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Transient Dynamic Crack Analysis in Magnetoelectroelastic Materials

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Abstract

Magnetoelectroelastic materials have many advanced applications in smart devices and structures due to the coupling effects between the mechanical, electrical and magnetic fields. The electromagnetic coupling effect can be achieved by the concept of composite materials, either as layered or as particulate fiber composites, which combine and utilize the advantages of the most beneficial properties of each constituent. Since such composites are usually very brittle, static and dynamic crack analysis is an important issue to their design, optimization and engineering applications. Beside interior cracks inside the homogeneous domains, interface cracks may also play an important role in such composites. In this talk, transient dynamic crack analysis in two-dimensional (2D) and linear magnetoelectroelastic materials is presented. For this purpose, efficient time-domain boundary element method (BEM), extended finite element method (XFEM), and meshless local Petrov-Galerkin (MLPG) are developed and applied. Numerical examples are presented and discussed to verify the accuracy and the efficiency of the implemented numerical methods. The effects of the crack size, location and orientation, the magnetoelectroelastic coupling and the dynamic impact loading on the dynamic field intensity factors and the elastic wave propagation characteristics are investigated and discussed in details.

Keywords: Magnetoelectroelastic materials, transient dynamic crack analysis, impact loading, dynamic intensity factors, elastic wave propagation, time-domain BEM, XFEM, MLPG.