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BOOK REVIEWS

ACOUSTICS: BASIC PHYSICS, THEORY AND METHODS, 1999, by P. Filippi, D. Habault, J.P. Lefebvre and A. Bergassoli, London: Academic Press, 336 pp. price £44.95, ISBN 012251902

This text was derived from course notes designed to provide graduate students with an introduction to theoretical acoustics. It presents significant detail on the development of methods used in linear acoustics, starting with the basic equations and covering techniques applicable to propagation and scattering of waves in both bounded and unbounded media. It includes chapters on boundary integral methods, acoustic enclosures, outdoor sound propagation, guided wave propagation, and transmission and radiation of sound by thin plates. In addition, there is extensive discussion of analytical methods and solutions to the wave equation. The approach is more up to date than is found in classical texts on acoustics, and extensive use is made of the theory of distributions, which is reviewed in the Appendix.

Chapter 1 lays out the basic equations that describe the motions of fluids and solids and derives the acoustic wave equation. Boundary conditions at discontinuities, including shock surfaces, are specified. The solution to the wave equation in free space is then discussed in both the time and frequency domains. An example is given which describes the propagation of sound across a fluid/fluid interface and this is followed by a section giving units and orders of magnitude of the associated quantities. Finally, a section is included on wave propagation in elastic solids. In general, the discussion is directed towards the acoustics of stationary fluids and is not extended to aerodynamic sound generation by moving sources. Apart from this omission, this chapter is very complete, but care needs to be taken in tracking the notation. A list of symbols for each separate chapter in the book would be a worthwhile addition that would allow first time readers to make use of individual sections without the necessity to study the complete chapter.

Chapter 2 describes the acoustics of enclosures. It is written from a fundamental perspective, deriving modal descriptions of harmonic sound fields in rectangular rooms and extending the results to consider transient acoustic excitation. This leads to a discussion of reverberation time and Sabines formula. There then follows a discussion of the method of separation of variables, followed by a description of the method of images. Finally, the solution to the wave equation in a bounded medium is obtained using Green functions, which leads into the third Chapter on boundary integral methods.

Chapter 3 deals with diffraction and boundary integral equations. It describes in great detail the difficulties associated with the singularities of these equations when the observation point approaches the surface. Both interior and exterior problems with different boundary conditions are discussed, and there is a section on diffraction by infinitely thin surfaces. In the final section, the approach is illustrated with an example of a two-dimensional circular boundary with Neumann boundary conditions.

The first three chapters lay out the fundamental solutions of the acoustic wave equation and the remaining chapters are more applied describing specific techniques and applications. Chapter 4 is entitled outdoor sound propagation and includes discussions of ground absorption, diffraction by obstacles and screens and sound propagation in an

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inhomogeneous medium. This last section however seems to be out of place since the discussion emphasizes methods typically used in underwater acoustics. The examples presented in Figures 4.23 and 4.24 are for sound propagation over 100 km in 5000 m of water. Some examples of how these methods are applied in air would be preferable since they would help identify the requirement of this type of modelling in airborne acoustics.

Chapters 5–8 are the most valuable parts of this book. The first of these describes analytic expansions and approximation procedures used in acoustics, including a clear explanation of the method of stationary phase and the method of steepest descent. This is followed by a description of the Kirchhoff approximation, Neumann series and the WKB method. Rays and the geometrical theory of diffraction are then described, followed by a section on the parabolic equation approximation. Finally, a brief introduction is given to the Wiener Hopf method. Chapter 6 provides a useful description of the numerical techniques required for boundary integral methods. It includes descriptions of Galerkin and collocation methods. Although the shortest chapter, this may prove to be one of the more useful contributions of the text. Chapter 7 gives a reasonably complete description of sound propagation in ducts, including infinite ducts of rectangular and circular cross-section, and the Perkeris solution for sound propagation in a range-dependent shallow water channel.

Chapter 8 deals with sound radiation and transmission by thin plates. The one-dimensional example given in section 8.1 provides a clear description of the important physical effects which occur in structural acoustics. The discussion is then extended to two-dimensional plates which support flexural waves with light fluid loading, baffled plates and finally a brief description is given of a plate excited by a turbulent boundary layer.

This book is designed for graduate students and researchers with advanced skills in mathematics. It provides a summary of the mathematical techniques currently used in linear acoustics. The approach is more up to date than in many other texts and so this book will be useful for those who apply theoretical and numerical methods to acoustic propagation and radiation problems. Care must be taken when reading the book to keep track of the notation. There are many inconsistencies between chapters especially in definition of variables describing density, pressure and distance. Each section is self-consistent but cross-referencing equations between sections can be confusing. At times the book appears to be repetitive when read from cover to cover, but the main use of this text will undoubtedly be as a reference and so if may be an advantage to have similar material presented from different perspectives for each application. In general, this book will be useful to students of theoretical acoustics, and researchers interested in boundary element methods and sound radiation from vibrating structures.

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IN FASCINATION OF FLUID DYNAMICS. A SYMPOSIUM IN HONOUR OF LEEN VAN WIJNGAARDEN, 1998, A. Biesheuvel and G. F. van Heijst, editors. Dordrecht: Kluwer Academic Publishers. x + 502pp. Price NLG 395.00, USD 214.00, £135.00. ISBN 0792350782

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