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PREDICTION OF RAILWAY INDUCED VIBRATIONS IN AN URBAN ENVIRONMENT

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The numerical prediction of railway induced vibrations is a challenging three–dimensional (3D) problem which involves various complex physical phenomena, such as the generation of dynamic loads at the railway track, wave propagation in the soil, and vibration transmission within buildings [1]. Computational restrictions as well as the lack of knowledge on appropriate model parameters necessitate the introduction of simplifying assumptions in numerical models.

A common assumption is related to dynamic through–soil coupling of neighbouring structures. This is often neglected in numerical models where only a single building is considered or several buildings are supposed to act independently. This assumption might not be valid in dense urban areas (where vibration annoyance is mostly experienced), as the distance between buildings is of the same order of magnitude as the wavelength in the soil in the frequency range of interest [2]. Rigorously accounting for through–soil coupling requires the solution of multiple 3D dynamic soil–structure interaction problems, however, which is computationally very demanding.

This paper addresses the prediction of railway induced vibrations in an urban environment. A numerical methodology which allows modelling an (idealized) city without jeopardizing the computational efficiency is presented. The model is based on an efficient two-and-a-half-dimensional (2.5D) coupled finite element–boundary element (FE–BE) approach [3], assuming invariance of the structures' geometry in the longitudinal direction. A spatial windowing technique in the wavenumber domain [4] is subsequently applied to the 2.5D results to account for the presence of multiple structures of finite length. This technique is employed to model wave propagation in a realistic setting of 90 non-equally spaced and non-equally sized buildings, considering three different soil profiles. It is shown that the wavefield in the soil and the structural response are significantly affected by the presence of surrounding buildings.

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