theorem, a characterization of minimax polynomial approximation, and least squares methods.

In Chapter 5 we find a discussion of the classical methods of numerical integration, as well as a discussion of the treatment of singular integrals, and numerical differentiation.

Chapter 6 contains the classical methods for solving ordinary differential equation initial and boundary value problems, as well as a discussion of stiff differential equations and the method of lines.

Chapter 7 contains an introduction to linear algebra. This material serves mainly as reference material for Chapters 8 and 9, which cover methods for solving linear equations and the matrix eigenvalue problem.

In Chapter 8 one finds a comprehensive discussion of Gaussian elimination, a discussion of error analysis, the residual correction method, iterative methods, the numerical solution of Poisson's equation, and the conjugate gradient method.

Chapter 9, the final chapter, discusses methods of finding eigenvalues, such as the power method, using orthogonal transformations, Householder matrices, the QR method, inverse iteration, and least squares solution of linear systems.

F. S.

6[65Mxx, 65Nxx, 76–08].—Zhu You-Lan, Zhong Xi-Chang, Chen Bing-Mu & Zhang Zuo-Min, *Difference Methods for Initial-Boundary-Value Problems and Flow Around Bodies*, Springer, Berlin and Science Press, Beijing, 1988, viii+600 pp., $24\frac{1}{2}$ cm. Price \$120.00.

Inviscid flow solutions contain shocks and contact discontinuities. These can be handled either by shock capturing or by shock fitting. In the first case, there is some dissipation mechanism such that oscillations are avoided, but the price to be paid is that the discontinuities are smeared out to a certain extent. In the second case, the positions of the discontinuities are kept as separate variables and the solution in between is computed by standard methods for smooth solutions. The authors of this book are well-known specialists on this latter class of methods. The book is a result of their long experience from computation of external flow problems using the Euler equations. In fact, Part II is a 360-page description of these computations.

Part I contains general theory for difference methods. In the first two chapters, initial-boundary value problems are treated for time-dependent equations, and in Chapter 3 the boundary value problem for steady state solutions is discussed. There is plenty of material, but unfortunately, it is not easy to read. The notation is complicated, and there are many subscripts and superscripts everywhere. When trying to interpret a certain estimate, it is sometimes virtually impossible to remember the meaning of all the symbols which occur. On the other hand, if one really gets through, one finds many important results concerning stability.

Only steady state problems are solved in Part II, and this is done without using time-dependent methods. In supersonic regions there is a hyperbolic system with a time-like direction, and some of the methods from Chapter 2 are used. Chapter 3 seems to be intended as (or should be) a theoretical foundation for all other applications which are presented. However, this chapter is only 14 pages long and does not contain much theory. The methods are based on shooting in one space direction, and the authors point out that this leads to approximation of initial value problems for elliptic equations, which is an ill-posed problem. There are some remarks about that, but they end up with the conclusion that "the number of lines must be properly selected", where "lines" refer to the number of points in one space direction. There is no analysis to guide the reader in that selection.

Part II is a detailed description of all the equations which are necessary to apply the numerical methods. This is in a sense the strength of the book. For example, anyone who wants to know an approximation formula for the specific enthalpy expressed in terms of pressure and density will find it with all the coefficients given in tables. The internal boundary conditions used at discontinuities and other singularities are worked out in detail. Numerical results are presented for blunt body computations, and for bodies composed of spheres, cones and cylinders. These computations are impressive, not the least considering that the computers used were no real supercomputers. The problems probably belong to the most difficult ones that have been solved by shock-fitting methods.

Unfortunately, as indicated above, the book is not as informative as it could have been. The theory and the methods are presented in a very technical way, which makes it difficult to understand the basic structure and ideas. The book could possibly be useful for engineers who want to solve flow problems with a similar structure using the same methods, but for graduate students it is of less value. Nevertheless, for someone, who really wants to work his way through the book, there is certainly a large amount of material to be found and to learn from.

BERTIL GUSTAFSSON

Department of Computer Sciences
Uppsala University and
National Defense Research Institute (FOA)
Stockholm, Sweden

7[41A15, 41A63, 65D07].—CHARLES K. CHUI, *Multivariate Splines*, CBMS-NSF Regional Conference Series in Applied Mathematics, Vol. 54, SIAM, Philadelphia, 1988, vi+189 pp., 25 cm. Price Softcover $19.00.

Since the late seventies the subject of what may be called "multivariate splines" has become a rapidly growing field of mathematical research. However, it soon became clear that there is no hope to ever arrive at anything nearly as unified as the univariate theory. In fact, trying to extend particular features