BOOK REVIEWS

P. L. Marston

Physics Department, Washington State University, Pullman, Washington 99164

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Finite Element and Boundary Methods in Structural Acoustics and Vibration

Nouredine Atalla and Franck Sgard

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This book concisely describes the basic theory, use, and implementation of the finite element (FE) and boundary element (BE) methods applied to vibroacoustic problems. Both authors have a long research history in the fields of propagation in complex environments, fluid-structure interaction, and boundary element methods. The book is divided into eight chapters.

Chapter 1, *Introduction*, describes the fluid-structure problem in the context of scattering theory and its classification into interior, exterior, and interior/exterior problems, accompanied by examples.

Chapter 2, *Basic Equations of Structural Acoustics and Vibration*, describes the fundamental equations governing the three classical problems in mechanics: linear acoustics, linear elastodynamics, and linear poro-elasticity.

Chapter 3, *Integral Formulation of the Problem of Structural Acoustics and Vibration*, introduces classical methods for obtaining the variational integral formulation associated with some common problems in continuum mechanics. This chapter also discusses important topics like principles of stationarity, virtual work, and minimum potential energy with many good examples.

Chapter 4, *The Finite Element Method: An Introduction*, discusses fundamental concepts of the FE method through the study of the solution of the one-dimensional wave equation. The chapter concludes with several examples for different boundary conditions and use of various FE basis functions.

Chapter 5, *Solving Uncoupled Structural Acoustics and Vibration Problems Using the Finite Element Method*, revisits the step by step FE methodology introduced in Chap. 4 with several examples, applied to the uncoupled three-dimensional acoustic and structure problems. The appendixes describe various shape functions in two and three dimensions and present formulas for their numerical integration over various elements, accompanied by useful Fortran codes.

Chapter 6, *Interior Structural Acoustic Coupling*, discusses the coupled interior acoustic problem. It introduces various formulations with emphasis on the classical pressure-displacement formulation. The implementation of this method using the uncoupled modes of the structure is discussed in detail.

Chapter 7, *Solving Structural Acoustics and Vibration Problems Using the Boundary Element Method*, provides a detailed description of the acoustic application of the BE method. Its various formulations (direct, indirect, and variational) are presented with an emphasis on numerical implementation and techniques to reduce the difficulties associated with the calculation of singular integrals. The non-uniqueness problem associated with the boundary element method is discussed and both the CHIEF and Burton-Miller methods are described in detail.

Chapter 8, *Problem of Exterior Coupling*, discusses the fluid-structure interaction for the exterior problem. This chapter presents various formulations combining the FE method for the structure and the BE for the unbounded fluid medium and discusses their advantages and disadvantages. Like some other chapters, this chapter uses examples to illustrate the accuracy of the methods by comparing the resulting solutions with those obtained from analytical or other FE-based solutions.

The book contains a rich collection of references and includes MATLAB codes that can readily be used and expanded. I find the latter particularly useful in understanding the concepts. I have a few comments about the writing of the book. I think there is some loss in translation. For example, the use of the word “resolution” apparently as a substitute for “solution” or “...vibrations” instead of “...vibration” in the title of Chap. 3 or the omission of the article “The” in the title of Chap. 8. There are probably other cases that I have not caught, but some might just be typos. Despite these minor issues, I find the book very useful and highly recommend it to students and researchers in science and engineering.

AHMAD T. ABAWI

Chief Scientist, HLS Research, San Diego, California 92130, USA