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REDUCED ORDER SOURCE MODEL FOR RAILWAY INDUCED VIBRATION BASED ON THE PROPER GENERALIZED DECOMPOSTION

G. Herremans*, S. François and G. Degrande

KU Leuven, Department of Civil Engineering, Structural Mechanics Section,
Kasteelpark Arenberg 40 box 2448, 3001 Leuven, Belgium,
geertrui.herremans@kuleuven.be

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A novel methodology is presented to efficiently assess dynamic axle loads for railway induced vibrations. The goal is the construction of a computational vademecum of the response, allowing for fast parametric studies on vibration mitigation. The methodology is elaborated for 2.5D track-soil models exploiting the geometrical invariance of the track. To this end, formulations based on finite elements coupled with boundary elements (BE) and perfectly matched layers (PML), have been developed. Multi-parameter studies involving all track design parameters, however, remain expensive in terms of CPU time and memory. This curse of dimensionality is tackled by means of an a priori model order reduction technique, namely the Proper Generalized Decomposition (PGD) [1].

The PGD formulation is based on the assumption of a separable form of the multidimensional field [1]. Each contribution therefore consists of a rank-1 tensor and is computed in a greedy manner. To this end, the PGD formalism is introduced into the weak form and the resulting non-linear problem is solved using fixed point iterations.

The methodology is elaborated for 2.5D track models consisting of beams connected to a Winkler foundation. An analytical Euler-Bernoulli formulation and a finite element model are used for the beam. Apart from the frequency and longitudinal wavenumber, model parameters as the rail pad stiffness are included in the formulation. Damping terms result in non-Hermitian properties of the operator, hindering convergence of the standard Galerkin approach PGD. Therefore, alternative solution strategies, like Petrov-Galerkin based solvers, are considered [2].

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