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Book review

Nonlinear Vibrations and Stability of Shells and Plates, M. Amabili. Cambridge University Press, Cambridge (2008). 374 pp., ISBN: 978-0-521-88329-0

The excellent book by N. Yamaki, published in 1984, has long served as a standard reference for any work on nonlinear dynamics of shells. However, so much has been added to our knowledge since then, on fundamentals, new techniques and new materials, that a new book on the subject was well overdue. However, this monograph by M. Amabili is *not* just an up-date; it is much more, as I shall endeavour to convey in what follows.

First of all, it should be stressed that the book integrates very nicely the nonlinear theory (in fact, all nonlinear theories) of both plates and shells. The classical nonlinear theories for plates and for cylindrical and spherical shells are presented in Chapter 1, very systematically and thoroughly. Even if steps are jumped over in derivations, they are carefully described, so that the reader can follow and, if desired, reproduce the result; (remarkably, even the "it is easy to show" statements can be reproduced without undue difficulty). This is followed, in the same thorough yet accessible style, by the treatment of doubly curved shells in Chapter 2, which also includes more advanced topics of practical importance; e.g., composite and functionally graded shells, moderately thick shells, and thermal effects. Thus, Chapters 1 and 2 cover the foundation on which the rest of the book builds. The treatment throughout is rigorous without being heavy; hence it is very accessible and readable.

Then, in Chapter 3 are presented the fundaments of modern nonlinear dynamics, which are used in what follows, such as bifurcation and Floquet theory, Lyapunov exponents and Lyapunov dimension. Here too the presentation is purposely simplified for it to be followed without difficulty.

With all necessary tools now in place, the book proceeds with the treatment of linear and nonlinear vibration of rectangular plates and circular cylindrical shells, empty or fluid filled, in Chapters 4 and 5. These chapters benefit immensely from the fact that the author has himself contributed some excellent theoretical and experimental work in these topics, so the presentation is doubly interesting and valuable, e.g. on chaotic dynamics of water-filled shells. This is followed in Chapter 6 by a very useful, compact presentation of the relatively hot topic of Reduced-Order Modelling.

Chapters 7–12 present a number of particular topics that are extremely interesting for researchers, designers and students working in this general area and on which the author is undoubtedly an expert; e.g., the comparison of the different shell theories, the effect of different boundary conditions (with comparison to experiment), vibrations of rotating disks (with obvious application to computer disks), and meshless discretization methods.

Chapter 13 presents a thorough treatment of nonlinear stability of cylindrical shells under static or dynamic loading and Chapter 14 on shells conveying fluid. In these topics the treatment is very authoritative; indeed, the author has made many seminal contributions in these topics. Finally, Chapter 15 deals with the effect of imperfections.

Throughout, plentiful and clear illustrations help the reader and enliven the text, as do comparisons with experiment.

This book is a gem: for theoreticians because it injects interesting applications which have animated recent work in this area; for engineers and designers because it provides a thorough yet accessible treatment of the mathematical/physical aspects; for students because it treats the subject in a manner that can be studied easily, say in a course or be self-taught. In the latter case, if Chapters 1–6 and 13 are covered, then the basic topic is well understood, and one can pick and choose which of the other chapters may be of interest.

For anyone working with plates and shells, perusal of the book for even an hour or so guarantees that he/she will want to have it permanently on his/her bookshelf. This, indeed, is an excellent book!

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