REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the American Mathematical Society classification scheme. The 1991 Mathematics Subject Classification can be found in the annual subject index of *Mathematical Reviews* starting with the December 1990 issue.

29[65–01, 65Mxx, 65Nxx].—DANIEL EUVRARD, *Résolution Numérique des Équations aux Dérivées Partielles: Différences Finies, Éléments Finis, Problèmes en Domaine non Borné*, 3rd ed., Masson, Paris, 1994, xiv + 329 pp., 24 cm. Price: Softcover F 182.

This is the third edition of a textbook, in French, intended for students in physics, mechanics, and engineering, on the numerical solution of partial differential equations. It has grown out of courses given by the author over more than 20 years at a number of different universities in France, most recently at the University of Paris VI.

Since it is not intended for students with a good mathematical background, it avoids mathematical rigor, but the choice of material and the presentation are nevertheless strongly influenced by the mathematically oriented school of numerical analysis originating with Professor J. L. Lions, which is also acknowledged in the introduction of the book.

The author emphasizes the point of view that in order to be able to reasonably solve a PDE numerically, one has to know the properties of this equation and its solutions. He therefore spends about as much time on the continuous problems as on their discretization, deriving exact solutions for specific examples where these can be easily found, and using these to elucidate general properties. These examples replace a general theory, and are used to motivate properties of numerical methods.

The book is divided into three parts headed I. Finite Differences, II. Finite Elements, and III. Numerical Problems in Unbounded Domains. In Part I, which makes up about half of the book, the five chapters are concerned with Laplace's equation, the heat equation, the wave equation, Burgers's equation, and the Navier-Stokes equations. Basic material, and concepts such as consistency, stability, and convergence are discussed as well as discrete maximum principles and energy arguments, and the standard finite difference methods are presented.

In Part II, making up about one fourth of the book, there are three chapters on Basic Finite Elements, Advanced Finite Elements, and Applications to Elasticity Problems. Again, the material is standard, with emphasis on practically useful elements, and on applications.

Part III, finally, also has three chapters, entitled The Boundary Element Method, Applications to Wave Propagation, and Alternative Methods. The emphasis in this part is on integral representation with singular kernels of solutions. In the first of the chapters, the exterior Neumann problem is discretized using collocation with piecewise constants and a polygonal approximation of the domain. In the second, the ideas are applied to problems in acoustics and hydrodynamics, and in the final chapter, the method of coupling of finite elements and integral representations is discussed.

Even though I would personally have preferred a somewhat bigger dose of mathematical analysis in a text on numerical methods for PDEs for the type of students targeted (and we do include that in the course for engineering students in our university), I have quite a bit of sympathy for the presentation and the list of topics covered in the present book.

V.T.

30[49-02, 49M15, 49N99, 90C30].—R. Bulirsch & D. Kraft (Editors), *Computational Optimal Control*, Internat. Ser. Numer. Math., Vol. 115, Birkhäuser, Basel, 1994, x + 382 pp., 24 cm. Price $94.00.

This book is a collection of selected papers of the ninth IFAC Workshop on Control Applications of Optimization held in Munich in September 1992. There are 30 papers ranging from 6 to 19 pages in length. The collection is divided into five sections. The first section contains four invited papers surveying the field of computational optimal control. Two of the papers describe the transcription of optimal control problems into nonlinear programming problems and discuss sequential quadratic programming (SQP) methods for solving them. The other two papers survey optimal control problems that have been studied in robotics and aerospace applications.

There are five papers in the second section of the book which discusses the theoretical aspects of optimal control and nonlinear programming. These papers discuss recent work on methods of solving boundary value problems, synthesizing adaptive optimal controls, reduced SQP methods, and time-optimal control of mechanical systems. Unfortunately, several of the proofs of the theoretical results have been omitted and are referenced in "forthcoming papers" or theses (that generally take some time to obtain).

Section three contains eight papers presenting algorithms used for optimal control computations. Algorithms discussed include SQP methods, backward procedures for calculating the solvability sets in differential games, repetitive optimization, and interior-point methods. While most of these papers outline algorithms for a class of problems and subsequently illustrate their use on example problems, a couple of the papers are more specialized in that they discuss algorithms for solving particular problems (time-optimal control of a type-2 third-order system and space shuttle reentry with uncertain air density).

In Section four, there are four papers detailing available software and recent efforts in producing software for optimal control calculations. Approaches used in these software packages include symbolic differentiation of equations, using a symbolic manipulation language to generate optimization routines for numeric solution, and interfaces for allowing the user to view the status of numerical results as well as to change design parameters. Examples are given in each of these papers to give the reader a flavor for how the software packages operate.