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Semi-analytical integral approach for wave propagation simulation in layered composites with defects

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Mesh-based simulation of wave processes in lengthy multilayered composite structures with obstacles is a time consuming procedure due to complex wave patterns demanding too many mesh cells. Semi-analytical integral approach radically reduces the costs providing in addition physically clear insight into the wave structure. It is based on the integral representations in terms of Green's matrix for the composite structure as a whole obtained using the Fourier transform in time and space domains. Efficient algorithms of their calculation and far-field asymptotics have been elaborated, derived and computer implemented. The wave fields diffracted by obstacles are computed via the discretization of boundary integral equations that, in particular, allows investigation of spectral scattering resonance properties. Resonance trapping mode effect in a waveguide with delamination is simulated and experimentally validated as an example. The development of hybrid schemes combining local mesh discretization with the integral approach is discussed.

Keywords: layered composites, elastic waves, cracks, integral transform, Green's matrix