

◆ BOOK NEWS AND REVIEWS ◆

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ORDINARY DIFFERENTIAL EQUATIONS IN THEORY AND PRACTICE

Reviewed by Michael N. Vrahatis

Ordinary Differential Equations in Theory and Practice, by R.M.M. Mattheij and J. Molenaar; John Wiley & Sons, Chichester, UK, 1996, 407 pp., ISBN 0 471 95674 0, \$79.95 US (hardcover), 0 471 96530 8, \$44.95 US (paperback).

"The laws of nature are expressed by Differential Equations."
—Isaac Newton

Differential equations form the basic mathematical models of science and engineering, and they provide many of the connections between mathematical theories and scientific applications. By solving differential equations, we can obtain significant information for modeling numerous physical processes. Moreover, given the difficulty in obtaining exact (analytical) solutions, we must often approximate solutions using numerical computations.

Applications emphasis

In this book, Mattheij and Molenaar present a fairly comprehensive theory of ordinary differential equations, with special emphasis on applications in initial and boundary value problems in areas such as classical mechanics and continuous media. They cover many issues in the field, providing insight into qualitative and quan-

titative aspects as well as applications in real-life problems and mathematical modeling.

The book is self contained and starts with a reference of basic concepts, including the existence and uniqueness theorems that are necessary for developing both one-step and multi-step methods for solving ODEs numerically. The authors also examine the theory of linear systems of ODEs with constant or nonconstant coefficients, and analyze the phase space of plane-autonomous systems and difference equations obtained by discretization. They even include theoretical elements necessary for the stability analysis of solutions of nonlinear ODEs using Lyapunov functions.

Coverage of more specialized subjects, although not examined in detail, is stimulating enough to inspire further pursuit. For example, the authors also study some modern aspects of ODEs as related to chaotic dynamics, strange and chaotic attractors, fractal dimension theory, and applications in Hamiltonian mechanics, biology, and water wave problems. Furthermore, they present techniques of singular perturbation theory in problems often encountered in hydrodynamics and boundary layer theory. They also present methods for dealing with stiff equations, differential-algebraic equations, and boundary value problems.

The MIT Press

iWarp

Anatomy of a Parallel Computing System

Thomas Gross and David R. O'Hallaron

"There is no doubt that iWarp was an important research effort. This work is significant as an archival record of the innovative research undertaken in the project."

—Siddhartha Chatterjee, University of North Carolina at Chapel Hill

The iWarp is an experimental parallel system designed and built jointly by Carnegie Mellon University and Intel Corporation. This book describes the complete iWarp system, from instruction-level parallelism to final parallel application.

530 pp., 270 illus. \$45

NUMERICA

A Modeling Language for Global Optimization

Pascal Van Hentenryck, Laurent Michel, and Yves Deville

"This is a well written presentation of a significant new modeling language that provides an exciting new tool for solving an important class of problems. The authors are careful to motivate their work and facilitate understanding through both abstraction and example. It serves a clear purpose with demonstrated success."

—Eugene C. Freuder, University of New Hampshire

232 pp. \$25 paper

FORTRAN 95 HANDBOOK

Jeanne C. Adams, Walter S. Brainerd, Jeanne T. Martin, Brian T. Smith, and Jerrold L. Wagener

A comprehensive reference work for the Fortran programmer and implementor, this book contains a complete description of the Fortran 95 programming language. This new version includes several new features that bring Fortran into the world of high-performance parallel computing, and is authored by members of the international standards committees that designed and certified the language.

Scientific and Engineering Computation series • 750 pp., 20 illus. \$50 paper

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<http://mitpress.mit.edu>

Reader Service Number 3

I really recommend this book to anyone who wishes to know about and work with ODEs. Mattheij and Molenaar effectively combine both analytical and numerical aspects of ODEs—rigorously describing many topics while maintaining accessibility for scientists and engineers outside the field. They cover the topics in a practice-oriented manner. The theory is not too extensive—covering just

what is necessary—but the study is complete, and it is filled with illustrative examples.

Software on the Net

I believe that with its comprehensive and compact discussion of theory and applications, this book will be useful as a source of reference and inspiration for students, researchers, and scientists alike. Also, for the interested reader,

the software used to obtain the numerical results in this book is available on the Internet. ♦

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