Book Review

Vibration and Damping in Distributed Systems, Volume I: Analysis, Estimation, Attenuation, and Design; Volume II: WKB and Wave Methods, Visualization, and Experimentation by Goong Chen and Jianxin Zhou, Published by CRC Press, Inc. Boca Raton, FL, 1993

As the authors indicate in their preface to Volume I, the main objective of these volumes is to expound the many quantitative and qualitative mathematical methods that are fundamental in the analysis of vibration, damping, and wave propagation in systems governed by partial differential equations. These volumes thus are more in the nature of applied mathematics texts than engineering guides. Indeed, engineers without extensive mathematics backgrounds are likely to find these books virtually unintelligible, and even those with significant credentials in mathematics may need to expend considerable time and effort to make use of these texts.

The first chapter of Volume I is intended as a general introduction. It deals with one-dimensional systems, that is, with systems that obey partial differential equations involving only a single space variable. It begins with a review of lumped parameter control systems, addresses vibrating strings stabilized (damped) by boundary forces, progresses to beams with feedback stabilization, presents applications of the wave propagation method to strings and beams, discusses point controllers and stabilizers for beams, and analyzes damping devices for one-dimensional acoustical systems.

Chapters 2 and 3 develop much of the mathematical foundations for the rest of the book by discussing a number of topics from functional analysis and modern theory of partial differential equations. Chapter 2 introduces Banach and Hilbert spaces, develops the basic principles of linear analysis, derives the fundamental principles of linear operators, and explains the Lebesgue measure and integral. Chapter 3 introduces the theory of distributions and Sobolev spaces, and also presents the results of several elliptic boundary value problems.

Chapter 4 deals with representation of solutions of linear time-dependent partial differential equations by strongly continuous semigroups. Chapter 5 addresses stability and the exponential decay of energy, and Chapter 6 deals with the method of energy identities that involves the use of multipliers to estimate the asymptotic decay rates of solutions. Chapter 7, the last chapter of Volume I, is entitled "Holomorphic Semigroups Corresponding to Structures with Strong Damping" and includes consideration of hysteretic damping.

With Volume I having laid the foundations of functional analysis and stability theory and having set forth methods for treating damped distributed systems, Volume II proceeds to cover four additional topics. Chapter 1 introduces the WKB method for eigenvalue problems with one spatial dimension; it provides heuristic motivation and discusses asymptotic expansion and eigenvalue estimation. Chapter 2 extends the aforementioned method to the considerably more complicated situation of multidimensional spaces.

Chapter 3 consists of a collection of miscellaneous methods. It addresses the Rayleigh method and the Courant nodal domain theorem, introduces finite-element and boundary-element methods, discusses the Legendre-spectral numerical method, and presents Bolotin's asymptotic method as applied to some plate and shell examples. Chapter 4, entitled "Visualization," presents a collection of plots illustrating mode shapes and excursion distributions for several two-dimensional domains.

The final chapter, Chapter 5, which was con-

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tributed by David L. Russell, is entitled "Remarks on Experimental Determination of Modal Damping Rates in Elastic Beams." It considers a beam that is hung from strings for measurement of its damping and analyzes the beam's energy transfer to the supporting strings and by acoustic radiation to the ambient air. The chapter also presents an analysis of the energy that an idealized clamp-supported elastic beam loses at the clamp and concludes by showing how the motions of such a beam depend on its damping.

Reviewed by:
Eric E. Ungar
Bolt Beranek and Newman, Inc.
and *Acentech Incorporated*
Cambridge, MA