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BOOK REVIEWS

Modern Software Tools for Scientific Computing. Edited by E. ARGE, A. M. BRUASET & H. P. LANGTANGEN. Birkhäuser, 1997, 380 pp. ISBN 3 7643 3974 8. DM 140.00.

The availability of a comprehensive software library with a tree-like structure that would allow scientists and engineers to generate numerical solutions to a broad range of problems with a high degree of confidence, a specified level of accuracy, and at a reasonable cost, while requiring minimum training, is highly desirable. Efforts have been made to produce branches of such a library in the areas of numerical linear algebra, computational fluid dynamics, computational physics, and others, but the job is far from complete. There are several intrinsic difficulties and important challenges: unlike business applications software, the intelligent use of scientific software requires that the user have a good understanding of the fundamentals, and a bachelor's or even graduate degree in science or engineering; to unify and standardize scientific software requires breadth of knowledge, strong and committed leadership, and a substantial amount of resources.

This book makes a pioneering step in the right direction. The seventeen chapters consist of an equal number of refereed articles presented at the 1996 International Workshop on Modern Software Tools for Scientific Computing, in Oslo. The articles emphasize the design of large software codes, computational efficiency, object-oriented programming, software reliability, and parallel computing. The volume is divided into three parts, on Computational Differential Equations (11 articles), Computational Geometry (2 articles), and Software Development (4 articles). The scope of the individual articles varies in breadth. Some articles discuss general-purpose tools that are pertinent, for example, to a class of differential equations, with user-specified initial and boundary conditions and visualization tools appended to the solvers. Other articles discuss, in detail, specific applications and implementations, and the authors' chosen strategy for laying out a code.

Object-oriented programming is a key term in this volume. It is mentioned virtually in all articles and advertised with infectious enthusiasm as an important tool. The traditional FORTRAN 77 programmers will be happy to know that they have been doing it all along with the extensive use of subroutines; object-oriented languages simply facilitate argument passing. Sensible object-oriented programming and the use of computer languages that allow for it are certainly desirable, but one should remember that this is just one aspect of scientific programming, and perhaps not the most important one. On the other hand, thinking in terms of library classes, which are inherent in object-oriented programming, helps the physical intuition by engaging the programmer in a process of analytical decomposition.

The quality of presentation and production of this volume are excellent, and this confirms that the editors and the publisher have successfully endeavoured to make an impact. I recommend this book to those who want to keep up with the state of the art in scientific software architecture, and to those who are keen on ideas on how to improve their codes.

C. POZRIKIDIS

The Numerical Solution of Integral Equations of the Second Kind. By K. E. Atkinson. Cambridge University Press, 1997. 552 pp. ISBN 0 521 58391 8. £50.00.

Professor Atkinson's well-known book on numerical analysis is distinguished by clarity, elegance, and comprehension; this book on integral equations shares all of these qualities. In an effort to make the subject matter accessible to a large audience, Professor Atkinson has targeted several groups: applied mathematicians, with the objective of pointing out to them problems that are of interest in engineering; engineers, with the objective of convincing them that understanding the theoretical foundation is necessary for writing intelligent computer codes; and graduate students in both areas, with the objective of convincing them that understanding the theoretical foundation is necessary for writing intelligent computer codes; and graduate students in both areas, with the objective of offering them a balanced introduction to integral formulations leading to boundary-element methods. The reader should be aware that this book is not intended for casual reading; following the discourse requires a good background on functional and numerical analysis. Furthermore, readers are expected to filter out the whole or parts of sections that are of no immediate or particular interest, on their own.

Chapter 1 is a brief introduction to linear integral equations from the perspective of the applied mathematician. Chapters 2–6 discuss the general theory of numerical methods for solving Fredholm integral equations of the second kind, and integration equations of the first kind whose analysis is similar to those of the second kind. Chapters 7–9 apply the general methods to Laplace's equation in two and three dimensions. There is a fair amount of new material, fresh perspectives, and extensive references throughout the discussion.

In the short time I had this book, it has become one of my favourites on its subject matter. I highly recommend it for self-study, and I guarantee its usefulness as a reference source and as an authoritative survey.

C. Pozrikidis

SHORT NOTICES

Mathematical Methods for Physics and Engineering. By K. F. Riley, M. P. Hobson & S. J. Bence. Cambridge University Press, 1997. 1008 pp. ISBN 0 521 55529 0. £17.95.

This substantially revised and enlarged version of an old favourite text by Riley will surely find its way onto the book lists of many university courses in engineering and physical sciences. In a clear and attractive form, this book offers in a single volume all the mathematics which a student will need to go from the current standard of school mathematics (in the UK, at least) to the end of a university course. Starting with elementary calculus and complex numbers, the book encompasses all the expected topics of an undergraduate course plus a few less common ones (such as calculus of variations, integral equations and representation theory). Each section has highlighted worked examples, as well as exercises for which hints but not full solutions are given. Even with 1000 pages, the pace is not slow. Certainly the style is more demanding than most of the competing textbooks in this area. The compensation is that this book will remain an invaluable reference source on the shelves of postgraduate students and professional scientists and engineers, long after the tutorial style of more plodding

works has become irritating. Anyone teaching a course in mathematics for scientists or engineers would do well to consider recommending this book.

Special Functions of Mathematics for Engineers. By L. C. Andrews. SPIE Press, Oxford Science Publications, 1998. 479 pp. ISBN 019 856558 5. £50.00.

This useful book on special functions, first published in 1985, is back in print under the auspices of the Society of Photo-Optical Instrumentation Engineers. It covers the Gamma, Bessel and Hypergeometric Functions, some orthogonal polynomial families, and related functions. It is mathematically rigorous but anchored throughout in applications from physics and engineering, and it provides a valuable source of information which is otherwise usually buried in more impenetrable mathematical works.

Collected Papers of W. R. Sears Through 1973 (Vol. I). Edited by N. H. Kemp. 1974. 483 pp.; **Collected Papers of W. R. Sears Post 1973 (Vol. II).** Edited by K.-Y. Fung, D. A. Caughy & P. C. Tobias de Boer. 1997. 250 pp.

These paperback volumes contain facsimile copies of the collected papers of W. R. Sears from the journals in which they first appeared. Each volume has a brief biographical introduction (by N. H. Kemp and W. J. Rae respectively). The volumes are printed by Cornell University, and the Sibley School of Mechanical and Aerospace Engineering at Cornell welcomes requests from those interested in receiving a copy of Volumes I or II.

Sedimentation of Small Particles in a Viscous Fluid. Edited by E. M. Tory. Computational Mechanics Publications, 1996. 281 pp. ISBN 1 85312 357 9.

This volume consists of a series of invited chapters each intended to offer a critical review of recent research, rather in the spirit of *Annual Reviews of Fluid Mechanics*. Each chapter is concerned with a particular aspect of the sedimentation of non-Brownian but inertialess particles in a viscous liquid.

The book starts with an obituary of T. Brooke Benjamin (which seems out of place here). Subsequent chapters are:

Kynch Theory of Sedimentation, by M. C. Bustos & F. Concha
Phenomenological theory of sedimentation, by F. Concha, M. C. Bustos & A. Barrientos
Some basic principles in interaction calculations, by D. J. Jeffrey
Motion of a rigid particle in Stokes flow, by N. Liron & E. Barta
Velocities of sedimenting particles in suspensions, by R. H. Davis
The stochastics of sedimentation, by C. H. Hesse & E. M. Tory
Theoretical and experimental evidence for a Markov model for sedimentation, by E. M. Tory & C. H. Hesse

Despite claims to the contrary, this is not a unified treatment: chapters written by different contributors are marked by changes in style, notation and level of rigour. Indeed it is not obvious that the approaches taken by different authors to the central issue of *randomness* in sedimenting suspensions based on an analysis of relative particle configurations on the one hand, and a stochastic analysis of particle trajectories on the other, are consistent.

Rarefied Gas Dynamics 20. Edited by C. SHEN. Peking University Press, 1997. 1007 pp. 7-301-03352-4/0.391.

The 20th International Symposium on Rarefied Gas Dynamics (RGD) was held in Beijing 19–23 August 1996. This volume of the Proceedings contains 155 papers presented in 13 technical sessions by delegates from 20 countries. The 13 technical sessions are: kinetic theory and transport theory; direct simulation: methodology and applications; mathematical and numerical methods; gas surface phenomena and beams; external flows and space vehicles; jets, plumes and expansion flows; internal flows and vacuum technology; relaxation processes, reaction rates and shocks; collision dynamics in RGD; low density ionized gas flows and plasma processing; clusters, aerosols, RGD aspects of condensation and evaporation; experimental techniques and instrumentation in RGD; RGD of micromechanical devices.

Erosion and Sedimentation. By P. Y. JULIEN. Cambridge University Press, 1998. 380 pp. ISBN 0 521 44237 0. £19.95.

This is the paperback version of the book that appeared in hardback in 1995. It was reviewed by R. L. Soulsby in *J. Fluid Mech.*, vol. 304, 1995, p. 373.

Topographic Effects in Stratified Flows By P. G. BAINES. Cambridge University Press, 1998. 482 pp. ISBN 0 521 62923 3. £24.95.

This is the paperback version of the book that appeared in hardback in 1995. It was reviewed by P. G. Drazin in *J. Fluid Mech.*, vol. 326, 1996, p. 439.