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.

14[65–01].—DAVID KINCAID & WARD CHENEY, *Numerical Analysis—Mathematics of Scientific Computing*, Brooks/Cole Publ. Co., Pacific Grove, California, 1991, viii+690 pp., 24 cm. Price $50.00.

All that is required to understand the mathematics of scientific computing, its algorithms, and its software libraries can be found in the ten chapters of this scholarly exposition. The authors designed a compact, attractive, uncrowded text that contains a wealth of material, by skillfully using TEX to prepare the manuscript. The subject matter has been tested through many years of research, classroom use, and practical computing experience—during which the algorithms have been refined and precisely defined in "pseudocode."

Homotopy methods of recent vintage are described in Chapter 3 and are used, in particular, to motivate the idea for Karmarkar's interior method to solve linear programming problems—while a more detailed analysis of convexity, the simplex method, tableaus, and duality are presented in the last chapter. Explanation of how and why the multigrid method works for solving elliptic partial differential equations is based on a heuristic description of its use to solve a second-order ordinary differential equation.

The mathematical treatment is suitable for upper-level undergraduate and first-year graduate students who can work with the ideas of analysis that are so carefully presented here. Other readers may compensate for a not so thorough mathematical background, provided they have the skill to work with computers and are motivated to learn from the many computer exercises that are listed in the ample problem sets.

Perhaps there may be a need for a sequel, when parallel computing systems become widely available—the authors could then well provide another masterpiece.

Chapter 1. Mathematical Preliminaries – 27 pages
Chapter 2. Computer Arithmetic – 29 pages
Chapter 3. Solution of Nonlinear Equations – 59 pages
Chapter 4. Solving Systems of Linear Equations – 110 pages
Chapter 5. Selected Topics in Numerical Linear Algebra – 52 pages
Chapter 6. Approximating Functions – 152 pages
Chapter 7. Numerical Differentiation and Integration – 56 pages
Chapter 8. Numerical Solution of Ordinary Differential Equations – 86 pages

Chapter 9. Numerical Solution of Partial Differential Equations – 64 pages
Chapter 10. Linear Programming and Related Topics – 26 pages
Answers and Hints (to selected exercises) – 5 pages
Bibliography – 16 pages
Index – 8 pages

E. I.

15[65–06, 65Fxx, 65D07, 65K99].—M. G. COX & S. HAMMARLING (Editors), *Reliable Numerical Computation*, Clarendon Press, Oxford, 1990, xvi+339 pp., 24 cm. Price $75.00.

The work and personality of J. H. Wilkinson has had a profound impact on setting standards for numerical computations, especially those hard-working modules of numerical linear algebra software that most computer users often use but seldom see, and just have to rely upon. A generation of numerical analysts, including this reviewer, felt happiness from some encouraging words, and challenge from some intriguing remarks, received from J. H. Wilkinson and written on the characteristic mechanical typewriter that stood in his office at NPL (National Physical Laboratory) east of London.

This volume documents the talks given at a conference devoted to his memory at NPL in 1989. Most of the 18 contributions are research papers, adding new stones to the building to which J. H. Wilkinson laid the foundations.

Appropriately enough, it starts out with matrix eigenvalues: B. Parlett continues his 15 years of studying the Lanczos algorithm by giving a theoretically sound and graphically convincing explanation of a seemingly erratic convergence behavior, and C. L. Lawson and K. K. Gupta apply Lanczos to a very special case. J. Demmel puts a discussion of Wilkinson on how to detect when a matrix is close to defective in a differential geometric context, and T. Beelen and P. Van Dooren give a new algorithm for approximating the Jordan Normal Form of such a defective matrix.

Continuing with linear systems, C. C. Paige studies QR factorizations appropriate for generalized least squares, while N. J. Higham studies Cholesky decomposition of semidefinite matrices, and A. Björck iterative refinement. Four papers deal with sparsity, two of these, with I. S. Duff involved, deal with multifrontal methods and tearing, one by M. G. Cox with block angular coefficient matrices, while sparse quadratic programming is discussed by P. Gill, W. Murray, M. Saunders, and M. Wright, the four-leafed trefoil who carried the Wilkinson spirit to the optimization community.

Two contributions deal with rounding errors: F. Chatelin and M. C. Brunet study a probabilistic model, and F. W. J. Olver an alternative to floating point which is closed under arithmetic operations. J. H. Varah estimates parameters in differential equations, G. W. Stewart solves homogeneous linear inequalities, and C. H. Reinsch studies shape-preserving splines.

The last two contributions deal with mathematical software: D. A. H. Jacobs and G. Markham give a software engineering perspective, and J. Dongarra and S. Hammarling report on the current status of dense linear algebra routines.

The book also contains a historical prologue by G. H. Golub, the principal propagator of the ideas of J. H. W., and a very personal epilogue by his colleague L. Fox.

The volume can best be characterized as contemporary, which means that it has new interesting results for the eager follower of the field, but also that most of its contributors will go on and find new results and better formulations in a few years' time. The influences of J. H. Wilkinson, on the other hand, will be with us in the numerical computation field for a much longer time.

AXEL RUHE

Department of Computer Science
Chalmers Institute of Technology
S-41296 Göteborg, Sweden

16[65-01, 65Fxx].—DAVID S. WATKINS, *Fundamentals of Matrix Computations*, Wiley, New York, 1991, xiii+449 pp., 26 cm. Price $51.95.

People who work in numerical linear algebra like to write, and by and large they do a good job of it. For this reason the field has always been well supplied with excellent monographs, such as Wilkinson's classic treatise [5], or Parlett's book [3].

When it comes to undergraduate textbooks the field is less well supplied. The one by Forsythe and Moler [1], the first textbook to fully embrace the modern view of numerical linear algebra, is long out of print. My own book [4] is dated and in need of revision. The authoritative volume [2] by Golub and Van Loan, though written as a textbook, is too comprehensive to be used successfully in an undergraduate course.

Therefore, the publication of the present book by David Watkins is a welcome event. The text fits the requirements of a one-semester or two-quarter course that covers the canonical topics of dense matrix computations: linear systems, least squares, and eigenvalue problems. The author omits iterative methods for linear systems—a conscious and defensible decision.

Chapter 1 is devoted to direct algorithms for solving linear systems. The author begins with triangular systems and proceeds through increasingly complex algorithms for positive definite systems, general systems, and banded systems. The chapter concludes with a useful discussion of matrix computations on vector and parallel computers.

Sensitivity and rounding errors are the subject of Chapter 2. The treatment of perturbation theory and condition numbers is amplified by geometric interpretation and numerous examples. The author, rightly I think, does not present detailed rounding error analyses but cites the pertinent results and illustrates them with numerical examples.

Chapter 3 treats the solution of least squares problems, with an emphasis on orthogonality; i.e., plane rotations, Householder transformations, and the Gram-Schmidt algorithm. Although this approach is now conventional for dense problems, I would like to have seen a more careful discussion of the use of the normal equations, which is an important and sometimes essential alternative.

Chapters 4–6 treat the algebraic eigenvalue problem. After a detailed exposition of the QR algorithm, the author considers iterative methods suitable for the sparse eigenvalue problems, methods such as subspace iteration and the Arnoldi and Lanczos algorithms. The sixth chapter on the symmetric eigenvalue problem contains, among other things, a treatment of Jacobi's method and its implementation as a parallel algorithm. The book concludes with a chapter on the singular value decomposition, including a discussion of canonical angles between subspaces.

The book is very well written. The author has aimed at an integrated treatment of his subject; he introduces theoretical material only as it is required and places running exercises in the text proper. The result, which could have been a muddle in the hands of a less skilled expositor, is a lively and pleasing narrative.

Unfortunately, there are some serious omissions. QR updating and related topics are passed over in silence. Algorithms are presented in scalar form, although the modern style of coding relegates vector and matrix-vector operations to subprograms, which can be tailored to individual computer architectures. Finally, the author is at best a casual bibliographer, which diminishes the value of the book as a reference.

But these reservations should not be allowed to obscure the fact that *Fundamentals of Matrix Computations* is a fine introduction to the ways of a matrix on a computer. It fills an important pedagogical niche, and we owe Watkins a debt of gratitude for undertaking to write it.

G. W. S.

1. G. E. Forsythe and C. B. Moler, *Computer solution of linear algebraic systems*, Prentice-Hall, Englewood Cliffs, NJ, 1967. [Review **27**, Math. Comp. **24** (1970), 482.]

2. G. H. Golub and C. F. Van Loan, *Matrix computations*, 2nd ed., The Johns Hopkins University Press, Baltimore, 1989. [Review **4**, Math. Comp. **56** (1991), 380–381.]

3. B. N. Parlett, *The symmetric eigenvalue problem*, Prentice-Hall, Englewood Cliffs, NJ, 1980. [Review **19**, Math. Comp. **37** (1981), 599.]

4. G. W. Stewart, *Introduction to matrix computations*, Academic Press, 1973.

5. J. H. Wilkinson, *The algebraic eigenvalue problem*, Oxford University Press, New York, 1965. [Review **90**, Math. Comp. **20** (1966), 621.]

17[51M20, 57Q15, 65H10, 65–04].—EUGENE L. ALLGOWER & KURT GEORG, *Numerical Continuation Methods—An Introduction*, Springer Series in Computational Mathematics, Vol. 13, Springer, Berlin, 1990, xiv+388 pp., 24 cm. Price $69.00.

As a graduate student at The University of Michigan, I remember well the excitement generated by the simplicial fixed point proofs of Scarf, Kuhn, Eaves, and Saigal. The first Ph.D. thesis I read was that of Merrill, passed along by Katta Murty, who was Merrill's advisor and my mentor. Having studied under Cleve Moler, Dave Kahaner, and Carl de Boor, I fancied myself a numerical analyst, and was predictably skeptical of these guaranteed global simplicial methods. Yet the potential power was clearly enormous, if only the ideas could be implemented in a numerically stable and computationally feasible way.

A few years later, while I was a colleague of S. N. Chow at Michigan State University, Chow, Mallet-Paret, and Yorke and Herb Keller independently proposed probability-one homotopies. These had the same potential power as simplicial methods, but were based on smooth maps. The two camps convened at a NATO Advanced Research Institute on Homotopy Methods and Global Convergence in Sardinia in June, 1981. By then the two classes of methods (simplicial and continuous) had been pronounced applicable to just about every problem under the sun, and listening to the speakers, one had the impression that nonlinear systems of equations and nonlinear constrained optimization were as routine as Gaussian elimination.

But chalkware does not solve real problems, and when the grandiose claims were not backed up, the whole subject of globally convergent homotopy algorithms was disparaged by numerical analysts and engineers. Allgower and Georg's book makes a strong case that, after two decades of hard work and many theoretical and computational successes, homotopy methods are to be taken seriously. The stigma persists, though, as the title of the book has "numerical continuation" instead of "homotopy."

The book constitutes an update of the authors' 1980 *SIAM Review* article, and is excellent in many regards: the bibliography is lengthy, historical perspective is provided throughout, the writing style is lucid, there is a wealth of material, and the presentation is balanced (with a few glaring exceptions). Chapters 3–10 deal with continuous homotopy methods (which they call "predictor-corrector"), Chapters 12–15 discuss simplicial methods (which they call "piecewise linear"), and there are six appendices with programs. The foreword says that the programs "are primarily to be regarded as illustrations" and "not as perfected library programs." The reader should take this caveat to heart! Having taught numerical analysis to thousands of students out of textbooks with "illustrative programs," and watched the ensuing computational disasters, I personally believe that such code is akin to giving someone a faulty loaded gun. Also, the expressive power of Pascal (which they mistakenly write as an acronym *PASCAL*) is so weak I cannot understand using that syntax for pseudocode.

It is difficult for the student to be critical of the master (and Allgower and Georg are masters), but I will mention a few shortcomings of the book. There are numerous errors, which invariably occur in the worst possible places—the statements of definitions and theorems. Figure 12.1.b illustrating a triangulation is wrong, and the minimization problem (P2.1) on which a whole appendix is based is unbounded. The index is not in alphabetical order, and not very complete. A listing of codes on page 5 omits one of the most widely used codes, HOMPACK. Certainly one of the major developments in the field was probability-one homotopies, yet it does not merit a chapter in the book (the philosophy of the construction of probability-one homotopies is sufficiently different from classical continuation to warrant a long chapter) and "probability-one homotopy" is not even in the index! With a few exceptions, the bibliography ignores the IEEE, AIAA, and ASME literature, and is heavily weighted with German references (not bad, just misleading).

The stated goal of the book is "to provide an easy access for scientific workers and students to the numerical aspects" of both continuous and simplicial continuation methods, and show that they "are actually rather closely related." I would say that goal has been admirably met, and everyone seriously interested in numerical continuation methods should have a copy.

Layne T. Watson

Department of Computer Science
Virginia Polytechnic Institute
Blacksburg, VA 24061

18[65-02, 76-02, 76M25].—KARL E. GUSTAFSON & JAMES A. SETHIAN (Editors), *Vortex Methods and Vortex Motion*, SIAM, Philadelphia, PA, 1991, viii + 212 pp., $25\frac{1}{2}$ cm. Price: Softcover \$48.50.

The SIAM Frontier series, within which format the present book was invited, is aimed at providing a forum for modern, and possibly provocative, views of a subject area. The editors of the eight essays on vortex methods and vortex motions have taken this brief seriously and have produced an interesting volume on the subject.

The subject of vortex dynamics is a classical field of mechanics, having been studied in considerable depth by nineteenth-century mathematicians. Kelvin, in particular, made significant contributions to the field, many of which still have a modern ring, and there is an enormous body of literature associated with the subject. It is not surprising, therefore, that the present volume addresses a rather narrow, albeit important, aspect of the subject, concerning itself largely with the now familiar vortex method for computing the dynamics of inviscid and slightly viscous fluid motions.

The development of the subject matter is nicely structured, with the opening chapters providing a summary of the current theoretical standing of particle methods for large and infinite Reynolds number flows, followed by four chapters concerning applications (or potential applications) of the vortex method, and finishing with two theoretical chapters, one discussing vortex models for the flow of superfluid helium, and the other discussing some particular aspects of vortex dynamics and their relation to turbulent flows. In keeping with the philosophy of the Frontier series, the book has a good mixture of carefully argued sections, applications, and some chapters of a more speculative nature. The blend seemed to work quite well except for a few instances when the license to speculate and be provocative was treated too liberally. I think it is a wonderful idea for authors to have an opportunity to discuss in print some of their ideas which, under normal refereeing methods, might never see the light of day. Thus, in the final article of the book, Chorin takes the opportunity to outline ideas concerning vortex motions and turbulent flows, and analogues with statistical mechanics, some of which present some interesting speculation about, for example, intermittancy and the inertial range. I found the essay by Chorin a rather enjoyable article whereas, by contrast, I had great difficulty in coming to terms with the speculation presented in the long essay by Gustafson. Here the discussion was just too woolly and diffuse to allow one to sort out the firm ground from the quicksand.

The first chapter by Sethian provides a fairly comprehensive review of recent work in particle methods and closely related areas, and the second (Hald) gives a nice assessment and summary of the status of convergence results for the discrete approximation. The next four chapters describe applications relating computational studies to laboratory flows. To my taste, the applications described here did not work well. For the most part, the phenomena were too complicated to admit detailed quantitative comparisons with numerical computations, so that we were not able to see the value of the computational schemes when they were asked to perform against a practical problem. The qualitative pictures looked very encouraging, but it is only under the microscope of careful quantitative comparisons that the real strengths and weaknesses of numerical schemes come to light. The above comments are not meant to belittle the ingenuity of the studies described, especially not the very interesting hovering motion discussed in the article by Freymuth, Gustafson and Leben, but, given the present state of development of the field, it might be necessary to consider less complicated flows to allow a careful, scientific assessment of the modelling process. The book rounds off with two essays of a more theoretical nature. The penultimate chapter by Buttke gives a nice introduction to the theory of vortex motions in superfluid helium, and the final chapter is the aforementioned essay by Chorin.

A very important practical issue with regard to particle methods is that of computational complexity as, all too often, this can limit the scope of a particular computation. The workload becomes just too time-consuming to allow properly converged solutions to be obtained. There are many very attractive features associated with using the vortex method, and thus the reduction of the computational complexity is an issue of central importance if the methods are to be used on complicated practical problems. Several advances in this direction have been made in recent years, and more emphasis could have been placed on these issues. Nevertheless, I found the book to present an interesting and provocative view of the subject. I think it will provide a very useful introduction for people who wish to get a good overall view of the current status of the area associated with vortex and particle methods.

W. G. PRITCHARD

Department of Mathematics
Pennsylvania State University
University Park, PA 16802

19[35–06, 35A20, 35B25, 35B40, 65–06, 65N06, 65N12].—HANS G. KAPER & MARC GARBEY (Editors), *Asymptotic Analysis and the Numerical Solution of Partial Differential Equations*, Lecture Notes in Pure and Appl. Math., Vol. 130, Dekker, New York, 1991, viii+271 pp., $25\frac{1}{2}$ cm. Price: Softcover $99.75.

This book is the proceedings of a Workshop on both asymptotic analysis and numerical solution of partial differential equations held at Argonne, Illinois in February, 1990. The Workshop (and resulting proceedings) had an ambitious objective of stimulating the combination of numerical and analytical techniques for studying differential equations, especially singularly perturbed ones. The book succeeds quite well by displaying different problems where singular perturbations arise, and by giving substantial evidence that progress can be made by combining both approaches.

The combination of numerical and analytical techniques could occur in various ways. One would be to use analytical techniques to handle the more singular part of the problem and thereby simplifying the numerical solution. A variant of this is to use asymptotic techniques to derive novel discretization schemes. Another is to use analytical techniques to analyze the limiting behavior of numerical methods for differential equations which become singular as some parameter tends to a limit. All of these combinations (and more) are well represented in the volume.

Numerous physical applications areas are presented in the book, mostly in fluid dynamics, but those range from oceanography to combustion. Research regarding the limiting behavior of numerical methods for singularly perturbed differential equations has been done in solid mechanics for some time and new results [3, 1] have recently appeared. In the area of neutral particle transport, studies of this kind have been carried out for many years and are continuing [2]. The growing interest (and success) in this type of research makes the book quite timely and easy to recommend strongly.

L. R. S.

1. I. Babuška and M. Suri, *On locking and robustness in the finite element method*, SIAM J. Numer. Anal. (to appear).
2. C. Börgers, E. W. Larsen, and M. L. Adams, *The asymptotic diffusion limit of a linear discontinuous discretization of a two-dimensional linear transport equation*, J. Comput. Phys. **98** (1992), 285–300.
3. S. C. Brenner and L.-Y. Sung, *Linear finite element methods for planar linear elasticity*, Math. Comp. **59** (1992), to appear.

20[65-04].—Julien C. Sprott, *Numerical Recipes—Routines and Examples in BASIC*, Cambridge Univ. Press, Cambridge, 1991, xi+398 pp., 23 cm. Price: Softcover $32.50.

This book contains translations into BASIC of the routines contained in [1] as well as of the demonstration routines in [2]. The author cautions the reader that the routines will run only on more advanced BASIC dialects, for example, without change, on Microsoft Corp.'s QuickBASIC 4.5 or later versions, and, with minor modifications, on Borland International's Turbo BASIC and its compatible successors.

W. G.

1. W. H. Press, B. P. Flannery, S. A. Teukolsky and W. T. Vetterling, *Numerical recipes—The art of scientific computing*, Cambridge Univ. Press, Cambridge, 1986. [Review **3**, Math. Comp. **50** (1988), 346–348.]
2. W. T. Vetterling, S. A. Teukolsky, W. H. Press, and B. P. Flannery, *Numerical recipes example book*, Cambridge Univ. Press, Cambridge, 1985. [Review **4**, Math. Comp. **50** (1988), 348–349.]

21[78-01, 78-04, 78-08].—Yves R. Crutzen, Giorgio Molinari & Guglielmo Rubinacci (Editors), *Industrial Application of Electromagnetic Computer Codes*, Computer and Information Science, Vol. 1, Kluwer, Dordrecht, 1990, v+263 pp., $24\frac{1}{2}$ cm. Price $94.00/Dfl.150.00.

This book is part of a series devoted to the publication of courses and educational seminars organized by the Joint Research Centre Ispra. It focuses on the underlying mathematical models and capabilities of current computer-aided design software tools for the computation of electromagnetic fields. The exposition is given from an engineering point of view.

Electromagnetic computer codes deal with the approximation of solutions to Maxwell's equations. The codes discussed are for magnetostatic field problems, eddy current problems and magneto-hydro-dynamic problems. These problems lead to static and transient nonlinear systems of partial differential equations developed from various vector and scalar potential descriptions of Maxwell's equations. Described are the different potential approaches and the resulting equations and boundary conditions on which the codes are based. From a mathematical point of view, the discussion presented is somewhat lacking. In most sections, systems of equations are written down without any regard for possible existence and uniqueness of solutions. In contrast, a section provided by J. C. Verite provides some indication that analytical work is being done on this class of problems.

In addition to the development of the differential systems, the book describes the discretization methods employed in the various codes. The most used technique for this class of problems is the finite element method. Integral and boundary element discretizations are discussed for some of the simpler applications as well. In most of this description, there is little concern for stability or error analysis.

The book also considers the basic software complexity issues associated with these problems. All of the applications in this area require meshing and description of rather complex geometrical devices. Thus, the codes are compared not only from an algorithmic point of view but also from a user interface perspective. Typically, geometrical specification is aided by a front-end code with extended graphics running on a workstation.

The book should be useful to industrial engineers who must solicit codes for supporting magnetic device design. Extensive description and comparison of the codes and the underlying mathematical models are given. The basic applications as well as typical application results are illustrated. The book may also be of interest to applied mathematicians in that it provides a class of differential formulations, which although not completely analyzed, appear to produce reliable results in practice.

JOSEPH E. PASCIAK

Department of Applied Science
Brookhaven National Laboratory
Upton, Long Island, New York 11973

22[65–01, 65–04].—STEVEN E. KOONIN & DAWN C. MEREDITH, *Computational Physics—Fortran Version*, Addison-Wesley, Redwood City, CA, xvi+635 pp., 24 cm. Price $46.25.

This textbook is the Fortran language edition of a previous volume entitled *Computational Physics*. The authors mention that the texts in both editions are identical except for the computer examples in this edition which are written in Fortran whereas those in the previous edition are in BASIC.

The authors believe that the traditional university physics curriculum does not prepare students for doing physics on a computer. The purpose of this textbook is to improve the computational skills of physics students at the advanced undergraduate and beginning graduate levels.

The book is organized into eight chapters and a set of appendices. Each chapter presents a brief discussion of numerical techniques for solving a class of numerical problems. This is followed by applications of these techniques to nontrivial physical problems given in examples and projects. Both examples and projects begin with a detailed discussion of the physics of the problem and an explanation of how the numerical methods are to be applied. For the examples, a Fortran code is available in an appendix, and the student is expected to use and modify this code in a sequence of exercises designed to enhance his understanding of both the physical principles and the numerical techniques. Each chapter ends with a computer project that allows the student to solve a substantial physical problem. A sequence of steps is provided to guide the student, and sample programs are available in the appendices. These computer codes make up about two thirds of the book. Fortunately, they are available (for a fee) on IBM-PC and Macintosh formatted diskettes.

Most of the topics usually presented in an introductory numerical analysis course are covered briefly. These include: numerical differentiation, quadrature, solutions of equations in one variable, direct and iterative methods for systems of linear algebraic equations, the symmetric eigenvalue problem, evaluation of special functions, methods for ordinary differential equations (initial value, boundary value, and eigenvalue problems), and elementary methods for elliptic and parabolic partial differential equations. There is also a chapter on Monte Carlo methods. Some of the physical applications of these methods include: particle scattering by a central potential, the structure of white dwarf stars, the Hartree-Fock model for atomic structure, quantum scattering, determining nuclear charge densities, two-dimensional fluid flow, and the Brusselator model for a chemical reaction.

The physical problems are very interesting, but some are quite advanced as applications of an elementary numerical method. For example, the project in the chapter on elliptic problems requires the solution of the two-dimensional steady-state Navier-Stokes equations for flow around a plate. The project is divided, however, into a sequence of more manageable steps. In general, the discussions of the numerical methods are satisfactory. For example, there is a nice summary of methods for numerical quadrature, especially Gaussian quadrature, and a good discussion of the stability of methods for differential equations. The emphases on using analytical solutions for portions of a numerical problem whenever possible, and on relying on physical considerations to judge the numerical output, are very appropriate. Unfortunately, part of the section on matrix operations was disappointing. The Gauss-Jordan method for calculating the actual inverse of a matrix was presented instead of emphasizing that in almost all applications what is really needed is the calculation of the solution of a system of equations. Also, the symmetric eigenvalue problem was approached by finding the roots of the characteristic polynomial by a rudimentary equation solver instead of the QR algorithm.

On the whole, this volume is a welcome addition to the physics curriculum. It probably would not be successful as a supplementary text for a general numerical analysis course, since the physics background of the student would have to be quite advanced. For the physics student, however, this book should whet the appetite for numerical computation.

EDWARD J. DEAN

Department of Mathematics
University of Houston
Houston, TX 77204

23[41-06, 46-06].—CHARLES K. CHUI (Editor), *Approximation Theory and Functional Analysis*, Academic Press, Boston, 1991, x+247 pp., $23\frac{1}{2}$ cm. Price $49.95.

This book contains a collection of papers written to honor Professor George G. Lorentz on the occasion of his eightieth birthday, which was marked by a two-day conference on *Approximation Theory and Functional Analysis* held at Texas A&M University in February, 1990. The two topics of the conference constitute the main research interests of Professor Lorentz, and are represented in the book by eleven invited papers of which eight are in Approximation Theory and three are in Functional Analysis.

The approximation papers deal with Bernstein-Durrmeyer polynomials (Berens and Xu), wavelets (Chui), Birkhoff interpolation (R. Lorentz), restricted derivative approximation (Makovoz), orthogonal polynomials on the unit circle (Pan and Saff), box splines (Riemenschneider and Shen), fair curves (Roulier, Rando and Piper), and rational approximation (Varga and Ruttan). The functional analysis papers deal with weak inequalities in Orlicz and Lorentz spaces (Edgar and Sucheston), subspace structure of infinite-dimensional Banach spaces (Rosenthal), and projections on 2-dimensional spaces (Tomczak and Jaegermann).

The book also includes an autobiography of Lorentz, lists of his publications and doctoral students, and a survey of Lorentz' work in the period 1975–1990 prepared by P. Nevai (his earlier work having been summarized in an article in *Journal of Approximation Theory* **13** (1975). Several photos taken at the conference are also included.

L. L. S.

24[14Qxx, 65-06, 65D17].—PIERRE-JEAN LAURENT, ALAIN LE MÉHAUTÉ & LARRY L. SCHUMAKER (Editors), *Curves and Surfaces*, Academic Press, Boston, 1991, xviii + 514 pp., $23\frac{1}{2}$ cm. Price $49.95.

This volume records 77 of the 124 talks given at the International Conference on Curves and Surfaces held in beautiful Chamonix-Mont-Blanc in France during the week of June 21–27, 1990.

Here, as an indication of the scope of the conference, is the list of the six of the ten invited survey lectures which appear in this volume:

M. Attéia, *Spline manifolds*;

W. Dahmen, *Convexity and Bernstein-Bézier polynomials*;

R. Q. Jia and C. A. Micchelli, *Using the refinement equations for the construction of pre-wavelets* II: *Powers of two*;

F. Natterer, *2D sampling in tomography*;

F. I. Utreras, *The variational approach to shape preservation*;

G. Wahba, *Multivariate model building with additive interaction and tensor product thin plate splines.*

Some of the shorter research contributions in this volume formed part of minisymposia, on Geometric Continuity, Optimal Recovery and Information Based Complexity, Data Storage and Reduction, Quasi-interpolants, and Radial Functions.

The volume reflects the diversity of background, motivation, goals, and methods of those presently engaged in this active research area.

The editors are to be congratulated for having succeeded in persuading the contributors to use a unified TEX format, producing so handsome a book that one is even tempted to look for an index.

C. DE BOOR

Center for Mathematical Sciences
University of Wisconsin
Madison, WI 53705

25[65–06].—S. GÓMEZ, J. P. HENNART & R. A. TAPIA (Editors), *Advances in Numerical Partial Differential Equations and Optimization*, SIAM Proceedings Series, SIAM, Philadelphia, PA, 1991, xii + 365 pp., $25\frac{1}{2}$ cm. Price: Softcover \$47.50.

These are the proceedings of the Fifth Mexico-United States Workshop on Numerical Analysis held January 26, 1989, in Merida, Yucatan, Mexico. Like the preceding workshops, it was mainly concerned with current research on the numerical aspects of optimization, linear algebra, and partial differential equations. The present volume contains 22 contributions.

W. G.