

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.

8[65-02, 65F10, 65L05, 76D05, 65N99].—GURI I. MARCHUK (Editor), *Numerical Methods and Applications*, CRC Press, Boca Raton, FL, 1994, x + 272 pp., 24 cm. Price \$59.95.

This volume contains six articles by leading Russian numerical analysts working in Moscow. They are selected and translated, in some cases in slightly modified form, from Vol. 8 in a series entitled *Numerical Processes and Systems* and which is associated with the Institute of Numerical Mathematics of the Russian Academy of Science. Even though the quality of presentation and translation is somewhat uneven, the volume gives a good overview of the activity that is presently pursued in numerical mathematics in Moscow. We refrain from reviewing the papers individually but indicate the scope of the volume by reproducing its table of contents:

- E. G. Dyakonov, *Iterative Methods Based on Linearization for Nonlinear Elliptic Grid Systems.*
- V. I. Lebedev, *How to Solve Stiff Systems of Differential Equations by Explicit Methods.*
- G. M. Kobelkov, *On Numerical Methods of Solving the Navier-Stokes Equations in "Velocity-Pressure" Variables.*
- R. P. Fedorenko, *Stiff Systems of Ordinary Differential Equations.*
- A. A. Zlotnik, *Convergence Rate Estimates of Finite-Element Methods for Second-Order Hyperbolic Equations.*
- N. S. Bakhvalov and A. V. Knyazev, *Fictitious Domain Methods and Computation of Homogenized Properties of Composites with a Periodic Structure of Essentially Different Components.*

V. T.

9[65L05].—B. P. SOMMEIJER, *Parallelism in the Numerical Integration of Initial Value Problems*, CWI Tracts, Vol. 99, Centrum voor Wiskunde en Informatica, Amsterdam, 1993, vi + 195 pp., 24 cm. Price: Softcover Dfl.50.00.

During 1988, the Centrum voor Wiskunde en Informatica, in Amsterdam,

initiated a research program on parallel methods for ordinary differential equations. This tract is a compilation of six papers [1, 2, 3, 4, 5, 6] coming out of this research, together with an extended introduction by B. P. Sommeijer. The introduction is more than a preamble to the rest of the monograph, and is, in essence, a further paper. The aspect of parallelism considered here, "across the method", makes sense only for multistage methods. Explicit Runge-Kutta methods, in their traditional formulation, have little to offer, but there seem to be reasonable prospects for iterated Runge-Kutta methods and for the type of multivalued multistage methods described here as block Runge-Kutta methods. For stiff problems, implicit Runge-Kutta methods can sometimes be effectively implemented using parallel iterations. To all these options, methods generalizing predictor-corrector methods can be added. The papers included here discuss many aspects of these many method types, such as order, convergence of iterations, stability, local error estimation and stepsize control. The theoretical work is supported by insightful numerical evaluations and comparisons. For both nonstiff and stiff problems, and for the related differential-algebraic equations, parallelism across the method is still a vital area of research and the work presented in this tract is a valuable introduction to this topic.

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1. P. J. van der Houwen and B. P. Sommeijer, *Parallel iteration of high-order Runge-Kutta methods with stepsize control*, J. Comput. Appl. Math. **29** (1990), 111–127.
2. ———, *Block Runge-Kutta methods on parallel computers*, Z. Angew. Math. Mech. **72** (1) (1992), 3–18.
3. B. P. Sommeijer, W. Couzy, and P. J. van der Houwen, *A-stable parallel block methods for ordinary and integro-differential equations*, Appl. Numer. Math. **9** (1992), 267–281.
4. P. J. van der Houwen, B. P. Sommeijer, and W. Couzy, *Embedded diagonally implicit Runge-Kutta algorithms on parallel computers*, Math. Comp. **58** (1992), 135–159.
5. P. J. van der Houwen and B. P. Sommeijer, *Iterated Runge-Kutta methods on parallel computers*, SIAM J. Sci. Statist. Comput. **12** (1991), 1000–1028.
6. ———, *Analysis of parallel diagonally implicit iteration of Runge-Kutta methods*, Appl. Numer. Math. **11** (1993), 169–188.

10[65L15, 65Y15, 34B24].—JOHN D. PRYCE, *Numerical Solution of Sturm-Liouville Problems*, Monographs on Numerical Analysis, Oxford Univ. Press, Oxford, 1993, xiv + 322 pp., 24 cm. Price \$56.50.

The past few years have seen a remarkable production of mathematical software for Sturm-Liouville problems; all of these codes treat various fairly wide classes of Sturm-Liouville problems (both regular and singular) with automatic error control of some kind. The timely text of Pryce discusses all of these codes (as well as other numerical methods) and, more importantly, provides considerable detail on the underlying mathematics. In the words of the author "It