Shi, F.; **Lowe, M. J. S.**; **Skelton, E. A.**; **Craster, R. V.**

A time-domain finite element boundary integral approach for elastic wave scattering. (English) Zbl 1446.74148

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Summary: The response of complex scatterers, such as rough or branched cracks, to incident elastic waves is required in many areas of industrial importance such as those in non-destructive evaluation and related fields; we develop an approach to generate accurate and rapid simulations. To achieve this we develop, in the time domain, an implementation to efficiently couple the finite element (FE) method within a small local region, and the boundary integral (BI) globally. The FE explicit scheme is run in a local box to compute the surface displacement of the scatterer, by giving forcing signals to excitation nodes, which can lie on the scatterer itself. The required input forces on the excitation nodes are obtained with a reformulated FE equation, according to the incident displacement field. The surface displacements computed by the local FE are then projected, through time-domain BI formulae, to calculate the scattering signals with different modes. This new method yields huge improvements in the efficiency of FE simulations for scattering from complex scatterers. We present results using different shapes and boundary conditions, all simulated using this approach in both 2D and 3D, and then compare with full FE models and theoretical solutions to demonstrate the efficiency and accuracy of this numerical approach.

MSC:

74J20 Wave scattering in solid mechanics
74S05 Finite element methods applied to problems in solid mechanics

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