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.

35[65–01, 65L05].—J. D. LAMBERT, *Numerical Methods for Ordinary Differential Systems: The Initial Value Problem*, Wiley, Chichester, 1991, x + 293 pp., 25 cm. Price $49.95.

There are a few excellent monographs on the computational aspects of initial value problems for ODEs, notably Butcher's book and the two volumes by Hairer, Wanner and Nørsett and Hairer and Wanner, and there is a large number of introductory textbooks on the subject, with various objectives and at different levels; but none of them is well suited for use in an upper undergraduate or general graduate course for *mathematics* students. The new text by J. D. Lambert fills this gap and proves that it is possible to write an introductory text in an area of computational mathematics which combines rigorous mathematical arguments and computational heuristics to produce a homogeneous and didactically excellent book. The fundamental tool by which the author succeeds in attracting the reader's attention to the crucial questions, before he starts discussing them, is the use of exquisitely chosen key examples; in their clever choice, illustrating the desired effects and discriminating between methods, they go considerably beyond the standard demonstrative examples commonly used. Their presentation, analysis, and discussion is one of the aspects which make this book outstanding.

The author also managed exceedingly well in keeping a balance between the theoretical analysis of the methods presented and the discussion of techniques necessary for their efficient implementation. This balance is apparent in the overall layout of the book, e.g., in the restriction to classes of methods which are actually found in software packages, as well as in the treatment of individual issues, like the predictor-corrector mode of linear multistep methods. In his mathematical explanations, the author has succeeded in being convincing without giving formal proofs at all times and for everything, though a good number of proofs have been spelled out and used to convey further insight. There are also some delightful didactic tools like a 'syntax for stability definitions'.

The text begins with two introductory chapters: 'Background Material' on ODEs and some analytic tools, and 'Introduction to Numerical Methods', which culminates in the display and analysis of the behavior of six different methods on the same well-chosen example. (Incidentally, its right-hand side $f(u, v)$ does *not* satisfy a Lipschitz condition for all values of u and v; thus Theorem 1.1 should have been formulated a bit more generally.)

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Chapter 3 gives a thorough exposition of Linear Multistep Methods along classical lines, with perhaps too many details about individual Adams methods. Delightful is the simple example which shows that the *local* eigenvalues of the Jacobian may not give insight into the solution behavior and thus into the actual stability behavior of a method. Chapter 4 explains the well-known theoretical, and important implementational, aspects of the predictor-corrector approach, with sufficient detail to convey genuine understanding. The difficulty of stepchanging in linear multistep methods is explained and the three customary techniques are discussed. The rationale for choosing the step and order in such methods concludes this chapter.

The following Chapter 5 is necessarily devoted to Runge-Kutta methods. Here, the author has succeeded in presenting and using the essentials of Butcher's theory (based on elementary differentials and Butcher series) in a form which is intuitive and rigorous at the same time. In a concluding section, he even presents the alternative approach of P. Albrecht's A-methods in sufficient detail (not found in most of Albrecht's own publications) to make it transparent, and he establishes its equivalence with Butcher's approach in classical cases.

The final two chapters are devoted to stiffness (Linear and Nonlinear Stability Theory). Again, cleverly chosen examples play an important role in assisting the student to understand the central concepts and technical discussions. The treatment proceeds up to the 1990 state-of-the-art and includes order stars, the algebraic stability concepts, one-sided Lipschitz constants and logarithmic norms, G-stability, and B-stability and B-convergence.

I have no doubt that this book will become the classical text for the audience for which it has been conceived. Besides, it will provide a welcome and urgently needed easy access for computational scientists of all persuasions to appreciate the modern view on solving numerically initial value problems in ODEs.

H. J. S.

36[65-06, 65Y05, 68-06].—JACK DONGARRA, KEN KENNEDY, PAUL MESSINA, DANNY C. SORENSEN & ROBERT G. VOIGT (Editors), *Parallel Processing for Scientific Computing*, SIAM, Philadelphia, PA, 1992, xviii + 648 pp., 25 cm. Price: Softcover $67.60.

This collection of 94 papers and short abstracts from the 1991 SIAM Conference on Parallel Processing for Scientific Computing covers six areas: matrix computations (including dense linear algebra, sparse direct methods, and iterative methods); nonlinear equations and optimization; differential equations; applications, modeling and simulation (including biology, reservoir simulation, simulation and modeling); performance evaluation and software tools (including performance, parallel software development tools, programming environments and novel architectures), and mathematical software. Papers range from theoretical studies to performance evaluation to descriptions of software and hardware systems. Many of the major researchers in these fields are represented, and these papers give a good overview of research in this fast-changing area as of 1991. In this short review we will simply list the topics covered, since the number of papers is too large to mention each one individually.