REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the American Mathematical Society classification scheme. The 2000 Mathematics Subject Classification can be found in print starting with the 1999 annual index of *Mathematical Reviews*. The classifications are also accessible from `www.ams.org/msc/`.

1[65-01]—*Numerical methods*, by Germund Dahlquist and Åke Björck, translated by Ned Anderson, reprint of the 1974 English translation, Dover Publications, Mineola, N.Y., 2003, xviii+573 pp., ISBN 0-486-42807-9, $29.95

This book was first published in 1974 and has been used in advanced undergraduate and beginning graduate courses at many universities all over the world. The authors manage to discuss many topics in scientific computing in a rigorous way without introducing cumbersome notation. This helps readers grasp important aspects of scientific computing without getting lost in the details. Moreover, the book covers many topics that are not commonly found together in numerical analysis textbooks. The first twelve chapters discuss the following topics.

1. Some general principles of numerical calculation.
2. How to obtain and estimate accuracy in numerical calculations.
3. Numerical uses of series.
4. Approximation of functions.
5. Numerical linear algebra.
6. Nonlinear equations.
7. Finite differences with applications to numerical integration, differentiation, and interpolation.
8. Differential equations.
9. Fourier methods.
10. Optimization.
11. The Monte Carlo method and simulation.
12. Solutions to problems.

A thirteenth chapter contains a bibliography. This chapter was very valuable when the book was published in 1974, but it is the least useful chapter today.

In summary, the book under review was amazing when it was first published and has contributed significantly to the development of modern scientific computing. It still is valuable reading for students, scientists, and engineers who want to understand, use, and/or design numerical methods. The authors should be commended for making their book available again.

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2[35-XX, 65-XX, 76M10, 76M12, 76M20]—*Mathematical and computational methods for compressible flow*, by M. Feistauer, J. Felcman, and I. Straskraba, Oxford Science Publications, 2003, xiii+535 pp., ISBN 0-19-850588-4, $99.50

This book presents a comprehensive introduction to the mathematical and computational aspects of modeling compressible flows. The authors provide a strong theoretical background in the underlying mathematics of the algorithms to solve the basic model problems of computational fluid dynamics (CFD) in order to motivate the use of these algorithms on more complicated, real world, CFD problems. The book is separated into four chapters.

The first chapter covers the fundamentals of the equations describing compressible flow. After establishing the underlying partial differential equations describing compressible flow, a quick primer in functional analysis is provided in order to assist the reader with the mathematical analysis provided in later chapters.

The second chapter presents some classical mathematical results, i.e., hyperbolicity, existence of smooth and weak solutions, entropy conditions, etc., for nonlinear hyperbolic conservation laws. In addition, a short exposition of the existence of solutions for the compressible Navier-Stokes equations is presented.

Chapters three and four form the bulk of the book with a discussion of finite difference, finite volume, and finite element methods. To motivate the discussion of the various algorithms, an extensive analysis of the Riemann problem for the Euler equations is presented in the first part of chapter three. Basic finite difference schemes i.e., Lax-Friedrichs, Lax-Wendroff, Godunov, Engquist-Osher, Steger-Warming, Roe schemes, etc., for one-dimensional hyperbolic systems are presented in the first half of chapter three along with a discussion of their numerical properties. Higher order accurate finite difference (W)ENO schemes are also discussed.

The second half of chapter three is concerned with finite volume mesh methods for multidimensional Euler equations. A brief discussion of meshing is presented. The various numerical properties of generalized finite volume schemes are reviewed and the Osher-Solomon method is explained in detail. Both TVD-MUSCL schemes and mesh adaptation are discussed as two paths to higher resolution simulations. The chapter finishes with a variety of examples of finite volume simulations.

Chapter four discusses finite element methods (FEM) for viscous compressible flow. A brief introduction to FEM is provided before a discussion of various schemes for handling convective dominated flows, including the streamline diffusion method, combined finite volume–finite element methods and the discontinuous Galerkin finite element method. Numerical examples are provided to illustrate the capabilities of each technique.

Overall, the book provides a complete introduction to the variety of numerical techniques and the mathematical analysis behind them to solve problems in compressible flow, and it is suitable for researchers and advanced level graduate students in computational science and engineering.

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