Abstract

MIXED BOUNDARY VALUE PROBLEMS ON WAVE PROPAGATION IN ELASTIC MEDIA

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In recent years, problem involving propagation of elastic waves in presence of cracks or failures are considerable importance in view of their application in Earth Science, Geophysics, Aerospace Engineering etc. Cracks and failures are present essentially in all structural materials. The presence of such cracks may significantly affect the stiffness and integrity of the material. A primary objective of fracture mechanics is to observe singular stress field near the vicinities of the cracks and to arrest the cracks once they started growing. This thesis addresses following problems on the impact of wave propagation in cracked elastic media.

Problem-1: P-wave diffraction by an asymmetric crack in an isotropic strip under an impact load has been investigated. The problem has been transformed into a Fredholm integral equation of second kind in the Laplacian domain and it has been solved numerically by employing Fox and Goodwin's method. Time dependent stress intensity factor has been derived by Zakian's Laplace inversion approach and displayed graphically to demonstrate the influence of impact load over the crack surface.

Problem-2: Interaction of shear waves by two collinear cracks in an infinite magnetoelastic orthotropic medium is analysed. The problem has been solved with the help of Abel's transform, Hilbert transformation. The expressions of stress intensity factor and crack opening displacement have been computed and demonstrated graphically to exhibit the effect of magnetization on elastic media.

Problem-3: The magneto-elastic coupling effect on the dispersion of longitudinal waves in a magnetized elastic solid containing three co-linear cracks has been investigated. The physical problem have been transformed to a set of integral equations introducing Abel's transform which have further been simplified using perturbation method for low frequency by concerning the iterative expansion of Bessel's and Hankel's functions. The converted integral equations have been solved by Hilbert transformation and Cooke Results. Crack opening displacement and stress intensity factors for several crack lengths with the presence of magnetic field have been computed and presented graphically to exhibit the influence of magnetization. Some special cases have been discussed.

Problem-4: Torsional impact on a penny shaped crack positioned at the intersection of an isotropic half space and a transversely isotropic magnetoelastic layer of finite thickness has been analysed. The problem has been solved with the aid of Hankel transform, Fox and Goodwin's method and Zakian's Laplace inversion formula. Physical parameters such as stress intensity factor has been calculated and plotted graphically for several elastic and magnetic parameters.

Subhas 05/09/2023
Prof. Subhas Chandra Mandal

Professor
DEPARTMENT OF MATHEMATICS
Jadavpur University
Kolkata – 700 032, West Bengal

Ujjal Dhabal 05/09/2023
Ujjal Dhabal