Journal of Sound and Vibration 332 (2013) 228

Contents lists available at SciVerse ScienceDirect

Journal of Sound and Vibration

journal homepage: www.elsevier.com/locate/jsvi

Book Review

Sound Propagation: An Impedance Based Approach. John Wiley & Sons, Asia (2010). 416 pp., $140.00 USD, ISBN:10:0470825839

This book is based on the courses taught by Yang-Hann Kim at Korea Advanced Institute of Science and Technology (KAIST), *whom I have known well for over two decades*, and thus retains the essential ingredients of a text book. The reader is well advised to read the preface first where the author provides his perspective and a three-dimensional view of knowledge in terms of axes that are labeled in acoustic terms such as wave number, sound pressure, and the like. The book is designed to suit the needs of both undergraduate and graduate students; more mature researchers or practicing engineers could utilize the book as well for a tutorial on many topics. More mathematical topics, as well as some analytical background, are placed in appendices though they are titled "Essentials of" a given topic.

As the title suggests, this book addresses the concepts of acoustic waves, propagation, transmission, radiation, diffraction, etc. The unifying feature is the acoustic (or mechanical) impedance $\boldsymbol{Z}$ concept; subscripts such as *m*, *r and* 0 are then used to denote mechanical, radiation, and characteristic impedances, respectively. Since a common nomenclature for all chapters is not given in the book, the reader may struggle with the precise meaning and units of some symbols; for instance, $\boldsymbol{Z}$ may assume the units of force to velocity, pressure to velocity and so on. The driving point impedances for both infinite and finite media are also derived for many cases, and their significance is illustrated via analytical derivation or examples. In most cases, the dissipative effect (damping or real part of $\boldsymbol{Z}$) is not described except when discussing the sound absorption and the acoustic behavior of enclosed spaces. Additionally, the impedance approach places the focus of analytical treatment on the frequency domain; of course, most expressions are valid for a linear time-invariant system. As the title implies, the acoustic sources such as monopole, dipole, and piston radiator are briefly described and the rest of the book addresses essentially the path and receiver aspects.

The book is divided into 5 chapters. The first chapter begins to introduce the one-dimensional waves, harmonic solutions, and interrelationships between acoustic plane waves and propagation in strings, rods/beams, membranes, and plates. Impedance expressions for single and two degree of freedom mechanical systems are presented in the "essentials" section though the reader should read them first from the pedalogical viewpoint. The author introduces the plane, spherical, and three-dimensional wave equations in Chapter 2 along with physical variables such as pressure, particle velocity, intensity, and power; the Green's functions are also described. Chapter 3 addresses the absorption, reflection and transmission concepts based on the infinite media theory. The utility of the impedance approach and its practical application are now very clear. Exterior radiation, diffraction and scattering topics are presented in Chapter 4. The book concludes with a discussion of interior acoustics, using both lumped and distributed parameter methods; the notion of spatially-distributed material (of known impedance) is also described. Interesting aspects of Helmholtz resonator cases are described to give students a flavor for the origins of simpler expressions. More details on the table of contents can be found on the companion website.

Like any text, this book includes exercises at the end of each chapter, some of which are rather interesting. The author has placed the solution of these exercises along with some MATLAB codes and lecture slides on the companion and author's websites. These features would attract the teachers and students though some unsolved problems would have challenged the students; this can be easily remedied by any teacher as many homework assignments can be easily developed. Finally, the book is not cluttered with too much information or references, and thus it retains the basic elements of an introductory text (and not an encyclopedia) and is thus student friendly. I recommend this book for a semester-long course, although supplementary material might be needed depending on the background of the students.

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http://dx.doi.org/10.1016/j.jsv.2012.08.014