REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the American Mathematical Society classification scheme. The 1980 Mathematics Subject Classification can be found in the December index volumes of Mathematical Reviews.

8[65–01].—ROBERT F. CHURCHHOUSE (Editor), *Numerical Methods*, *Handbook of Applicable Mathematics* (Walter Ledermann, Chief Ed.), Vol. III, Wiley, Chichester, New York, Brisbane, Toronto, 1981, xvii + 565 pp., 25 cm. Price $85.00.

The premise of this volume is that it is a work for the novice who wants to quickly break into a particular topic and then apply it. The topics treated are by and large typical of a one year basic course in Numerical Analysis. However, the chapters on quadrature and, in particular, on integral equations go beyond the typical university course.

The eleven chapters live up to their promise of being independent and it is thus possible to start reading exactly the chapter one is interested in. The numerical methods are well explained with worked examples. An Appendix contains seventeen Fortran programs. These are mainly of a very basic nature; many similar ones are preprogrammed in modern calculators. Listing them may, however, be a service to people working in places isolated from serious computing power.

This volume is appropriate for a reference library. I may envision its use as follows: In my office. Enter a graduate student from, say, Biology. "I need to solve this differential equation but I never took a course in numerical methods. Could you point me to a book where I could learn something quickly about what our canned programs do?" I would be happy to direct that student to this book.

L.B.W.

9[65M10].—ROBERT VICHNEVETSKY & JOHN B. BOWLES, *Fourier Analysis of Numerical Approximation of Hyperbolic Equations*, SIAM Studies in Applied Mathematics, SIAM, Philadelphia, PA, 1982, xii + 140 pp., $23\frac{1}{2}$ cm. Price $21.50.

This book is devoted to a detailed understanding of phenomena in numerical solution of hyperbolic problems. Simple model cases are treated where it is possible to use Fourier techniques in an effortless way; without this use of Fourier analysis, many of the phenomena discussed would at present not be understood.

The numerical methods considered include finite difference methods, Galerkin-spline methods, collocation methods and spectral methods. Interrelations between

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these methods are pointed out. Classical asymptotic convergence analysis involving truncation error and stability estimates is presented, but the emphasis is on more subtle features of the approximations. These features are of great, sometimes paramount, importance in practice. The phase velocity error (numerical dispersion) is given prominent play and the amplitude error (numerical dissipation, a.k.a. diffusion or damping) is also treated. The concept of group velocity and its role in explaining, e.g., spurious reflections at downstream boundaries is discussed. In a final chapter the numerical anisotropy of the phase velocity in approximations to the advection equation in two space dimensions is treated. The effects of numerical sampling and filtering are also briefly considered.

The book is well written in a fast moving style. The topics treated are easy to find because of an excellent Table of Contents, 75 sectional entries listed for a book of 129 pages, and an equally excellent index of some 250 entries. In the Preface the authors express hope that the book will be useful as a reference. One may quarrel with this since the brisk pace has completely dispensed with stated theorems. However, the tight sectional organization compensates for this lack of directly quotable results and, in the simple context treated, theorems would have so few and obvious hypotheses that the reader can easily supply them if needed. This brisk style leaves the arguments very sketchy at times. For example, on page 76, in connection with a discussion of the propagation of a wave packet, a rather impossible form of its envelope is assumed in (6.2) and the subsequent analysis is merely indicated.

The authors have frequently dispensed with references to the literature, in particular to results that go beyond the simple cases treated. The unaware reader may thus be left with the impression that what is given in this book is the state of the art. However, more than a dozen years ago Fourier analysis had been used in a sophisticated way to treat, e.g., the following questions: (i) sharp estimates of the rate of convergence and its dependence on the smoothness of initial data (I refer here to the investigations of Brenner, Hedström, Serdjukova and Thomée; see, e.g., [1] and references therein; (ii) the effect of jump discontinuities in data, cf. Section 8.2 in the present book (here the research of Apelkrans, Brenner, Hedström, Kreiss, Lundqvist and Thomée come to mind, cf. [2]); (iii) the effect of using a preliminary smoothing of initial data, cf. again Section 8.2 (this question was treated in [1]); (iv) in connection with Chapter 7, I missed references to the basic work of Gustafsson, Kreiss and Sundström and its predecessors, cf. [3].

Within the aims that the authors have set themselves they have succeeded. This is a work that succinctly explains how to use elementary Fourier techniques to explain phenomena of great practical importance.

L.B.W.

1. P. Brenner & V. Thomée, "Stability and convergence rates in L_p for certain difference schemes," *Math. Scand.*, v. 27, 1970, pp. 5–23.

2. P. Brenner & V. Thomée, "Estimates near discontinuities for some difference schemes," *Math. Scand.*, v. 28, 1971, pp. 329–340.

3. B. Gustafsson, H.- O. Kreiss & A. Sundström, "Stability theory of difference approximations for mixed initial boundary value problems. II," *Math. Comp.*, v. 26, 1972, pp. 649–686.