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BOOK REVIEWS

VIBRATION OF MINDLIN PLATES, 1998, by K. M. Liew, C. M. Wang, Y. Xiang and S. Kitipornchai. New York: Elsevier. 250 pp. Price (hardback) NLE 241.00 (US$138.50). ISBN 0080433413

Vibration of plates has never ceased to fascinate researchers in this area. In this age of finite element methods, with many varieties of finite elements as well as codes using them, interest in semi-analytical methods is still strong, because such methods model the structure as a whole and the results can be used as bench marks for those obtained by using even the most sophisticated finite element codes.

Even a novice in plate vibration must know the monograph, "Vibration of Plates", by A. W. Leissa [1]. Subsequent to that, there have been several similar compilations of results even though not as large in scope as reference [1]. The present monograph is one such exercise confining itself to the area of Mindlin Plates and using the Rayleigh–Ritz technique. As the authors point out, "Ritz technique once thought to be awkward for general plate analysis, can be automated through suitable trial functions (for displacements) that satisfy the geometric plate boundary conditions *a priori*." With the precision available in present day computers, the numerical problems associated with solving large-sized fully populated eigenvalue problems are not there, and this has paved way for the renewed interest in the Rayleigh–Ritz method.

The present monograph provides a brief theory of Mindlin Plates to begin with in chapter 2 and goes on to formulate the Mindlin plate vibration problem in polar co-ordinates, rectangular co-ordinates and skew co-ordinates. Each of these formulations is followed by copious results obtained by the authors for a variety of plate geometries. Exact results obtained by other researchers are provided for some cases. Some results on the convergence of the Rayleigh–Ritz method and direct comparison of the converged Rayleigh–Ritz results with the exact results would have given an enhanced value to the monograph. Personally, having worked in the area myself, I am convinced of the accuracy of the method and the value of these results to the research community in this area. Mindlin plates with complicating effects, such as in-plane stresses, elastic foundations, stiffeners, non-uniform thickness, curved supports, point supports, mixed boundary conditions, perforated plates and sandwich construction are discussed in the final chapter. Computer codes are provided for each of these cases which should be of use to researchers in the plate vibration area.

A comprehensive list of references and some relevant books in the area at the end of the monograph are quite useful. The monograph has an attractive and inviting look and as one browses inside, the material is quite able to hold the interest. The

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mode shape patterns presented for different cases are quite artistic and presents a picture of visual harmony.

The authors are to be congratulated for their effort and a fine contribution to the literature in the area of vibration of plates.

R. B. BHAT

REFERENCE

1. A. W. LEISSA 1969 *Vibration of Plates* U.S. Government Printing Office (NASA SP-160) reprinted by the Acoustical Society of America 1993).

ROBUST RELIABILITY IN THE MECHANICAL SCIENCES, 1996, by Y. Ben-Haim. Berlin, Heidelberg, New York: Springer-Verlag. xvi + 233 pp, 56 figures, 107 references, author and subject indexes, Price 98 DM (approx. 50 EURO). ISBN 3-540-61058-8

Robust reliability is a new non-probabilistic theory of reliability of mechanical systems. It is based on information gap models of uncertainty which express the gap between what is known and what needs to be known. According to this theory, the mechanical system is reliable if it is immune to a wide range of uncertainty. On the other hand, if a failure can occur even under small fluctuations then the system is vulnerable to uncertainty and, thus, unreliable.

In technical practice, we can find many examples where the input (loads) to a mechanical system or its properties are more or less uncertain: for example, vibrating structures subjected to external uncertain forces and internal imperfections, such as aerospace structures, bridges, buildings, machines and mechanical devices of all sorts. In addition, the reliability analysis of fluid flow systems, such as turbo-machinery, heat transfer devices, cooling fins, and manufacturing processes, such as extension and milling, are tackled in examples and homework problems in the book.

The book is divided into nine chapters.

Chapter 1 presents the main ideas of robust reliability and shows some practical examples of its applications without going into mathematical details.

The mathematical basis of robust reliability is represented by convex models rather than by probabilistic density functions. Therefore, some geometrical and algebraic properties of convex models are summarized in chapter 2.

Chapters 3 and 4 constitute the heart of the book because the basic method of robust reliability is developed here. The author explains the theory of convex models first on static and then on dynamic systems. He shows also the analogy with classical probabilistic theory of reliability.

Chapter 5 deals with fault diagnosis, system identification and reliability testing. The author seeks to identify the mechanical system and associated uncertainties, in order to determine if the performance will be robust with respect to the estimated degree of uncertainty. In considering fault diagnosis, the author emphasizes the assessment of the robust reliability of the diagnostic algorithm itself.

Chapter 6 introduces the analysis of robust reliability of mathematical models of mechanical systems. The theory is applied to the evaluation of both the reliability of mathematical models of systems and the robustness of design or operational decisions based on these models.

In Chapter 7, the author shows that uncertainty and probability are not synonymous and some limitations of probabilistic theory for reliability analysis is discussed.

In chapter 8, a hybrid robust—probabilistic analysis of reliability is developed. In some cases, information about the distribution of discrete events in time or space can be confidently modelled statistically by using the Poisson distribution.

Chapter 9 concludes the book with a brief summary and discussion of some speculative aspects of reliability and its interpretation.

The book may be well recommended to all scientists, practicising engineers and students who are interested in the reliability of mechanical and other systems. It presents a solid base for the estimation of the reliability and for further study of the subject.

The author introduces each chapter with a brief conceptual survey of the main ideas, which are then developed through the theory, examples and problems. The book gives a good opportunity to the readers to extend their understanding and to perform the numerical calculations.

L. FRÝBA

THE PHYSICS OF MUSICAL INSTRUMENTS (second edition), 1998, by N. H. Fletcher and T. D. Rossing, New York: Springer, 760 pp. Price (hardback) £53.00, US$69.95, DM 138.00. ISBN 0 387 98374 0

The authors of this edition of a book first published in 1990 have taken the opportunity to bring the discussion up to date by including new insights that have arisen over the past decade, to revise the presentation of some aspects and to correct errors. The amount of revision can be judged by the fact that the book has been extended by over 130 pages, although some of this can be accounted for by changes in layout.

The contents of the book is primarily confined to Western musical instruments in current use. Readers are assumed to have a reasonable grasp of physics and not to be frightened by a little mathematics. It is divided into six sections. The first, which consists of five chapters, is concerned with vibrating systems. Topics covered include free and forced vibration of systems having one, two and many degrees of freedom and continuous systems. These include strings, bars, membranes, plates and shells. Applications to musical instruments are discussed throughout. There are only a few slight changes in this section, which either improve the presentation or correct errors. However, two main changes have been made. The section on vibration of shells has been expanded to include cylinders as well as spheres. Also, the material on non-linear vibration has been rearranged and expanded.

The second part consists of three chapters dealing with various aspects of acoustics and their relevance to musical instruments. The first two chapters, on sound waves and sound radiation, contain a number of small changes to improve understanding, but only one major change consisting of a new section on radiation from large plates. The third chapter (chapter 8) deals with pipes, horns and cavities. Again, the text has been improved in a number of places, but more significantly, three new sections on curved horns, measurement of acoustic impedance and network analogues have been added.

The third part consists of four chapters which deal with various types of stringed instruments. The first chapter, on guitars and lutes, has three new sections which describe scaled guitars, the use of synthetic materials and one-sided bridge constraints. The next chapter, on bowed stringed instruments, contains nine new sections as well as many minor changes. The next chapter has had the dulcimer added to harps, harpischords and clavichords. The final chapter in this section, which is on the piano, has had five new sections added.

The fourth section, on wind instruments, consists of five chapters. The first of these, which deals with sound generated by reed and lip vibrations, has undergone a major rewrite. In contrast, the next chapter, which describes lip-driven brass instruments, contains only slight changes. The chapter on woodwind reed instruments, which comes next, contains three new sections: on acoustic efficiency, the limiting spectrum and capped reed instruments. In addition, four other sections have been expanded. The next chapter, which deals with flutes and flue organ pipes, also contains new sections on rigorous fluid dynamic approaches and aerodynamic noise, together with a few other small changes. The last chapter in this part, which is on pipe organs, contains only slight changes.

The fifth section, on percussion instruments, consists of four chapters: drums, mallet percussion instruments, cymbals, gongs, plates and steel drums and bells. These chapters are largely unchanged in content, but some renumbering of sections has been introduced. New sections include one on chaotic vibration in relation to cymbals and another on bass handbells.

The final section, on materials, contains one chapter on materials for musical instruments which is new to this edition. After a description of the mechanical properties of materials, the use of woods, plastics, composite materials and metals for musical instruments is discussed.

The many changes introduced, together with the inclusion of more than 200 additional references, will ensure that this book will continue to serve as an up to date reference book as well as a good introduction to the wide range of musical acoustics.

M. PETYT

DYNAMICS OF MACHINES WITH VARIABLE MASS, Volume 7 of the Series on Stability and Control: Theory, Methods and Applications 1998, by L. Cveticanin. London: Gordon and Breach Science Publisher. 236 pp. ISBN: 90-5699-096-9

This monograph is the seventh volume of the mentioned series edited by A. A. Martynyuk. Different analytical methods for obtaining oscillatory solutions of non-linear differential equations of motion, the basic theory of stability and the dynamics of systems with variable mass are presented. The latter cannot be found in most text books on machine dynamics and vibrations. The first pioneer in this field was the famous Russian scientist I. V. Mehcherski whose basic work was published at the end of the last century. This theory was first applied in rocket dynamics. The author applies this theory to machines in which the mass is varied. The predominant part of the book deals with the methodological side of these problems. The style of presentation is rather similar to that used in books on applied mathematics and theoretical physics, which could discourage engineers. The advantage of the book consists in the citation of a large amount of the literature. Each chapter ends with comments and further references. From the engineering point of view the analysis presented yields more methodological advice than practical directions for designers.

The contents of the book is presented in seven chapters and introduced by an Introduction to the Series and by the author's Preface.

Chapter 1 describes different machines and mechanisms with variable mass, e.g., rotors (spindles) with variable mass, rolling machines, mechanisms for waggon or convertor turning, etc. In the Comments and References of this chapter the author says: "Periodical mass variation is unusual in working machines and mechanisms and will not be considered in this book", with which I cannot agree. It is necessary to take into account systems for which, when constructing the model, reduced masses are used: e.g., systems with torsional elasticity of crank-shafts rotating with constant speed, mechanisms and robots having elastic elements or elastic shafts in driving systems and repeating periodically their motions, etc.

Chapter 2 deals with the general principles of the dynamics of systems with variable mass. Basic mathematical models of some systems are derived.

In Chapter 3, the vibrations of some systems with small non-linearities are discussed. Waggon-measuring mechanism and a rotor system are analyzed. The results obtained analytically and numerically are compared with those obtained experimentally.

Chapter 4 deals with systems containing strong non-linearities. The vibration of a centrifuge with variable mass and of a rotor with a winding band are discussed.

The possibility of chaotic motion initiation is analyzed in chapter 5. Melnikov's criteria are applied and systems of lifting crane mechanisms, and of a rotor are discussed.

Chapter 6 contains the application of conservative laws and adiabatic invariants for systems with variable mass.

The last chapter deals with stability of motion. The basic Lyapunov theory along with the application of Lyapunov functions are presented.

A list of numerous references and Index close the book.

As already mentioned the main attention is given to the theoretical, especially methodological, background. The author does not always use standard terms (e.g., "rigidity" instead of "stiffness") but this does not cause any difficulties.

The book can be recommended to postgraduate students of applied mathematics, theoretical mechanics and theoretical engineers interested in the dynamics of systems where some parameters, especially masses or reduced masses, are varied.

A. Tondl

STRUCTURAL DYNAMICS,—Proceedings of the fourth European Conference, EURODYN '99, 1999, by L. Fryba and J. Náprstek. Rotterdam: A. A. Balkema. 1264 pp. (2 Vols). Price £112.00, $190.00, EUR 160.00. ISBN 90 5809 056 6

The two volumes contain the Proceedings of the Fourth European Conference on Structural Dynamics, EURODYN'99, held in Prague in the Czech Republic. Between them they contain nearly 200 papers.

The first volume begins with a section which contains the eight Keynote Lectures presented at the conference. The topics covered include the modelling of wind turbulence and the response of towers to wind, experimental bridge dynamics, mathematical modelling of stress waves in solids, the dynamics of soil–structure interaction, the reliability of vibrating structures, wave-induced dynamic behaviour of marine civil engineering structures, the estimation of random response, and ground borne vibration from railways. The remainder of Vol. 1 consists of seven sections which contain mainly theoretical papers on the theory of vibration, stochastic dynamics, non-linear vibration, vibration of structural elements, wave propagation, material properties and noise and experimental methods in dynamics.

The second volume comprises six sections which contain papers covering the application of structural dynamics to the vibration of bridges, railway and highway track dynamics, dynamics of buildings, ground vibration, wind effects and seismic effects.

The theoretical papers in Vol. 1 deal with a wide variety of problems in structural dynamics. However, the applications papers in Vol. 2 concentrate on the dynamics of civil engineering structures. These Proceedings show clearly the progress and recent developments which are being made in structural dynamics. The organizers are to be congratulated on their achievements.

M. PETYT