Master Thesis

Structural dynamic model of railway switches for optimization of continuous monitoring system

Motivation

Konux is a Munich-based AI startup developing an IIoT Predictive Maintenance solution for railway infrastructure. We install a continuous monitoring system on railway switches (e.g. sensors placed on the sleeper measuring acceleration caused by passing trains) to monitor the health condition of the switches and, ultimately, to make recommendation on the optimal maintenance actions. For understanding the dynamic behavior of the monitored switches, interpretation of the signal and further development of the sensing system, structural dynamics model of the switch is needed. However, due to the complexity of problem, a preliminary investigation on the nonlinear interaction between the wheel, the railway and the underlying soil is necessary.

Fig. 1: Konux sensor

Fig 2. Spectral analysis of the acceleration signal

Tasks

The aim of this thesis is to further develop a formulation for the model of the railway-soil system [1, 2]. Using this model, the dynamic response of the railway-soil system to the excitation due to passing trains will be studied. Sensor data for the accelerations of the railway system are available and these contain information about the variability of the railway subsystems (design/construction types, geological conditions – properties of substructure and sub-grade), the effect of environmental conditions (e.g. temperature) and the impact of train/traffic characteristics. Finally, a concept for the integration of railway switches into the railway model, based on available sensor data, will be proposed. The thesis will be carried out at both the Chair of Structural Mechanics and at KONUX. It should preferably be written in English.

Project stages:

- Research on the state of the art and introduction into the methods to be used
- Introduction into the existing FEM program implemented in MATLAB
- Development of the dynamic load/excitation model
- Correlation of the model behavior with the available data
- Proposal for the integration of railway switches into the FEM model of the railway system


External supervisor: Olga Spackova, olga.spackova@konux.de, KONUX GmbH, Flößergasse 2, 81369 München

TUM Supervisor: Francesca Taddei (Raum N1152), francesca.taddei@tum.de