Universität Stuttgart

Institut für Nichtlineare Mechanik

Master thesis

Modeling and Simulation of the Defects on Rail Wheels for Analyzing Vibration Signals

The detection of faults and defects in both railway tracks and rolling stocks is an extremely time consuming and expensive process which ensures the safety of railway systems. In order to reduce the related costs the potentials of online-monitoring systems are an important field of research which aims to detect faults at an early stage. To this end, sensors are placed in different locations of the structure under consideration and the signals are analyzed.

The thesis focuses on the simulation of rail wheel defects. A multi-body simulation model of a train is used in conjunction with a finite element model of the rail wheel including a small geometric defect. The resulting vibrational signals at different locations of the respective bogie have to be identified by means of the simulation. Since the signals will depend on different assumptions such as the rotational speed and the geometry of the defect but also on numerical parameters such as the FE discretization and the time-integration scheme, an adequate method to analyze the signals has to be developed. At the same time, limitations and requirements of the numerical model have to be taken into account.

Within this thesis the following tasks have to be carried out:

- get familar with the software tools Simpack, Abaqus, Matlab and their interfaces
- review existing methods to detect faults and analyze the advantages and disadvantages
- set up the complete simulation tool from different components already existing
- run simulations and detect the respective acceleration signals for different parameters
- generate signals that are disturbed by different sources such as white noise or vibrations of specific different frequencies
- investigate and refine possible wavelet-transformation based methods to analyze the data aiming at a reliable prediction of the fault

Areas of work:	multibody simulations, finite element method, signal processing
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Examiners:	Prof. Dr. R. I. Leine Prof. Dr. U. Martin
Precognition:	knowledge of at least two of the related topics