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BOOK REVIEWS

APPLIED STRUCTURAL AND MECHANICAL VIBRATIONS: THEORY, METHODS AND MEASURING INSTRUMENTATION, 1999, by P. L. Gatti and V. Ferrari. Andover: E. & F. N. Spon. 826 pp. Price £80. ISBN 0419227105.

This book comprises a modern arrangement of classical material on vibrations theory and experimentation. It is divided into two separate parts: Part I: Theory and Methods and Part II: Measuring Instrumentation. The first three chapters provide in a logical sequence all the essential material necessary for the reading of subsequent chapters. Fourier and Laplace transforms, and Hilbert spaces are introduced at an early stage to emphasize their importance.

The first sentence of the Preface makes clear that the treatment is restricted to the linear theory, and this is adhered to quite rigidly throughout. A full discussion of Coulomb friction and the justification of equivalent viscous damping models was therefore not possible although the book runs to over 800 pages. A chapter on weak non-linearities, linearization and especially dealing with the use of perturbation methods in developing equivalent damping models would have been of real practical value. The restriction to linearity precluded a discussion on the effects of Coulomb friction in mechanical joints. A section on self-excited vibrations was another conspicuous absentee.

Of course, the scope of the book is very wide and in general the treatment is thorough. I appreciated in particular the coverage of defective eigenvalues and the geometric degeneracy of eigenvectors. The discussion on eigenvalue and eigenvector sensitivities is very good too.

Several important topics in the matrix analysis sections were missing though. Topics such as model reduction and component mode synthesis are not included. The matrix analysis is restricted to symmetric systems. I was disappointed not to find some commentary on the correlation of finite element result with experimental vibration data. Measurements errors (random and systematic) are considered but there is no discussion of modelling errors. The discussion of zeros (antiresonances) is very brief and vibration absorbers are not mentioned.

The excitation system, used in experiments, is mentioned in the chapter on modal analysis but is not returned to (contrary to my expectation) in Part II. Interaction between the test structure and the excitation system is not fully covered although the force drop-off phenomenon is mentioned.

In summary, the book presents well-established material in a clear, well-ordered and modern fashion. I am critical of what I consider to be some important omissions, but my overall opinion is that it will be widely appreciated by a mixed readership of specialists, undergraduates and practising engineers. It will form a very useful addition to my bookshelves.

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HIGH-SPEED FLOW, 2000, by C. J. Chapman. Cambridge, England: Cambridge University Press. 258pp. price £19.95 (paperback). £52.50, US$ 74.95 (hardback). ISBN 0 521 66647 3 (paperback); 0 521 66169 2 (hardback).

This book provides a concise (258 pp.) and readable introduction to the analysis of compressible flow. The material is most appropriate for applied mathematicians at high undergraduate or graduate level. It would also be suitable for engineering graduates who have seen many of the applications (nozzle flow, shock and expansion waves, aerofoil theory, etc.) before from the perspective of practical calculations and who now would benefit from a more comprehensive coverage of the theoretical basis of the methods. Although the book does not assume any previous knowledge of fluid flow, besides the concepts of conservation of mass, momentum and energy, it does assume familiarity with vector and tensor subscript notation, changing freely between the two as the context demands. The mathematical notation is standard throughout which means that the book can also be used to complement other books on gas dynamics and aerodynamics.

After a brief introduction, chapter 2 presents a control volume analysis taking careful account of the possible presence of discontinuities. This neatly derives the governing equations and the jump relationships for shock waves. Chapter 3 proceeds with thermodynamics, initially from a general viewpoint, ending with a discussion of the perfect gas with constant specific heats. Confusingly such gases are called polytropic gases, clashing with the usual thermodynamic definition of a polytropic process being one for which pv^n is constant for some n. One should no doubt be grateful that, in a book where barotropic, homentropic and homenthalpic flows also appear, this was the only detected instance of a non-standard (or at least not universally recognized) definition. Chapter 4 is particularly clear on Crocco's relation and the distinction between governing equations for the simplifications of steady and/or irrotational homentropic flow.

Chapters 6–9 cover in the space of 80 pages applications to normal and oblique shock waves, one-dimensional nozzle flow, Prandtl–Meyer expansions and aerofoil flows. This is much the same material as one would find in a standard gas dynamics text with the occasional entertaining aside for the non-mathematician — we learn, for example, on p. 110 that the oblique shock polar is in fact a strophoid, which is then clarified as being a folium of Descartes! The remaining chapters cover more advanced applications. Chapters 5 and 10 deal with characteristics. Chapter 11 is a mainly qualitative discussion of shock reflection, while chapter 12 introduces the hodograph method.

A particularly nice feature of the book is the bibliographic note at the end of each chapter pointing the reader at key literature. Also the whole of chapter 13 is devoted to a concise literature survey. This seems to be well up-to-date and gives an excellent lead into the most important recent papers. The book exaggerates in claiming that the student can go straight from this book to the research literature (viscous flow in general and turbulence in particular are omitted), but chapter 13 can certainly be used to point new researchers at the right papers. One disappointment is that chapters 1–12 make virtually no connections to modern numerical techniques and could have been written 30 years ago. The development and application of numerical techniques for high-speed flow is one area of current research where advanced analysis is being applied. A few examples of this would have broadened the appeal of the book. That aside, the material that is included is presented clearly and thoroughly and will prove useful for advanced students and researchers in the field.

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