BOOK REVIEWS

Introduction to unsteady thermofluid mechanics
Frederick J. Moody

Most engineers are familiar with the subject of unsteady fluid mechanics, which results in the passage of waves through the fluid medium. The author extends this concept of unsteadiness to systems in which both the thermodynamics and fluid mechanics are not in steady state. This book makes a definite contribution to the subject and it makes essential reading to those interested in unsteady fluid flow, particularly that in which thermal transients are occurring. The scope of the text is extremely broad but concentrates mainly upon waterhammer and compressible gas flows. Other chapters consider more peripheral aspects of unsteady fluid mechanics.

The reviewer considers the title of this book slightly misleading. The text is not an introduction to the subject but a comprehensive coverage of a broad range of ideas that are subsumed in the general title. The unsuspecting reader picking up this book and expecting to find an introduction would be extremely surprised, although after that initial feeling had gone he/she would find some assistance with his/her problem.

The first three chapters introduce a broad range of unsteady thermodynamic or fluid mechanic situations. The subject matter is not what is usually classified as unsteady fluid mechanics, but it presents interesting phenomena in which various parameters are time varying. These are all treated by intuitive approaches and contain certain assumptions that are not always explicitly described; in this sense, they can be dangerous for the unwary. Chapter 2 concentrates on unsteady thermodynamics and considers charging and discharging of vessels containing both perfect gases and steam. In addition, it introduces the dynamics of bubbles under various conditions. Jet flows and unsteady heat transfer are brought together under the title, "Convective Propagation," in the third chapter.

It is not until Chapter 4 that conventional unsteady fluid mechanics is introduced, and then Chapters 4 and 5 consider small amplitude and large amplitude hydrostatic (surface) waves. The equations are derived rigorously and solution methods, including graphical approaches, are introduced. Chapter 5 summarizes the method of characteristics (MOC) and extends this to flow with small shock waves. The authors also shows how the quasi-linear mesh method of characteristics can be established, and gives a flow diagram for a computer program. It is a weakness of the text that no programs are listed.

Chapter 6 is extremely interesting because it deals with unsteady thermofluid systems and normalization. The basic equations of flow are derived and then nondimensional coefficients for unsteady flow are introduced. These enable the flow equations to be derived in nondimensional form, which allows realistic scale model tests to be undertaken in unsteady flow.

The next two chapters deal with what is conventionally considered to be unsteady fluid mechanics. The analysis of waterhammer and compressible gas flows is rigorous and thorough. Many boundary conditions are introduced, including pipe area changes, junctions, inflow from and outflow to reservoirs, and more complex ones. Again, the author explains how computer programs can be written to evaluate these flows. Chapters 9 and 10 introduce more esoteric aspects of unsteady thermofluid flow. These include bubbles in the fluid, forces on submerged structures, sloshing of liquid in tanks, etc.

This book is one of the most comprehensive texts on unsteady thermofluid dynamics. It contains a plethora of fluid flow situations and proposed solution techniques. The intuitive approach in the early chapters might confuse the newcomer to the subject, but if he/she has the endurance to get to the latter ones then all should become clear. (The author explicitly refers the reader to later chapters in certain cases, which reinforces the reviewer's comments.) Numerous graphical solutions are given to problems and these should be extremely useful if used carefully. The author has introduced a method of characteristics as the technique for solving the equations governing the flows but has not referred to other finite difference methods. This might be a weakness in the future as the more modern techniques are more widely applied. It is also a pity that, in a book of this length and depth, no computer program listings are given. Comprehensive and copious references are given at the end of each chapter but, unfortunately, these are not fully integrated into the text. Each chapter has numerous tutorial problems associated with it.

Everyone working in the field of unsteady thermofluid mechanics should read this book. It contains so many concepts and ideas that there must be something new for all readers. This is a book that should be found in every library for reference by researchers. It is both too broad and too deep to be appropriate for teaching unless the course is specifically in unsteady fluid flow. Moody is to be congratulated on an excellent, provocative, and comprehensive text.

D. E. Winterbone

Instability and Transition, volumes 1 and 2
M. Y. Hussiani and R. G. Voigt, Editors
Springer-Verlag, New York, 1990, vol. 1: 439 pp., vol. 2: 496 pp.

These volumes transmit part of the spirit and information from the ICASE/NASA International Workshop on Instability and Transition held from May 15 to June 9, 1989. The well-focused workshop was aimed at younger researchers in single- phase, shear-layer instabilities and transition to turbulence of ultimate applicability in aerospace industry. The participants were given authoritative overview tutorials and worked cooperatively in small groups on selected open questions with available computer codes and four NASA experimental facilities. The results of this research (plus earlier associate material) are presented in 130 pages of volume 1 and 490 pages of volume 2 under the grouping of Experiments, Receptivity Theory, Advanced Asymptotic Theory, Linear Boundary-Layer Instability, Free Shear-Flow Instabilities (all supersonic), Compressible Stability and Transition, Numerical Transition Simulation 1 and 2, and Transition Modeling (based on modeling of turbulence!).

The first 300 pages of volume 1 present the views of the experts on the status of current burning issues that were delivered in concise position papers on six panels: Theory, High-Speed Transition Experiments, Low-Speed Experiments, Computational Prospects, Receptivity Phenomena, and Roughness Transition. (The critical overview of the mechanisms of receptivity to environmental disturbances was misplaced from p. 233 to p. 272.) The summaries by the six panel chairmen provide a perspective of the outstanding issues in 1989, a starting point for the research-oriented reader. The lucky participants had the additional benefits of creative personal interaction and critical discussion that no two-dimensional reporting can capture.

Mark V. Morkovin