

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/.

2[65M70, 76D05]—*High-order methods for incompressible fluid flow*, by M. O. Deville, P. F. Fischer, and E. H. Mund, Cambridge University Press, 2002, xv + 499 pp., hardcover, \$80.00, ISBN 0-521-45309-7

Deville, Fischer, and Mund have created an exciting contemporary monograph, which addresses modern aspects of scientific computing of incompressible flows.

The book begins with an excellent review of fluid mechanics from the point of view of both classical theory and computational requirements for successful simulations. The first chapter reviews equations for conservation of mass, momentum, and energy, as well as the first and second principles of thermodynamics and vorticity equations in a clear, concise manner. The authors go on to discuss dimensionless numbers, which characterize the different physical situation and simplified models which arise from the limit of the generalized equations when the dimensionless numbers get very large or small. Next, turbulence is discussed from both the modeling and the numerical point of view. Finally, in a discussion that unifies hardware, software, and parallel algorithmic issues, the authors justify the use of high-order schemes. This section (1.11) illustrates the unique flavor of the book.

The next six chapters present an impressive array of topics: numerical methods for elliptic, hyperbolic, and parabolic equations, multidimensional problems, steady and unsteady Stokes and Navier-Stokes equations, and domain decomposition methods. These topics are covered in enough detail to serve as a textbook, and yet are of interest to those practitioners familiar with the material. Each model's assumptions and equations are stated explicitly, and the algorithms are clearly presented; thus, the book serves as an excellent reference. At the end of each chapter there is a section in which the applications and numerical simulations are described and analyzed, making the book a treasure trove of benchmark problems.

Finally, the great strength of this book lies in its discussion of vector and parallel implementation. Chapter eight presents to the practitioner of these numerical methods the workings and limitations of parallel and vector computing. The authors describe, in jargon-free language, the serial and parallel implementation and performance of the high-order methods described throughout the book. This chapter is of great interest since, as the authors point out, the development of algorithms for high-order methods is partly driven by the advances made in computing.

Drs. Deville, Fischer, and Mund have put together a masterful book. It is both a textbook and a reference for the practitioner of numerical methods. The authors write that the goal of this book is

...to show the realm of feasibility of high-order methods: accuracy versus efficiency, tractable problems, nonlinearities, complex

geometrical configurations, and the influence of computer architectures. (page xxvi)

They have succeeded in this task and have produced a work of great usefulness and charm.

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3[90C25, 90C05]—*Lectures on modern convex optimization: analysis, algorithms and engineering applications*, by Aharon Ben-Tal and Arkadi Nemirovski, SIAM, Philadelphia, PA, 2001, xvi + 488 pp., softcover, \$106.00, ISBN 0-89871-491-5

This book gives a very nice treatment of the applications, theory, and interior-point algorithms for convex optimization in general and semidefinite/second-order cone programming in particular. The authors have clearly taken great care to motivate and explain, starting from basic linear algebra and analysis, the problems, the algorithms and their various properties (duality, tractability, complexity). This is aided by a generous but well-chosen collection of motivating examples. Thus, readers with little background in optimization can read the book with ease. At the same time, the topics are treated in much depth, often infused with new insights. And there is a wealth of exercises for those wishing to delve into the topics in more detail. Thus, readers familiar with optimization will also find much in the book to interest them. I further like the informal, but lively and engaging writing style. The reader feels almost as if he/she is present in the lectures. Good illustrations of this style are the motivating example and the follow-up questions on page 12 set up the reader nicely for the duality theory to follow. I wish more books were written in this style!

Over all, I find this book to be first-rate in all respects: topic, exposition, content. It should belong on the shelf of *anyone interested in convex optimization*.

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