Elastodynamic Wave Propagation in Rail Tracks

BSc-thesis, MSc-thesis or project/internship work
Electrical engineering / Computational engineering /
Numerical mathematics

TECHNISCHE UNIVERSITÄT DARMSTADT

Context: A train excites elastodynamics waves in the rail track. The track consists of rails, fasteners, railroad ties (or sleepers) and ballast. The system can be decomposed in waveguide parts and connections. The former are represented by waveguide modes with corresponding wave numbers and impedances. The latter are represented by additional impedances. In this respect, the track system has many similarities with a waveguide system for electromagnetic waves. This suggests exploiting well known techniques for electromagnetic waveguide systems to model rail tracks.

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Task: The occurring waveguide modes and associated wave numbers are calculated using a 2D cross-sectional finite-element solver. A mode matching technique is applied for bringing model parts together. In a first step, joints are modelled by reflection and transmission coefficients. The resulting transmission-line model is used to simulate the propagation of elastodynamic waves through long rail track systems. In a further step, the accuracy of the model will be increased by inserting S-parameters for the joints obtained from a 3D field solver.

Fig. 1: Rail track.

Prerequisites: Knowledge of electrodynamics or acoustics waveguides, programming skills, interest in numerical methods, fascination for wave theory.

Context: The thesis is co-supervised by Dr. Bart Van Damme of the Research Institute EMPA (www.empa.ch, Dübendorf, Switzerland). A visit to EMPA is foreseen. An internship in combination with this BSc or MSc thesis is possible.