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BOOK REVIEWS

APPLIED ASYMPTOTIC METHODS IN NONLINEAR OSCILLATIONS, 1997, Yu. A. Mitropolskii and Nguyen Van Dao. Dordrecht/Boston/London: Kluwer Academic Publishers (Series Solid Mechanics and its Applications, Vol. 55, Series Editor G. M. L. Gladwell). x + 341 pages, 102 figures. Price NLG 280.00, USD 165, GBP 99. ISBN 079234605 X.

Both authors are well-known mathematicians; the first author especially, is one of the pioneers of non-linear oscillations research. The book deals with asymptotic methods for analytical solution of non-linear differential equations governing non-linear oscillatory systems. The methods are explained and illustrated by examples. The contents are presented in six chapters and two appendices which are complemented by references and an index.

Chapter 1 is devoted to free oscillations of quasilinear systems. Conservative and dissipative systems are considered. Stationary and non-stationary solutions due to slowly varying parameters are treated. The basic explanation starts with differential equations of the first order. Also the systems governed by third and higher order differential equations are treated. The methods are illustrated by examples of mechanical and electrical systems.

Chapter 2 deals with self-excited systems. The basic theory of equilibrium state stability and of the phase plane is presented. Among rather classical examples the problem of quenching self-excited oscillations is treated in more detail and the theory of absorbers for different systems (e.g. systems with several degrees of freedom, beams and plates) is presented. Systems with so called soft self-excitation are considered (i.e. systems where self-excited oscillations occur when the equilibrium state is unstable).

Chapter 3 deals with forced stationary oscillations, resonant and non-resonant. Not only the main but also other resonances (e.g. subharmonic) typical for non-linear systems are analyzed. Great attention is given to non-stationary oscillations (e.g. non-stationary oscillations when exceeding the resonance). The work of the first author of this book represents an extraordinary contribution to this problem. The existence of several steady state solutions is a typical feature for non-linear systems. The book, however, does not deal with the determination of domains of attraction.

Chapter 4 treats parametrically excited systems. It would be useful to start this chapter with fundamental theory, especially with the Floquet theorem. Some basic examples (pendulum with oscillating suspension point, beam with axial periodic load, etc.) together with the basic properties of linear and non-linear Mathieu equations are presented. Analyzed systems with dry friction provide interesting examples. In section 6 so-called "indirectly excited parametric oscillations" are treated. These systems are most often called "autoparametric" systems.

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Chapter 5 deals with the problem of interactions in non-linear systems: i.e., with the effect of the combination of different types of excitations: self-excitation and external excitation, self-excitation and parametric excitation and parametric and external excitations. The first two lead to the phenomenon of synchronization.

Chapter 6 deals with the averaging method. The idea of averaging conceived by Bogoliubov, averaging in systems excited by impulsive forces, conditions of uniformity, systems containing slow and rapid motions and modified averaging methods form the contents of this chapter.

Appendix 1 deals with principal co-ordinates and Appendix 2 with trigonometric formulae used in averaging methods. References are limited to 53 items, which is rather small in view of the enormous amount of literature on non-linear oscillations.

The examples are illustrated by a number of figures and instructive diagrams. However few of them are far from being perfect (e.g., Figures 21–23, 102).

It cannot be expected that the book presents full information on non-linear oscillations because its main aim is to present asymptotic methods used in analysis of non-linear oscillatory sytems. From this point of view the aim has been achieved. Although the development and general use of computers have reduced interest in analytical methods these are still an important means for theoretical analysis. The researcher should use both analytical and numerical approaches. The book can be recommended to researchers in non-linear oscillations and to post graduate students.

A. TONDL

THEORETICAL ACOUSTICS OF UNDERWATER STRUCTURES, 1998, by E. A. Skelton and J. H. James. London: World Scientific Publishing (UK) Ltd., 411 pages. Price (hard cover) £47. ISBN 1860940854.

To write a new textbook on structural acoustics is both tempting and challenging. It is tempting because the field is so rich and the engineering applications so diverse that most researchers involved in analysis of structural–acoustic interaction are able to present their idea of the subject and share their experience with younger colleagues. It is challenging since there are several excellent classic textbooks (e.g., *Sound*, *Structures and their Interaction* by M. C. Junger and D. Feit; *Sound and Structural Vibration*: *Radiation*, *Transmission and Response* by F. J. Fahy; *Modern Methods in Analytical Acoustics*, *Lecture Notes* by D. G. Crighton *et al*.) so that considerable contribution is expected from any new text. Probably, the best way to reach the goal is to specify some rather broad and important technical application and then to present general concepts and methods along with author's own experience/results in view of the state-of-art in the selected field. I believe the book by E. A. Skelton and J. H. James is a good example of success in doing so. The authors have summarized their long experience in exploring vibrations and sound radiation of structures submerged in water and accomplished it with necessary mathematical pre-requisites.

The book is divided into 14 chapters, each of which is followed by references. Chapter 1 gives a mathematical ''toolbox'' for structural acoustics, and Chapter 2 provides the reader with foundations of the theory of dynamic response of mechanical systems. Chapters 3–5 address pure linear acoustics: general equations and Green functions; scattering from hard and soft surfaces; acoustic finite elements. Chapter 6 introduces three-dimensional theory of elasticity for isotropic, anisotropic and composite materials. In Chapters 7–9 the authors address classic problems of vibrations of thin spherical shell, thin infinite plate and thin infinite cylindrical shell in water. In Chapters 10–12 the same problems (the spherical shell, the plate and the cylindrical shell vibrating in water) are treated by means of matching layers having different properties (e.g., acoustic, elastic, viscous). Chapter 13 is concerned with vibrations of sound and radiation from a finite simply supported baffled cylinder and the last Chapter 14 is devoted to implementation of numerical methods for analysing acoustics of finite axisymmetric structures.

The book is well documented and contains more than 40 numerical examples of calculation of vibration/acoustic characteristics of various model structures that may be used as benchmark problems. Another distinctive feature of this book is a detailed and comprehensive treatment of the very important case of a composite shell or plate. The authors are also successful in the implementation of the dynamical stiffness method for analysis of sound propagation across layered media.

The first six chapters really look like a textbook for not-too-experienced newcomers. For example, a reader may find there very useful (and not obvious for one specialized in Engineering rather than in Mathematics) explicit formulation of vector and scalar identities (Chapter 1) or acoustic Green functions (Chapter 3) in typical co-ordinate systems. Clearly formulated practical suggestions for a use of FFT and a concept of time-harmonic power flow are available in Chapter 2, and concise formulations of variational principles for fluid and solid finite element method are given in Chapters 3 and 6. Algorithms for calculating of effective constants for composites are suggested in Chapter 6. However, two remarks should be made in respect to the first part of the book. First, it could be appropriate to provide the reader with some elementary pre-requisites relevant to the theory of plates and shells (Kirchhoff theory, Timoshenko–Mindlin theory, higher order theories) as the following Chapters 7–9 are concerned with thin-walled structures. Second, it seems rather awkward to have the variational formulation presented in a book on underwater acoustics separately for solid and fluid domains. Possibly it could be better to follow, for example, K.-I. Bathe, and derive the variational principle for a coupled fluid–solid (structural) system.

The second part of the book is strongly influenced by the research interests and experience of its authors and probably should be identified as a reference text for professionals working in the field. For example, the reference list for Chapter 9 (Acoustics of Cylindrical Shell) contains two standard textbooks (by A. W. Leissa and by M. C. Junger and D. Feit) and 13 papers including 7 written by the authors of the book. However, the absence of a detailed global picture of the

state-of-the-art in, say, vibrations of fluid-loaded plates or cylindrical shells does not undermine the good impression one gets upon reading Chapters 9–14. In particular, the analysis of acoustic scattering by parallel plates with periodic connectors or by a single plate with periodic resonators given in Chapter 8 provides the reader with valuable information hardly available elsewhere. The concept of spherically, cylindrically or planar layered media is successfully applied in Chapters 10–12 for analyzing vibrations of and sound radiation from steel and composite structures having decoupling and anechoic coatings. Unfortunately, the material given in these chapters looks rather isolated from the similar material obtained in the framework of classic theory of fluid-loaded thin-walled structures, Chapters 7–9. It would be more instructive for the interested reader to see in the textbook clear estimations of the validity range of simple Kirchhoff theory for an uncoated structure as the excitation frequency increases. It would be even more interesting to learn from the book whether it is possible to use higher order theories of plates and shells to describe the behaviour of coating layers and give threshold frequencies at which only 3D elastic or visco-elastic modelling is still reliable. Unlike previous Chapters, the last two refer to the structures of finite extent. Specifically, Chapter 13 (5 items in the reference list) concerns two case-studies: a simply supported isotropic thin cylinder in a rigid baffle, and a simply supported anisotropic layered cylinder. Chapter 14 is related to numerical analysis of vibrations of a finite axisymmetric structure in coupled finite element/boundary element modelling. Probably, it could be appropriate in the textbook to introduce other numerical techniques (structural modal analysis coupled with boundary element modelling of acoustics, expanding of structural response in Ritz vectors coupled with boundary element modelling of acoustics, etc.) along with the technique discussed. However, attempts to extend the coverage of the book could inevitably result in unacceptable growth of its volume that probably served as a limiting constraint for the authors.

To conclude the review I would like to recommend the book as a valuable source of information for researchers involved in design/analysis of underwater structures.

S. SOROKIN

MATERIAL IDENTIFICATION USING MIXED NUMERICAL EXPERIMENTAL METHODS, 1997, editors H. Sol and C. W. J. Oomens. London: Dordrecht, New York: Kluwer Academic Publishers. ix + 240 pp. Price (hard cover): NLG 195.00, USD 110.00, GBP 67.00. ISBN 079234779 X

This book summarizes the proceedings of a recent Euromech colloquium. As such it represents a cross-section of some recent European research on various aspects of material system identification and characterization. It should be of interest to those in the academic communities of the world who are pursuing similar research, but the technical level is such that it is likely to be of less interest to those engineers and scientists who are embroiled in related activities, on a day-by-day basis, in the industrial world. In other words, the text is a useful summary of recent research

but is not a textbook covering all aspects of the subject. The topics covered include characterization of composites and other materials (10 papers), elasto-plasticity (5 papers) and damage modelling (5 papers). The authors of the various papers are researchers in many European universities and research establishments. This text should be on the bookshelves of advanced university and technical institute researchers in the areas of behavior and failure of complex materials systems.

D. I. JONES