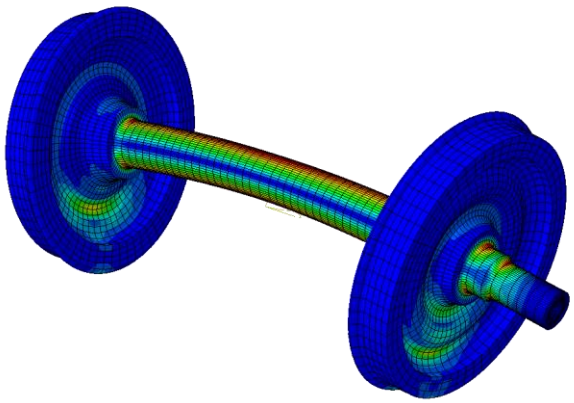

Figures: Clusters of wheel tread damage (left), and calculated stress distribution in a wheelset (right)