Book reviews

Annual Review of Numerical Fluid Mechanics and Heat Transfer. Volume 1

Edited by T. C. Chawla

New York: Hemisphere Publishing Corp., 1987. Pp. 454. $149.95

The rapid increase in the number of publications that describe the use of numerical techniques for solving fluid mechanics and heat transfer problems, which appear in a large number of different technical journals and conference proceedings, provided the motivation for initiating an annual book series on state-of-the-art survey reviews.

This initial volume contains eight invited review articles, five of which deal with numerical techniques and three of which describe physical modeling of specific phenomena. The titles of the articles and their authors are:

1. Thermal Radiation in Particulate Media with Dependent and Independent Scattering—C. L. Tien and B. L. Drolen
2. Pressure-Velocity Coupling in Incompressible Fluid Flow—G. Comini and S. del Guidice
3. New Explicit Methods for the Numerical Solution of Diffusion Problems—D. J. Evans
4. Numerical Methods for One-Dimensional Reaction-Diffusion Equations Arising in Combustion Theory—J. I. Ramos
5. Buckling Flows: A New Frontier in Fluid Mechanics—A. Bejan
6. Numerical Methods for Multidimensional Radiative Transfer Analysis in Participating Media—S. H. Chan
7. Fundamental Aspects of Analytical and Numerical Methods on Freezing and Melting Heat-Transfer Problems—S. Fukusako and N. Seki
8. Complex Heat Transfer Processes in Heat-Generating Horizontal Fluid Layers—F. B. Chung and T. C. Chawla

The depth of coverage in these articles ranges from an extremely detailed development and discussion of a particular technique (Evans) or phenomenon (Ramos, with 408 references) to an almost superficial treatment of the subject (Comini and del Guidice). Those interested in radiation may find the first and fifth articles nicely written and of interest. The last two articles in the volume contains surveys of specific phenomena.

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Computational Heat Transfer

By Y. Jularia and K. E. Torrance

New York: Hemisphere Publishing Corp., 1987. Pp. 366. $49.00

This book deals with the numerical solution of conductive, convective, and radiative heat transfer problems. Part 1 presents a brief discussion of the governing equations. The finite difference approximation of both the steady state and transient form of the diffusion equation is then introduced. Truncation errors, convergence, and stability are discussed. This part concludes with the presentation of the basic theory of the finite element method.

Part 2 deals with the matching of the computational method to the physics of the problem. Each of the basic modes of heat transfer is discussed individually. Both the stream function and the vorticity and primitive variable formulation of the conservation equations are discussed. The special treatment given invicid, creeping, boundary layer, and recirculating flow is discussed. The use of numerical methods with radiosity, absorption factor, discrete integrals, and the Monte Carlo methods for radiation heat transfer are presented.

Part 3 describes the application of the previously discussed techniques to the analysis and simulation of thermal systems in manufacturing and the environment.

The broad spectrum of problems discussed in *Computational Heat Transfer* makes it quite helpful for those working in thermal engineering who wish to become acquainted with numerical techniques. The major emphasis of the book is on finite difference techniques, although other methods are introduced. If the reader must solve complex problems, other books dealing with the specific method in more detail should be consulted, particularly if the solution technique uses finite elements.

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Fundamentals of Heat Exchanger and Pressure Vessel Technology

By J. P. Gupta

New York: Hemisphere Publishing Corp., 1987. Pp. 607. $45.00

The title of the book is misleading. A more accurate title would be *A Glossary of Heat Exchanger and Pressure Vessel Terminology*.

I am unsure as to the author's planned audience. The explanations of the various terms are generally very good. The book, however, does not give sufficient details and examples to be of value to the designer and those involved in the mechanical analysis of heat exchangers and pressure vessel designs. And there are numerous other texts that do a far superior job, in my opinion. The value of the book is thus limited to those wishing only to familiarize themselves with the terminology used in this industry.

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Handbook of Radiative Heat Transfer in High-Temperature Gases.

Edited by R. I. Soloukhin

New York: Hemisphere Publishing Corp., 1987. Pp. 309. $95.00

This book is aimed at researchers who are involved with the modeling of radiative transfer in high-temperature gases or plasmas, which is important in such fields as the reentry of

spacecrafts, laser processing, electric arcs, and discharges. The book is a translation of a Russian edition, originally published in 1984, and contains many references to important Russian works in this specialized area of radiation.

In Chapters 1 and 2, the authors discuss briefly the basics of radiation, its relation to other modes of energy transfer, some approaches available in the literature for handling the integration over all wavenumbers, and a few approximate methods of solution. These two chapters are not by any means complete, and the researcher must consult more complete texts such as *Thermal Radiation Heat Transfer* by R. Siegel and J. R. Howell or *Radiative Transfer* by M. N. Ozisik.

Chapters 3–6 present the theory and numerical results of a newly developed treatment of radiation in high-temperature gases, which is the significance of the text. However, the new method is limited to radiation problems in which emission and reflection from bounding surfaces and scattering are negligible. To save important computer times, the method is developed so that it utilizes data stored in the computer's memory. Such data, included in an appendix, cover the necessary information for hydrogen, argon, air, and carbon dixoide for a wide range of temperatures, pressures, and characteristic lengths. Since the data in the appendix cover 171 of the 308 pages in the text, it would have been worthwhile to provide the data on floppy disks. To obtain data for other constituents, it is necessary to perform calculations based on the theory presented in Chapter 4. Inspection of the results given in the text reveals that the new method is sufficiently accurate for most engineering applications.

This text is informative and well written. And credit should be given to R. Goulard, the editor of the English edition. As the integral computational method appears to be a promising approach, the text should serve as a welcome addition to the growing literature on radiative heat transfer in participating gases.

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Heat Transfer and Fluid Flow in Rotating Machinery

Edited by Wen-Jei Yang

New York: Hemisphere Publishing Corp., 1987. Pp. 553. $95.00

This book forms the *Proceedings of the First International Symposium on Transport Phenomena,* held in Honolulu in April/May 1985. It will either be confused with, or seen as a companion volume to, a recent title from the same publisher, *Heat and Mass Transfer in Rotating Machinery* (edited by D. E. Metzger and N. M. Afgan, 1983). Forty-three papers are included, without discussion, ranging from fundamental research likely to be of long-term value to product-specific studies of more ephemeral interest. The authors are predominantly from the United States and Japan, but other countries in the Pacific Basin are represented. A reasonable balance has been achieved between academic and industrial contributions.

Inevitably, many of the papers address phenomena that, although important to the operation of rotating machinery, are either affected by rotation to a negligible or small extent or are sufficiently poorly understood that studies in stationary frames of reference are currently the first priority. Approximately half of the papers are concerned with direct effects of rotation.

The papers are grouped into six sections. The *Blade Cooling* section (nine papers) begins with a valuable review by R. J. Moffat and includes several experimental studies of curvature effects on heat transfer and on film cooling effectiveness, together with work on end-wall heat transfer, mist cooling, and other topics. Visualization techniques and visualizations of secondary flows form a substantial part of the next section, entitled *Flow Visualization and Flow Measurements* (nine papers). The third and fourth sections, *Rotating Tubes, Channels and Heat Pipes* (four papers) and *Rotating Surfaces and Enclosures* (six papers), cover heat transfer and fluid dynamics studies on a variety of configurations, including shaft seals. Grouping of papers has had to be somewhat arbitrary, as subject areas in many cases overlap. A *General Topics* section (seven papers) contains some of the less obvious paper titles, on subjects as diverse as cooling of superconducting generators and numerical solutions for two-phase flow. The final section, *Turbines and Compressors* (eight papers), is equally wide ranging and includes discussions of radial turbomachinery measurements and steam/water flow.

Browsing through the book would have been easier if the subject index has been comprehensive and if all authors had begun their contribution with an abstract. However, the text and figures are generally very clearly printed, from camera-ready copy. The breadth of coverage makes it unlikely that many individual researchers will find it worthwhile owning a copy, but it should prove a useful addition to the library shelves.

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Heat Transfer in High Technology and Power Engineering

Edited by Wen-Jei Yang and Yasuo Mori

New York: Hemisphere Publishing Corp., 1987. Pp. 602. $95.00

This volume is the *Proceedings* of a seminar held in San Diego in September 1985 under the auspices of the U.S. National Science Foundation and the Japan Society for the Promotion of Science. To the potential reader it is important to recognize that the aim of this binational forum is to promote cooperative research between the two countries, and in consequence a number of the papers tend somewhat toward a qualitative review of a particular field. Overall, nearly half of the 39 papers are of this sort, the balance reporting specific research by the authors, with an odd distribution that is commented on below. The impression that lingers is of slightly guarded statements of research strategy from both countries' researchers supported by various presentations to establish technical credibility.

It is noted in the editors' introduction that the subject of the meeting reflects the diminution of interest in energy research and resultant shift toward high technology applications in the space, nuclear, and electronics industries. This is largely borne out by the contents, which are organized into four parts: (1) heat transfer in high technology; (2) high heat-flux technology; (3) high-performance heat exchanger devices; and (4) radiative heat transfer and solar energy utilization. Although some papers, particularly in the final section, have an air of "energy crisis" about them, even these are refreshingly free of the reexamination of economically discarded techniques so prevalent five or so years ago. In the opening review paper on relevant Japanese work, however, Professor Mori makes clear Japan's view that energy conservation research should still be pursued in preparation for expected oil price rises from 1990 onward, in parallel with the growth in high technolgy–related studies.

In the section on high technology the primary topics are from the space and electronics areas. In the former area a study on