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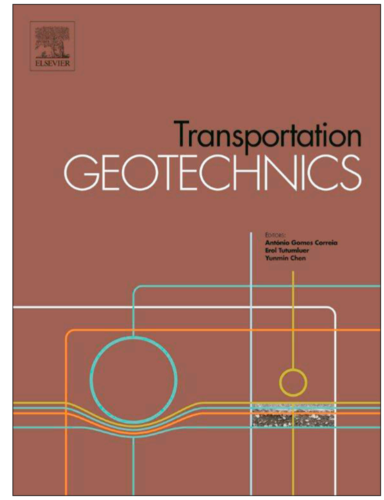

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Periodic track model for the prediction of railway induced vibration due to parametric excitation

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Abstract

Railway induced ground-borne vibration in urban areas has become a major environmental problem with large societal impact. Accurate computational models for the prediction of railway induced vibration generally require extensive modeling effort and computation time. To increase the computational efficiency, a large number of track models assume a simplified track structure in the longitudinal direction, therefore being unable to account for parametric excitation due to transition zones, hanging sleepers or spatially varying track or subgrade characteristics. This paper presents a track modeling approach based on a wave analysis technique for multi-coupled periodic structures that allows to efficiently model a track with varying characteristics in the longitudinal direction and, therefore, to predict railway induced vibration due to parametric excitation. The track is modeled by a finite number of track sections with different properties, while each section consists of periodic cells with the same properties. A case study is presented investigating a track with a transition zone between ballasted and slab track. The train-track interaction forces are computed, as well as the vibration of the sleepers, the slab and in the free field. The influence of the train direction and train speed is evaluated.

Keywords: Track modeling, parametric excitation, train-track interaction, railway induced vibration, transition zone

1. Introduction

To study railway induced ground-borne vibration, numerical track models are of great importance. The largest flexibility in modeling complex track and soil geometries is obtained by a fully three-dimensional (3D) finite element (FE) model [1, 2]. The infinite dimensions of the problem domain must be taken into account to avoid spurious reflections at the boundaries of the finite volume of soil. This is often solved by means of a coupled finite element-boundary element (FE-BE) approach [3, 4]. The main disadvantage of 3D models is that they require extensive modeling effort and computation time. A large number of authors

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