Abstract

Title: ELASTODYNAMIC PROBLEMS UNDER MECHANICAL, THERMAL AND ELECTRICAL LOADING

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In this thesis we tried to examin elastic and magnetoelastic wave interactions with cracks using analytical and numerical methods under mechanical, thermal and electrical loading to derive fracture parameters, offering insights into stress distribution, crack behaviour, and fracture mechanics.

In Chapter 1 details literature survey was made and background of the problems considered in this thesis have been elaborately discussed.

Chapter 2 deals with the methods used in solving the problems associated with this thesis.

Chapter 3 investigates shear wave interactions with cracks in magnetoelastic media. Section 3.1 examines shear wave interactions with a finite crack in an infinite magnetoelastic medium, transforming the problem into a Fredholm integral equation. Section 3.2 analyzes the diffraction of a Griffith crack in an infinite strip under magnetoelastic shear waves, solved using Abel's transform. Section 3.3 addresses an impact load on a finite crack in an infinite medium with a magnetic field, deriving SIF and crack opening displacement (COD) through Laplace and Abel's transforms.

Chapter 4 explores thermoelastic crack problems. Section 4.1 develops a refined thermoelastic model incorporating higher-order time derivatives and phase lags to study a Mode-I crack in a rotating fiber-reinforced solid. Section 4.2 examines two collinear cracks in a transversely isotropic medium under a non-Fourier heat conduction law, deriving Mode-II thermal SIF and COD while comparing heat conduction models.

Chapter 5 studies Love wave propagation and scattering in layered media. Section 5.1 formulates a dispersion relation for Love waves in a multilayered viscoelastic orthotropic medium with initial stress, validating results against classical Love wave theory. Section 5.2 investigates Love wave scattering due to an interface crack in an orthotropic layer over an elastic half-space, deriving DSIF and COD expressions through Fourier transform methods.

Chapter 6 analyzes anti-plane shear waves interacting with collinear cracks in piezoelectric quasicrystals, deriving explicit expressions for dynamic SIFs, crack opening displacement, and electric displacement. The study emphasizes the role of electric boundary conditions on crack behaviour and examines phonon-phason coupling effects on wave scattering and crack stability.

These findings contribute to fracture mechanics, structural integrity assessment, and non-destructive testing, providing valuable insights into material behaviour under dynamic wave interactions.

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