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Book review

Linear Elastic Waves by J.G. Harris, Cambridge University Press, Cambridge, 2001, pp. xv + 162, price £47.50, US$69.95 hardback, ISBN 0-521-64368-6, price £17.95, US$24.95 paperback, ISBN 0-521-64383-X

This is an advanced book dealing with propagation and scattering of linear elastic waves using, as a context, linear elasticity. The topics covered include reflection, refraction, propagation of interfacial waves, integral representation, radiation and diffraction and propagation in open and closed waveguides. The book describes part of the applied mathematics used in the description of the propagation and scattering of elastic waves.

Chapter 1 serves as an introduction and summarizes the basic equations of wave propagation in the context of linear elasticity. Fourier and Laplace transforms and their inverses are introduced. To underline aspects connected with the physical theory of wave propagation, the transmission of wave propagation in one-dimensional periodic structures is discussed.

Chapter 2 discusses the kinematics of waves in an unbounded medium. Emphasis is given to plane waves as they form the basis for more complicated wave interactions. The plane-wave spectral analysis technique is introduced and utilized to construct more general spherical and cylindrical wavefields as collections of homogeneous and inhomogeneous plane waves. In the Appendix to this chapter, general information about spherical and cylindrical waves is given.

Chapter 3 covers the reflection and refraction of plane waves at an interface between two materials with different propagation properties. Waves propagating along an interface while decaying perpendicularly away from it are also described. The reflection of an acoustic wave from a plate is also treated. Lastly, the branches of the radicals of the Rayleigh function are selected and how these selections manifest themselves in the physical domain is discussed.

Chapter 4 deals with the integral representation of the solution of rather complex problems in wave propagation. For this purpose, the techniques of reciprocity and the Green tensor are used. The principle of limited absorption and the specification of an edge condition are introduced and their role in constructing unique wavefield representations is analyzed. The power and generality of the described techniques are illustrated by treating the problem of scattering by an elastic inclusion.

Chapter 5 summarizes the basic processes encountered when studying radiation and edge diffraction. Three problems are analyzed. The radiation due to a line source at the surface of a half-space is treated using the Cagniard–de Hoop method of inverting the integral transforms. The use of plane waves and their interaction to construct more general wavefields is illustrated by calculating the radiation from a two-dimensional centre of compression buried in a half-space. Lastly, the diffraction of a harmonic plane wave by a semi-infinite slit or crack is calculated. The problem is solved exactly by using the Wiener–Hopf technique and approximately by using

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asymptotic expansions. In the Appendix to this chapter, the reduction of the diffraction integral to Fresnel integrals is described.

Chapter 6 deals with guided waves and their dispersion. Harmonic and transient excitations of a closed waveguide are studied using an expansion of modes. The harmonic excitation of an open waveguide by a line source is studied next by using both ray and mode representations. The propagation in a closed waveguide with varying thickness is treated using asymptotic expansions. The chapter closes by examining the role of dispersion and the information and energy propagation at the group velocity.

The book is very well written, the print is easily read and the list of references at the end of each chapter is complete. A small number of selected problems without answers appear throughout the book to engage motivated readers in the development of the subjects.

Readers without a previous background of the subject will find the book demanding. Although they may not fully understand every single detail, they may find a useful description of special techniques used in wave propagation problems. Any researcher or postgraduate student will find it competent and very useful for a deeper understanding of the subject due to the special attention paid to the physical aspects of wave propagation. The reviewer would highly recommend this book to researchers and advanced students in applied mathematics, engineering, physics and geology.

A. Trochidis
Physics Division, School of Technology,
Aristotle University of Thessaloniki,
Thessaloniki GR-54006, Greece
E-mail address: trochidis@gen.auth.gr