Editor: Stratis Gallopoulos, stratis@hpclab.ceid.upatras.gr
Send announcements to cchweh@computer.org

NUMERICAL COMPUTATION: METHODS, SOFTWARE, AND ANALYSIS

Reviewed by Nicholas J. Higham

Numerical Computation: Methods, Software, and Analysis, Vol. 1, by Christoph W. Ueberhuber, Springer-Verlag, Berlin, 1997, 474 pp., ISBN 3-540-62058-3, $44.95 (softcover).

Numerical Computation: Methods, Software, and Analysis, Vol. 2, by Christoph W. Ueberhuber, Springer-Verlag, 1997, 474 pp., ISBN 3-540-62057-5, $44.95 (softcover).

This book is a translated, revised, and updated version of *Computer-Numerik*, published in German by Springer-Verlag in 1995. It's divided into two volumes because of the work's size (over 900 pages) rather than because of a natural division in content. Volume 1 contains material on modeling, the basics of numerical methods and computers, numerical software, and interpolation. Volume 2 covers approximation theory, Fourier transforms, quadrature, numerical linear algebra (for both dense and sparse problems), nonlinear equations (including optimization), and random numbers. The book does not cover the solution of differential equations.

In the spirit of earlier works by John R. Rice,[1,2] Ueberhuber emphasizes software and algorithmic aspects and does not go into as much mathematical detail as typical numerical analysis textbooks—the book includes theorems, but they are usually stated without proof. It is therefore well-suited to mathematical-software and scientific-computing courses. Unlike Rice's books, this one contains no exercises, however.

The book's strengths are its wide coverage, including many topics rarely treated in numerical analysis textbooks; its many pointers to software in major program libraries; its thorough bibliography; and the many illustrative examples and figures. Material that is not easily found elsewhere includes

- computer memory systems (cache, virtual memory, and so on),
- performance measurement and optimization (including various loop transformations) for computer programs,
- how to access numerical software over the Internet (although this material already looks slightly dated, referring to Mosaic rather than Netscape and mentioning Archie rather than Web search engines), and
- thorough coverage of numerical integration, including the multidimensional case (in fact, Ueberhuber covers this topic in disproportionate detail, compared with most others).

A few minor criticisms: Because of the wide coverage, the level of detail is patchy. For example, Ueberhuber includes the Jordan canonical form and principal vectors, but only defines, not explains, the practically important WY representation of products of Householder transformations. The numerical example applying Lapack's condition estimator to Pascal-like matrices confuses a condition estimator's performance with the effects of rounding error (which are beyond the estimator's control). The index contains boldface page-number entries without defining their meaning, and contains no page ranges, even when an entry's coverage spreads across several pages. I found occasional typos (the definition of round to even, for example, is actually of round to odd) and a few statements that could potentially mislead or puzzle the reader (Horner's rule for evaluating a polynomial is stated to be optimal, without reference to methods that are faster provided they are allowed to precompute new coefficients[3]).

These two meaty volumes make a welcome addition to the literature and are suitable for use in any course concerned with the practical aspects of numerical computation. ♦

References

1. J.R. Rice, *Matrix Computations and Mathematical Software*, McGraw-Hill, New York, 1981.
2. J.R. Rice, *Numerical Methods, Software, and Analysis*, 2nd ed., Academic Press, San Diego, 1992.
3. D.E. Knuth, *The Art of Computer Programming, Volume 2: Seminumerical Algorithms*, 2nd ed., Addison-Wesley, Reading, Mass., 1981, pp. 471–475

Nicholas J. Higham *is a professor of applied mathematics at the University of Manchester, UK; higham@ma.man.ac.uk; http://www.ma.man.ac.uk/~higham/.*