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Book review

Acoustics of layered media I. Plane and quasi-plane waves
L. M. Brekhovskikh and O. A. Godin, Springer Series on Wave Phenomena, vol. 5, *Springer-Verlag, Berlin,* 1990, x + 240 pp, hardcover ISBN 3-540-51038-9, DM 128.

This book is not simply a revised version of Brekhovskikh's well-known and extremely useful monograph 'Waves in Layered Media', although it deals with the same subject. The English translation of the earlier work was first published in 1960 and much new material has been published since then and the influence of high-speed computing has been considerable. The emphasis throughout is on acoustic waves in homogeneous/inhomogeneous, moving/stationary material, with extensions to elastic waves but little mention of electromagnetic wave propagation. In this first volume, 'only the theory of plane and quasi-plane waves is treated'. What this means in practice is that the physical structure of the propagating medium varies in one (vertical) direction only and the theory is restricted to waves with a fixed phase velocity in a lateral (horizontal) direction.

As well as a discussion of plane wave interactions with a suite of parallel homogeneous layers (discrete layering) in Chapter 2, there is the corresponding review in Chapter 3 of reflection and refraction from a region where the wavespeed varies continuously with depth (continuous layering). In fact Chapter 3 deals only with velocity profiles for which analytic solutions are known; for example, the Epstein layer. For the case of general velocity variation with depth, the WKB method is presented in some detail in Chapters 8 and 9. The theory of point-sources (and bounded beams?—see 'Waves in Layered Media') is promised for a second volume.

The book begins with an exposition of the equations of motion for acoustic and isotropic elastic material together with the acoustic boundary and radiation conditions. In Chapter 7 the equations are extended to allow for energy dissipation and for anisotropic elasticity. As an example of the latter, the concept of the 'effective medium' is introduced for finely layered material. In addition, piezoelectric behaviour is discussed. Chapter 7 is, in fact, rather different in style from the rest of the book in dealing only briefly with a relatively large number of areas and therefore just giving essential details. Besides which, it is not clear why these particular types of material behaviour have been selected and not others.

The essence of the book lies in Chapters 2–5, which deal with plane acoustic and elastic, harmonic wave interactions with discrete layering, with acoustic wave interactions with continuous layering, and with the reflection of sound pulses. For acoustic waves in homogeneous layers, the concept of impedance is used; for elastic waves, matrix methods are discussed. Hypergeometric functions figure large in the section on continuous layering. Chapter 6 contains an interesting and important review of the properties (symmetries, etc.) of reflection and transmission coefficients.

Chapters 8 and 9 continue the main theme with the asymptotic (WKB) solutions for continuous layering, and this is extended in the final chapter (Chapter 10) to cases where the material varies continuously except at specific interfaces where the parameters are discontinuous. Chapter 10 includes an introduction to the method of invariant embedding to obtain an equation for the reflection coefficient as a function of depth. In addition there is a discussion of methods of dealing with a thin inhomogeneous layer (successive approximations) and with weakly reflecting layers (Born approximation).

In all, the book is a worthy successor to 'Waves in Layered Media' and it should prove as useful.

J. A. HUDSON
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