

## **The Handbook of Contemporary Acoustics and Its Applications**

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The goal of “The Handbook of Contemporary Acoustics and its Applications,” as stated at the beginning of the book, is to provide an updated, comprehensive reference book for senior undergraduate and graduate students. The book is also an excellent reference for specialists working in relevant fields. This broad goal is made possible by the well-organized contents; the format of which makes it also easy to be used as a textbook for acoustic courses. This comprehensive reference book educates readers on both fundamental concepts as well as their broader applications in the fast-moving technological world. It is in the comprehensive discussion of applications that the understanding of the wave equation can be fully realized for a student studying acoustics.

Chapter one covers the theoretical principle and analytical methodology of excitation, propagation and interface interaction of acoustic waves in an ideal (inviscid) media in which the acoustic wave has no energy loss as it propagates. The wave equation in this fluid system leads to the discussion of the conservation and thermodynamic laws and their importance in understanding the fluid particle as defined in the wave equation. The understanding of the fluid particle in this lossless media allows the understanding in a dynamic world where energy loss of various forms is inevitable. This chapter also presents the important aspect of superposition and linearization conditions. This is essential in setting the foundation for any student, since often acoustics is modeled in linear conditions. Whereas this makes for easy estimation, it is important to understand when those conditions may not be valid or may be incomplete.

Chapter two begins with a discussion of the Green's function, which is utilized throughout the book for linear acoustics. For an ideal fluid, the determination of the mathematics for the Green's function and the characteristics of the acoustic waves relative to radiation of and scattering from cylinders and spheres, as well as diffraction and reception of the acoustic wave, are important in unveiling of the dynamics of the acoustic waves in the real world. The directivity of the source is specified and then further clarified with figures. This chapter, as well as all others, further explains the dynamics of the acoustic wave in terms of both low and high frequency.

Chapter three then presents the non-ideal fluid media. The last section of chapter three then takes the totality of the information up to this point in the book to then discuss sound propagation in a viscous fluid and biological medium.

Chapter four discusses the acoustic field in a finite-size cavity and the reflections from walls with various properties. A standing wave or eigen-mode is provided. Constructive and destructive superposition is important to understanding of potential anomalies. Since this can become very complicated, an approximation method is discussed. Chapter four presents an acoustic field in a duct/pipe, waveguide and cavity. Dr. Wu typically concludes a chapter by discussing a further application. This chapter ends with a discussion of biological virus and bacterium cells as spherical resonators and the eigen-modes of vibrations of cells. This section, as the others in the book that examines real world applications, provides further insight into mathematical modeling of these problems. For a student, this could open a world of wonder about acoustics and its applications and the necessary tools to understand the problem better.

Chapter five presents the nonlinear acoustic wave, or finite amplitude acoustic wave. As done throughout the book, the mathematics and concepts are first presented for the least complicated medium and then the author explores more complicated applications and scenarios.

Chapters six through eight delves into propagation and the mechanisms of physical and biological effects and their broad modern applications such as sonoporation and targeted drug delivery, acoustic tweezers, noninvasive high intensity focused ultrasound (HIFU) surgery, and blood-brain barrier disruption, as well as sonoluminescence. Readers are also provided with the fundamental mathematic background and associated references necessary for their creative inventions and applications.

In conclusion, I truly enjoyed reading this book with its extensive application examples. Due to the interesting combined theoretical and direct applications, the book should be beneficial to students, as well as a broad spectrum of practitioners and researchers. I often deal with clients who know very little about acoustics and Dr. Wu's discussion of the linear vs. non-linear aspects of the acoustic wave will hopefully help me to help my clients better understand the importance of this concept.

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