FUNDAMENTALS OF PHYSICAL ACOUSTICS, 2000, by David T. Blackstock. Chichester: John Wiley & Sons, Ltd. xxi + 541 pp. Price £64.50. ISBN 0-471-31979-1

This introductory textbook is likely to become the basis for many graduate courses in acoustics. It provides a rigorous background on which students can build their more advanced studies. It fills the gap between very basic texts, which often do not include much detail, and more advanced texts, which are too complex for most students.

The material is organized as a two-semester graduate course sequence. Eight chapters are assigned to the first semester and seven to the second semester. In the first part of the book the basic concepts of acoustics are introduced using Cartesian rectangular co-ordinates and plane waves, avoiding some of the mathematics required for different types of geometry. In the second sequence of chapters, a detailed derivation of the four-dimensional wave equation is given, and problems are solved which require more advanced mathematics. This is a good division, which allows the most important concepts to be covered during the introductory semester without the distraction of mathematical details that sometime overwhelm students new to graduate studies.

The introductory material is covered in Chapters 1, 3–9 and includes wave propagation, plane wave transmission and reflection, normal modes, horns, ray tracing and sound absorption. Chapter 1 introduces the basic concepts of waves, propagation, intensity and decibel scales. This is a comprehensive summary that follows a clearly defined theme. The treatment is focussed on plane waves but a short discussion of spherical and cylindrical waves is also included. At the end of this and subsequent chapters, a large number of illustrative problems are available. These have obviously been complied over many years and are well posed, providing additional insight for the diligent student.

Chapter 3 describes reflection and transmission of normally incident plane waves. In a break from tradition, only time domain solutions are considered and the result is very elegant, smoothly transitioning from simple to more complex examples. Fluid/fluid interfaces are covered quite easily in the first two sections, and the results are then extended to ducts with changes in cross-sectional area. The final section gives examples of the sound generated in a shock tube and by a bursting balloon.

Chapter 4 extends the results from time domain to frequency domain solutions. Standing waves and the uses of a standing wave tube to measure impedance are discussed at length. Different types of the tube terminations are described which leads to the analysis of acoustic resonators and filters using the electrical circuit analog. Examples include orifices, reflection and transmission at tube branches, Helmholtz resonators used as filters, and probe microphone response characteristics. The last sections of the chapter deals with plane waves normally incident on a fluid layer, and finishes with sound transmission through a wall based on a lumped mass element approach.

Chapter 5 describes transmission phenomena at oblique incidence. It starts by considering the transmission across fluid interfaces, using a time domain approach. The analysis is then transferred to the frequency domain to explain evanescent waves that are generated at angles above critical. A very clear discussion of ground reflection at small grazing angles is then given. The chapter is completed with a description of transmission through panels, the mass law, co-incidence effects and composite partitions.

The objective of Chapter 6 is to consider wave fields in bounded regions. It starts with a discussion of a one-dimensional problem (the vibrating string), introducing the method of separation of variables, boundary conditions and initial displacements. A two-dimensional problem (a vibrating membrane) is considered next, followed by a three-dimensional example (sound in a rectangular enclosure). To illustrate the effect of mode cut off, and the concepts of phase and group velocity, an example is given of a membrane waveguide. A very nice discussion on the physical interpretation of these parameters is given in Section D3 of this chapter.

Chapter 7 deals with the acoustics of horns. The Webster horn equation is developed first, followed by a description of the WKB method of solution. The approach is straightforward and easy to follow without getting into too much detail. The essential points are clearly laid out and comparisons between horns of different shapes are given.

Chapter 8 introduces sound propagation in inhomogeneous media. The first part of the chapter gives the details of typical sound velocity profiles found in the atmosphere and the ocean. This is followed by a derivation for plane waves in a stratified medium. An example is given of acoustic waves generated by an earthquake being amplified as they propagate vertically through the atmosphere, which adds a note of interest to this chapter. Ray propagation is then described using a Snells law approach. Examples are given of underwater sound propagation with linear variations in sound speed, including discussions of ray curvature and propagation time. Chapter 9 discusses sound absorption in great detail (additional material is available in the appendix), and this completes the first part of the course. Students studying this sequence of chapters will have a thorough background in classical acoustics and without being overwhelmed by detail.

A second course in acoustics is based on Chapter 2, and Chapters 10–15. They use advanced mathematics and cover problems of sound generation, diffraction by orifices and plates, and arrays.

Chapter 2 derives the equations of fluid motion in great detail. It is a huge contribution that is relatively easy to follow. It gives the book lasting value and I expect this chapter will be referenced extensively. It includes derivations of the continuity, momentum and energy equations, followed by discussions of the equation of state and entropy equations. The next section derives the non-linear wave equation, and includes examples of non-linear wave propagation. The chapter is completed with a section on the small signal wave equation, including sections on sound propagation in a uniformly moving fluid, the effects of gravitational fields, and viscous fluids. The only missing part is the sound generation by flow, but since this is not covered in the rest of the book it is of less consequence.

Chapter 10 considers radiation from spheres and is extended to introduce the concept of multipole sound sources. It starts out by laying down the solution to the wave equation in spherical co-ordinates obtained using the method of separation of variables. An extensive discussion of this approach is given and example applications include a pulsating sphere, a bi-polar pulsating sphere, and spherical cavities. The multipole expansion is introduced, defining monopole, dipole and quadrupole sources. Mention is also given to distributions of simple sources and the inhomogeneous wave equation. Intensity and sound power from different source types are discussed, and the method of images is applied to multipole sources near infinite surfaces. This chapter is a comprehensive introduction to acoustic sources, which rigorously follows from the solution to the homogeneous wave equation.

Chapter 11 discusses cylindrical waves following the same layout as Chapter 10, introducing the solution of the wave equation in cylindrical co-ordinates and it's solution using the method of separation of variables. Bessel functions and their introduction are illustrated using the problem of a circular membrane and sound propagation along a circular tube. Radiation problems are illustrated by considering a pulsating cylinder and a vibrating wire.

Chapter 12 considers waveguides. It starts with the simple case of a rectangular duct and derives a modal solution that is illustrated by considering a source distribution at the entrance to the duct. A succinct example is given of modal selectivity by a simple source distribution and this is followed by a discussion of group and phase velocity. Cylindrical ducts and sound propagation between two parallel planes with a vertical line source complete this chapter.

Chapter 13 describes radiation from a baffled piston and follows a fairly standard approach to this problem, including the Rayleigh integral, the ring piston, the circular piston, directionality, intensity, sound power and source level, the acoustic field on the axis and radiation impedance. In addition, a section on transient radiation is included and the problem of non-uniform surface velocity is analyzed. Chapter 14 discusses diffraction by a circular aperture and a disk in both the frequency domain and the time domain, and finally Chapter 15 describes sound radiation from arrays of point sources.

This book provides a comprehensive introduction to physical acoustics which will enable students to progress onto more specialized topics, such as underwater acoustics, aeroacoustics, and non-linear acoustics. The extensive teaching experience of the author and his rigorous approach to research is clearly apparent throughout the book. This is a very valuable contribution to the field, and I expect it will be used extensively in both the classroom and as a reference text.

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INTRODUCTION TO EXPERIMENTAL NONLINEAR DYNAMICS, 2000, by L.N. Virgin. Cambridge: Cambridge University Press. xvi + 256 pp. Price £19.95, US$32.95. ISBN 0-521-77931 6 (paperback), £52.50, US$74.95. ISBN 0-521-662869 (hardback)

The body of literature concerned with non-linear dynamics is already huge and growing steadily. The novice researcher is faced with the serious problem of navigating this corpus. For applied mathematicians, the start of the path is clearly marked by established classics old (comparatively) and new, for example references [1, 2]. For the Engineer, many of these texts present too steep a learning curve and lack practical motivation. There are exceptions e.g. references [3, 4], but these are rather few and far between. Virgin's book is a welcome addition to this select group. As indicated in the title, many of the results in dynamical systems theory are discussed here in the context of mechanical vibrations.

The author follows Moon's approach [3] to an extent, in presenting us with a number of systems which can be built with relative ease in the laboratory. The most versatile experiment is based on a cart and track, and shows the most refreshingly direct approach to the problem that this reviewer has so far seen. Essentially, the shape of the track is prescribed to mimic a given potential energy curve. To an acceptable degree of approximation, it proves possible to construct a twin-well oscillator which can be used to illustrate a vast range of non-linear dynamical phenomena. With a little modification, the same rig can also be used to demonstrate the behaviour of impact oscillators. While the construction of the rig and instrumentation is not trivial, it could certainly be accomplished by judicious use of student projects, and this is another valuable aspect of the book. Other simple rigs include a hardening spring system which can be used to illustrate the behaviour of a system with non-linear stiffness cf. Ueda's oscillator. For those with little inclination for mechanical systems, a non-linear electrical circuit which accurately simulates Duffing's oscillator is discussed.

The range of phenomena illustrated is very broad. The earlier chapters show free oscillations, various bifurcation scenarios including the jump phenomena well known to structural dynamicists, and of course—chaos. Later chapters focus on more specific aspects of the subject for which the author is well known: escapes and impacts. While most of the book is concerned with local dynamics, the final chapter discusses and illustrates some