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# SIMULATION OF GUIDED WAVES IN SOLIDS USING THE SCALED BOUNDARY FINITE ELEMENT METHOD

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Guided waves can be excited in thin-walled structures, i.e. when the thickness of the structure is of the same order as the wavelengths of longitudinal and shear waves in the material under consideration. In the ultrasonic range, guided waves offer applications in non-destructive testing [1], structural health monitoring or material characterization [2]. On a different scale, similar wave phenomena are observed in soil layers [3] or dams [4] and are considered in geophysics and earthquake engineering. In this paper, a highly efficient approach for the simulation of guided waves is presented. The formulation is based on the Scaled Boundary Finite Element Method [5]. In particular, the current work focuses on the interaction of guided waves with cracks in the waveguide. The semi-analytical concept of the SBFEM allows for an elegant and accurate representation of the stress singularity at the crack tip [6]. For homogeneous (flawless) sections of the waveguide, only the cross-section is discretized, while the direction of wave propagation is described analytically [7, 8]. A stiffness matrix is derived that relates the degrees of freedom at both ends of the homogeneous section. To describe a long waveguide, a representative part of the structure is modeled and coupled to an unbounded domain. The stiffness matrix for the unbounded domain is also derived in terms of the SBFEM. For the discretization, higher-order spectral elements are employed to further reduce computational costs. Numerical examples demonstrate the applicability for problems in non-destructive testing. For instance, the simulation of the fundamental Lamb wave modes in a plate and their interaction with a crack can be performed using approximately 100 degrees of freedom - irrespective of the length of the plate.

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