enhancement. The package provides options for tracing and check-pointing the calculations. Calling sequences are necessarily complicated, but there are drivers which cover the majority of cases occuring in practice.

The user documentation is excellent. After leading the reader through a simple example, the authors give a general overview of the capabilities of the package. An appendix contains detailed descriptions of the various drivers. Nothing can make learning to use a package of this magnitude actually easy, but the authors have taken care to see that it is not unnecessarily difficult. I asked students in a class of mine to get ARPACK up and running on problems of their choice. They had little trouble with the project.

Technical documentation can be divided into program details and mathematical underpinnings. Of the former there is none, and the reader must go to the programs to find out what is going on. Fortunately, they are well formatted and commented. I was disappointed in the mathematical description of the algorithm in Chapter 4. There is a lot of information there, but it is not very well organized, and I found parts very tough reading. Important topics (e.g., locking in eigenpairs after they have converged) are slighted while peripheral topics (e.g., block methods) are given undue attention. Since the guide itself is not long, the authors could have easily found extra space for a more leisurely, didactic treatment—a treatment not to be found in the literature.

But this lost opportunity will not be missed by most of the users of ARPACK. The authors, starting from an elegant idea, have produced a sound, well-documented package, which has deservedly become widely popular. We may hope that others with new ideas for solving large eigenvalue problems will hew to the authors' high standards.

REFERENCES

[1] R. B. Morgan, *On restarting the Arnoldi method for large nonsymmetric eigenvalue problems*, Math. Comp. **65** (1996), 1213–1230. MR **96j**:65028

[2] B. N. Parlett, *The Symmetric Eigenvalue Problem*, Prentice-Hall, Englewoods Cliffs, NJ, 1980. Reissued with revisions by SIAM, Philadelphia, 1998. MR **99c**:65072

[3] D. C. Sorensen, *Implicit application of polynomial filters in a k-step Arnoldi method*, SIAM J. Matrix Anal. Appl. **13** (1992), 357–385. MR **92i**:65076

G. W. STEWART

6[65-02, 65D32, 65Y05, 65Y10, 65Y15, 65Y20]—*Computational Integration*, by Arnold R. Krommer and Christoph W. Ueberhuber, SIAM, Philadelphia, PA, 1998, xx + 445 pp., $25\frac{1}{2}$ cm, softcover, \$64.00

The book under review has three major parts entitled, respectively, *Introduction* (86 pages), *Symbolic Integration* (20 pages), *Numerical Integration* (288 pages), and a 23-page bibliography of some 450 items dating mostly from the last 15 years.

Part I contains three chapters. The first deals with various concepts of integrals and their properties: proper and improper Riemann integrals, and Cauchy principal value and Hadamard finite part integrals in one and several variables. Chapter 2 briefly describes selected areas in scientific computing that rely on numerical integration, while Chapter 3 spells out more concretely the types of integration problems occurring in practice. Also discussed are matters of conditioning, available software and interactive programming systems, and the benefits that can accrue from preprocessing (e.g., preliminary transformations) and postprocessing (various convergence acceleration techniques).

Indefinite integration in closed form is the subject of Part II, which includes Risch's Structure Theorem and Liouville's Principle without proofs.

Part III—the core of the book—has six chapters. The first (Chapter 5) deals with univariate integration formulae and their errors, and convergence properties. Included are Newton-Cotes, Clenshaw-Curtis, and Gauss-type formulae. Composite rules, specifically the composite trapezoidal rule and its superiority for periodic functions, are also considered, as well as periodizing transformations making nonperiodic integrands accessible to treatment by the composite trapezoidal rule. The chapter concludes with a brief discussion of Romberg integration. There follows a long chapter on multivariate integration formulae, including principles of construction, number-theoretic formulae, Monte Carlo techniques, and lattice rules, with lengthy discussions of the theoretical underpinnings for these rules. Chapter 7 presents various approaches for dealing with special integration problems: oscillatory integrals, integrals on unbounded domains, Fourier and inverse Laplace transforms, and weakly and strongly singular integrals in one and several variables. Chapter 8 deals with integration algorithms and related matters such as practical error estimation, adaptive and nonadaptive discretization refinement techniques, and methods of enhancing reliability and efficiency. There are many pointers to existing software. The next chapter on parallel numerical integration is a concise introduction to numerical integration software for parallel and distributed computer architectures, while the final chapter deals with issues relating to the assessment of numerical integration software products.

It is not entirely clear what kind of audience will benefit most from this work. The authors anticipate three groups of readers: graduate students, computer scientists and engineers, and researchers in applied numerical analysis and mathematical software development. As a textbook for students (and their instructors) the treatment lacks focus (and exercises!), as the authors tend to pursue all the ramifications of any particular subject, often without full details, and thus would seem to cause bewilderment more than enlightenment among students. The other groups of readers undoubtedly will benefit from the numerous references to the literature and to existing software, and perhaps will appreciate more the practical issues discussed in the book than the (sometimes discursive) theoretical presentations. The reviewer values the book as a useful reference work.

Walter Gautschi
Department of Computer Sciences
Purdue University
West Lafayette, IN 47907-1398
E-mail address: wxg@cs.purdue.edu

7[13-01, 13P99, 14-01, 14Q99]—*Computational methods in commutative algebra and algebraic geometry*, by Wolmer V. Vasconcelos, Algorithms and Computation in Mathematics, Vol. 2, Springer-Verlag, New York, NY, 1998, xi+394 pp., 24 cm, hardcover, $79.95