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 (1985 Revision) can be found in the December index volumes of Mathematical Reviews.

29[65-02, 65Mxx, 65Nxx].—STEPHEN F. MCCORMICK (Editor), *Multigrid Methods*, Frontiers in Applied Mathematics, Vol. 3, SIAM, Philadelphia, PA, 1987, xvii + 282 pp., 24 cm. Price $38.50.

There has been a great deal of research activity in the study of multigrid methods during the past two decades. The literature in this area is growing rapidly. However, very few books exist that give an overview of the method. This book, which consists of chapters written by experts in the field, is intended to meet such a need.

The book begins with an introductory chapter written by W. Briggs and S. McCormick. This chapter stands alone as a basic introduction to some of the essential principles of multigrid methods. Another purpose of this chapter is to lay the groundwork for the chapters that follow and, in particular, most of the notational conventions for the book are explained.

The second chapter, written by P. Wesseling, is devoted to multigrid methods designed for linear partial differential equations, with a focus on finite difference and finite volume discretization. The presentation concentrates mainly on the practicalities of the method. By considering model equations such as those arising from second-order elliptic boundary value problems, the major components of the multigrid method, namely prolongation, restriction and smoothers, are discussed. Some numerical experiments are presented. This chapter also contains a description and comparison of some multigrid software that existed up to the date of publication.

The subject of Chapter 3 (written by P. Hemker and G. Johnson) is multigrid approaches to the Euler equations. Facing the fact that a thorough mathematical basis is still missing, the authors adopt the point of view that practical developments and results obtained by multigrid Euler solvers have great potential in this branch of multigrid research. A number of algorithms that have proven to be efficient numerically are discussed in the two-dimensional case.

In Chapter 4, an introduction of the so-called algebraic multigrid (AMG) method is given by J. Ruge and K. Stüben. The authors demonstrate how to use the principles of the usual multigrid method to solve a matrix equation that

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does not have a natural multilevel structure. Discussions are presented on the setup of the multilevel structure, construction of multilevel components and the relationship with the usual multigrid method. Some theoretical analysis is also given. Many applications of the method and some directions of present and future research are discussed.

In contrast to the first four chapters of the book, Chapter 5, by J. Mandel, S. McCormick and R. Bank, is solely devoted to the theoretical aspects of the multigrid method. Based on the features of the method with respect to second-order elliptic boundary value problems discretized by finite elements, an abstract framework is presented for the convergence theory of multigrid methods. The theory is built upon a number of abstract algebraic assumptions, and both symmetric and nonsymmetric problems are discussed. This chapter includes a number of exercises and some research problems that a beginning multigrid researcher may find inspiring.

In addition to the five chapters described above, the book includes a list of over six hundred papers, a rather complete survey of the multigrid literature up to the year of 1986. Furthermore, the KWIC reference guide (at the end of the book) that groups the papers by key words, is extremely convenient to use. There is no doubt that this book is a very helpful and convenient reference for any researcher or practical user of multigrid methods.

Since multigrid is still a very young and rapidly changing field, some material in the book may be better presented today by using the latest developments. For example, the theory in Chapter 5 can be extended and some of the problems, open at the time, now have solutions. Nevertheless, this does not diminish the value of the book.

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30[70-01, 82-01, 82A50, 70-04, 82-04].—M. P. ALLEN & D. J. TILDESLEY, *Computer Simulation of Liquids*, Oxford Science Publications, Clarendon Press, Oxford, 1987, xix + 385 pp., 24 cm. Price $95.00.

This book was first published in 1987, but a paperback edition (with corrections) appeared in 1989. Its primary objective is to be a primer for the physical scientist who wants to do computational simulations (see the review by Banavar [1]). However, it can also provide the computational mathematician an introduction to some aspects of computational chemistry.

Computational chemistry is a broad subject with numerous subspecialties. Two of these, molecular dynamics simulations and Monte Carlo methods, are the primary subjects of the book. Quantum mechanical effects are excluded from most of the models discussed in the book, but they are discussed extensively in one chapter and briefly elsewhere.