Analysis of an interface crack in two-dimensional piezoelectric materials under impact loading

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Abstract

Based on the extended finite element method (XFEM), the problem of interface crack propagation in two-dimensional piezoelectric materials under impact loading is analyzed. By embedding the enrichment techniques as well as the partition of unity method (PUM) into the standard finite element approximation spaces, discontinuity problems can be fully processed. The major difference between the XFEM and the conventional finite element method (CFEM) is that the mesh in XFEM is independent of the internal geometry and physical interfaces, therefore there is no meshing and re-meshing difficulty in discontinuous problems. In this work, the stress and electrical displacement fields around a crack are analyzed. By using the interaction integral method, the fracture parameters, consisting of the stress intensity factors and the electrical displacement intensity factor, are evaluated. The influences of the geometric dimensions and external loads on the field intensity factors are discussed. In addition, the crack propagation problem is studied. The distribution of stress and electric field around the crack is given, and the influence of impact loading on the crack extension is emphatically discussed. To assess the accuracy of the proposed approach, the results obtained are compared with the analytical solutions, and consistent results were obtained.

Keywords: Extended finite element method; Field intensity factor; Piezoelectric materials; Impact load; Crack propagation.