BOOK REVIEWS

Numerical Computation of Internal and External Flows, Volume 1: Fundamentals of Numerical Discretization

C. Hirsch
John Wiley & Sons, Ltd., 1988

Volume 1 of this book is aimed at introducing the reader to the essential steps involved in the numerical simulation of fluid flows. The whole book consists of four parts: mathematical models for fluid flow simulations, basic discretization techniques, the analysis of numerical schemes, and the resolution of discretized equations. The discretization techniques introduced in this book are finite difference, finite element, and finite volume methods, but the spectral discretization methods are omitted.

The stability problem is discussed in Chapters 7 through 10. Chapter 8 gives a detailed discussion about the Von Neumann analysis. Chapters 9 and 10 discuss the method of equivalent differential equation and the method of matrix, respectively, both of which are found to be quite useful as more generalized stability analyses.

Many fundamental concepts are presented clearly and in an understandable way. The operator method is one of the unique approaches that many other competitive books do not have.

This book may be suitable for graduate courses and for scientists who are already engaged in computational fluid dynamics.

R. S. Amando

Handbook of Numerical Heat Transfer

Minkowycz, Sparrow, Schneider and Pletcher, Eds.
John Wiley & Sons, Ltd., 1988

The idea of creating a *Handbook of Numerical Heat Transfer* is a good one, and the editors deserve to be commended for their initiative and effort.

The Handbook attempts mainly to present available numerical methods for solving parabolic, elliptic and hyperbolic partial differential equations which govern the transport of momentum and energy in flows with heat transfer.

While the Handbook contains some of the well known numerical methods, it stops short of providing guidance to the reader as to which method best suits his specific problem. For example, there are four methods (Chapters, 2, 3, 4 and 5) for solving parabolic problems, and six (Chapters 6, 7, 8, 9, 10 and 11) for elliptic problems. Yet nowhere can the reader find a guide for selecting the appropriate one among these methods, or a list of the advantages and disadvantages of each method. I should emphasize here that these ten chapters describe their respective numerical procedures quite well and serve as a useful reference for them.

Because of the lack of user guidance, the Handbook is missing the main ingredient that would attract readers to a Handbook on numerical methods. I find this inconsistent with the editors' claim in the preface that 'From the very outset, it was the intent of the editors that the Handbook be user-friendly and that it accommodate various audiences ranging from relative beginners to experienced practitioners.' I do believe that this goal has not been accomplished.

A few of the 22 chapters are exempt from the above criticism, most notably the three chapters on hyperbolic and hyperbolic–parabolic systems, finite-difference versus finite-elements, and moving boundary problems. The authors of these chapters provide comparisons of the different methods of solving their respective problems with ample references.

The chapters on graphics and grid generation serve as reasonable introductions to these subjects.

This more-than-thousand-page volume contains much to be learned by practicing engineers, and perhaps the editors may wish to improve the Handbook in future editions.

S. Elghobashi

Viscous Flows: The Practical Use of Theory

Stuart Winston Churchill
Butterworths Series in Chemical Engineering, 1988 $52.95 602 pp.

This book, in spite of its general title, is essentially devoted to laminar, incompressible momentum transfer, primarily by analytic solutions, and subsequent comparison to experimental data. The book does not treat turbulent flow, compressible flow, heat transfer, mass transfer, flow instability, or numerical modeling. There is quite a bit of inviscid flow included, in spite of the book title, but very little boundary layer theory. There is a very good section on porous media.

The book is intended as a textbook for both a first-year graduate course or, with some material omitted, for a first undergraduate fluids course. It is based on the author's notes in his 35 years of teaching. There are over 700 problems for students, most rather brief but some quite challenging. There is apparently no Solutions Manual.

The author claims to introduce seven distinct characteristics in the presentation: (1) extensive use of simple theories; (2) developing skill in deriving theories; (3) comparison with experimental data; (4) use of asymptotic and correlating expressions; (5) focus on behavior rather than mathematics; (6) all derivations from first principles; and (7) emphasis on physical and quantitative understanding. These are, of course, similar to the goals set by authors of most engineering books. The author is especially successful with items 1, 3, and 4.

The book is divided into four parts, beginning with 130 pages (7 chapters) on one-dimensional laminar flows, derived and solved by simple "shell" balances. Non-Newtonian flows are included. Topics include tubes, channels, films, and Couette flows, each compared with an amazing amount of laminar-flow data.

Part 2, 120 pages long, treats the general equations, first derived and then applied to a variety of exact solutions, including inviscid and creeping-flow cases. Both differential and integral forms are considered. Derivations can be sketchy, sometimes strikingly so. For example, the Newtonian stress/strain-rate relations are simply inserted as "empirical expressions" which have "never been confirmed experimentally in the general sense." Stokes' hypothesis appears but is not explained. There is no energy equation, just mass and momentum. To the reviewer's knowledge the words *stress* and *strain-rate* are not mentioned in the book. An interesting variety of analytical solutions is given, but it is a somewhat confusing mixture of viscous and inviscid flows whose possible connection through, say, boundary layer theory is not emphasized.

Part 3 devotes 248 pages to "Unconfined Multidimensional Laminar Flows," including the flat plate, wedges and discs, two interesting chapters on the circular cylinder and the sphere, and a very good 70-page chapter on bubbles and droplets. The boundary layer equations are simply