

压电材料平面裂纹尖端场的杂交应力有限元分析

周勇, 王鑫伟

南京航空航天大学智能材料研究所, 210026

收稿日期 修回日期 网络版发布日期 接受日期

摘要 基于复势理论和杂交变分原理建立了一种适用于机电耦合分析的杂交应力有限元模型. 给出了建立刚度矩阵的主要公式和推导过程, 单元内的位移场和应力场采用满足平衡方程的复变函数级数解, 假设的复变函数级数解事先精确满足裂纹的无应力和电位移法向分量为零的条件, 单元外边界的位移场假设按抛物线变化, 单元的刚度矩阵采用Gauss积分的方法得出. 通过对机电耦合裂尖场的数值计算验证了程序的正确性和单元的有效性, 同时也用所得结果校验了理论解.

关键词 [压电材料, 裂纹, 杂交有限元, 数值计算方法, 复变函数](#)

分类号

Analyses Of Crack-Tip Fields Of Plane Piezoelectric Materials By The Hybrid Stress Finite Element Method

南京航空航天大学智能材料研究所, 210026

Abstract

A hybrid stress finite element based on the complex potential theory and hybrid variational principle is proposed for mechanical-electrical coupling analyses. The formulations are given in detail in this paper. The complex series solutions satisfying the equilibrium equations and compatibility equations are chosen as the displacement and stress fields in the element domain. Assume that the series solutions satisfy exactly the traction free and the zero normal electrical displacement boundary conditions along the crack surface in advance. While the displacements along the element outer boundaries vary parabolically. The element stiffness matrix is then obtained by using the Gauss quadrature method. Numerical examples verify the accuracy of the program and the efficiency of the proposed element. Meanwhile, the theoretical results are verified by the finite element results.

Key words [piezoelectric material](#) [crack](#) [hybrid stress finite element](#) [numerical calculation](#) [complex function](#)

DOI:

通讯作者

扩展功能

本文信息

- ▶ [Supporting info](#)
- ▶ [PDF\(376KB\)](#)
- ▶ [\[HTML全文\]\(0KB\)](#)
- ▶ [参考文献](#)

服务与反馈

- ▶ [把本文推荐给朋友](#)
- ▶ [加入我的书架](#)
- ▶ [加入引用管理器](#)
- ▶ [复制索引](#)
- ▶ [Email Alert](#)
- ▶ [文章反馈](#)
- ▶ [浏览反馈信息](#)

相关信息

- ▶ [本刊中 包含“压电材料, 裂纹, 杂交有限元, 数值计算方法, 复变函数”的相关文章](#)
- ▶ [本文作者相关文章](#)

- [周勇](#)
- [王鑫伟](#)