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COMPUTING GREEN'S FUNCTIONS IN TWO-DIMENSIONAL WAVE PROPAGATION USING PROPER GENERALIZED DECOMPOSITION

T. Alexiou*, **P. Reumers, G. Degrande, and S. François**

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

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A Proper Generalized Decomposition (PGD) formulation is used to approximate the Green's functions for the two-dimensional (2D) in-plane (P-SV) and out-of-plane (SH) elastodynamic problems. These fundamental solutions are important for the analysis of wave propagation. Moreover, a large number of source-receiver combinations is required to serve as input for boundary elements in dynamic soil-structure interaction (SSI) problems, especially for embedded structures. Utilizing PGD, the solution is decomposed to low-dimensional functions in successive enrichment steps [1], resulting in reduced storage requirements. In this work, the 2D P-SV and SH wave propagation problems are considered in the frequency-wavenumber domain, where the soil is discretized using the thin layer method (TLM) [3]. First, the solution is separated in 1D functions representing the effect of source and receiver depths z_s and z_r, as well as the wavenumber k_x. Second, the frequency ω is also incorporated in the formulation and treated as a separated variable. The enrichment functions are computed using progressive Galerkin-based PGD [2] employing a fixed point iteration scheme within each enrichment step. The methodologies are applied for the cases of a (layered) halfspace and of a layer on rigid bedrock. First, convergence of the PGD solvers and the separability of the variables are explored at a fixed frequency. Then, the discussion extends to the more complex case of decomposing the solution in the frequency domain, applying the second PGD formulation. The quality of the approximation, as well as the convergence of the scheme are investigated, showcasing the difficulties that may arise when the number of variables increases. Finally, memory requirements are discussed for each case and formulation.

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