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.

1[34-00, 35-00].—DANIEL ZWILLINGER, *Handbook of Differential Equations*, Academic Press, Boston, 1989, xx + 673 pp., $23\frac{1}{2}$ cm. Price $49.95.

This book is a very valuable addition to the literature since it acts as a concise reference for many of the popular techniques for solving ordinary and partial differential equations. Since many equations do not admit analytic solutions, approximate and numerical methods have been added to the text. The 673-page volume is divided into four parts.

The first part is a collection of transformations (e.g., contact, Liouville's, Kirchoff's, Von Mises', Lie's, etc.) and general ideas about differential equations. Well-posedness and natural boundary conditions are also treated.

The second part is a collection of exact analytical solution techniques. These are (mostly) listed alphabetically. For almost every equation one finds: the type of equations to which the method is applicable; the idea behind the method; the procedure for carrying it out; an example or two; any necessary precautions; notes; references for further study. The third part deals with approximate analytical techniques such as collocation, equation splitting, Floquet theory, harmonic balance, perturbation, variational calculus, etc.

The fourth part is concerned with the most important methods for finding numerical solutions of common types of equations. For ordinary differential equations we find continuation, shooting, finite elements, predictor-corrector methods, stiff equation procedures and weighted residual methods. For partial differential equations the list includes finite differences, Monte Carlo, characteristics, lines, finite and boundary elements, spectral methods and Schwarz's procedure.

This reviewer found the book useful the first day it arrived. It stands in a readily available place beside Kamke's book [1], which it admirably complements. The book is highly recommended to scientists and engineers who must find the solution of a variety of equations. And it surely is a must for applied mathematicians working in differential equations. The author is to be congratulated for adding this very useful book to the literature of applied mathematics.

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1. E. Kamke, *Differentialgleichungen. Lösungsmethoden und Lösungen.* I: *Gewöhnliche Differentialgleichungen*, 9th ed., Teubner, Stuttgart, 1977. II: *Partielle Differentialgleichungen erster Ordnung für eine gesuchte Funktion*, 4th ed., Akad. Verlagsges., Leipzig, 1959.

2[65-01, 65C10].—JOHN DAGPUNAR, *Principles of Random Variate Generation*, Clarendon Press, Oxford, 1988, xv + 228 pp., 24 cm. Price $69.00.

Pseudorandom numbers, i.e., deterministically generated numbers passing various statistical tests for randomness, are basic ingredients of simulation methods. The efficient generation of pseudorandom numbers with acceptable randomness properties is therefore an important concern in scientific computing. Some fundamental ideas and algorithms for pseudorandom number generation go back to the dawn of computer age and are associated with names like John von Neumann and D. H. Lehmer. A concerted and systematic effort to deal with the problems of pseudorandom number generation began in the sixties. The seventies and eighties saw a tremendous amount of activity in this area, one result of which was the introduction of more and more sophisticated methods for the analysis of pseudorandom numbers. The present state of knowledge is such that sufficiently good pseudorandom number generators can be designed for the great majority of simulation purposes, which was far from true 20 years ago. New challenges arise from the trend to parallel algorithms, so that in the future more attention will have to be paid to pseudorandom vector generation.

The field of pseudorandom number generation is actually composed of two almost disjoint parts, which have traditionally followed separate paths in their development. One branch is concerned with uniform pseudorandom number generation, i.e., the simulation of the uniform probability distribution on the unit interval [0,1], and the other with nonuniform pseudorandom number generation. The tools and algorithms of uniform pseudorandom number generation have a strongly number-theoretic flavor, whereas the generation of nonuniform pseudorandom numbers proceeds by suitably transforming uniform pseudorandom numbers and relies on methods from statistics and classical analysis.

The present book devotes one chapter to uniform pseudorandom numbers, three chapters to nonuniform pseudorandom numbers, and one chapter to multivariate distributions. Two more chapters deal, respectively, with the general philosophy of simulation methods and with miscellaneous topics such as the simulation of stochastic processes. FORTRAN 77 routines and graphical methods for generating nonuniform pseudorandom numbers with selected distributions can be found in appendices.

The book is well written, the various methods are explained in a clear style, and the author does not shy away from giving concrete recommendations to the practitioner. It is an attractive feature that competing methods are compared in detail with respect to several performance criteria such as statistical reliability, set-up time, marginal generation time, and portability. There are very few mathematical errors; one instance occurs on p. 21, where it is claimed that if a is a primitive element modulo the prime m, then so is a^k (this is of course only true if k is relatively prime to $m - 1$). The number of misprints is positive, but tolerable. However, it is irritating that proper names such as Muller, Tausworthe, and Tootill are consistently misspelled.

A major deficiency of the book is the fact that it is out of date in many parts. By and large, the book represents the state of affairs in pseudorandom number generation at the end of the seventies, while most of the developments in the eighties are left out. This is also reflected in the bibliography, which contains about 220 references, but only 14 of them date from after 1982, despite the vigorous activity during this period. The discussion of uniform pseudorandom numbers does practically not go beyond the treatment in the book of Knuth [3] from 1981. More recent advances in the linear congruential method such as systematic search algorithms and tables for optimal multipliers and improved basis reduction algorithms are not covered. Concerning shift register generators, the author expresses the belief that their theoretical properties are not well understood (see p. 46), thus revealing his ignorance of the host of results that were obtained recently. Relatively new methods for uniform pseudorandom number generation—such as nonlinear congruential methods—and matrix generators are not even mentioned.

The situation is just the same when one turns to the discussion of nonuniform pseudorandom numbers in this book. Various methods that were developed in the sixties and seventies are described in detail, but there are glaring omissions when it comes to more recent contributions. A case in point is the excellent work of Devroye on universal methods for nonparametric families of distributions, such as distributions with unimodal, monotone, or log-concave densities, which is completely ignored. To top it off, the monumental book of Devroye [2], a veritable encyclopedia of nonuniform pseudorandom number generation, and the standard reference in the field, is not listed in the bibliography. An oversight of this magnitude borders on gross negligence. Other important books that are not quoted are Bratley, Fox, and Schrage [1] and Ripley [4].

Because of its good expository style, the book may be used as an introduction to the subject of pseudorandom number generation. The researcher and the practitioner who needs to know the state of the art in this field will be better served by the book of Devroye [2] and a study of the recent literature on uniform pseudorandom numbers.

H. N.

1. P. Bratley, B. L. Fox and L. E. Schrage, *A guide to simulation*, Springer, New York, 1983; 2nd ed., 1987.

2. L. Devroye, *Non-uniform random variate generation*, Springer, New York, 1986.

3. D. E. Knuth, *The art of computer programming, vol.* 2: *Seminumerical algorithms*, 2nd ed., Addison-Wesley, Reading, Mass., 1981.

4. B. D. Ripley, *Stochastic simulation*, Wiley, New York, 1987.

3[65–06].—Tony F. Chan, Roland Glowinski, Jacques Periaux & Olof B. Widlund, (Editors), *Domain Decomposition Methods*, Proceedings in Applied Mathematics, SIAM, Philadelphia, PA, 1989, 463 pp., $25\frac{1}{2}$ cm. Price: Softcover $49.50.

This is the proceedings of a symposium on the subject of the title of this volume. It consists of 34 papers by invited speakers. The papers were not subject to the refereeing process. The proceedings is divided into four parts: Theory (9 papers), Algorithms (11 papers), Parallel Implementation (3 papers), and Applications (11 papers).

J. H. B.

4[65–06, 65W05].—R. Elliott & C. A. R. Hoare (Editors), *Scientific Applications of Multiprocessors*, Prentice-Hall International Series in Computer Science, Prentice-Hall, New York, 1989, vi + 143 pp., 24 cm. Price $28.00.

This volume grew out of a meeting entitled "Solving Scientific Problems on Multiprocessors" held December 9–10, 1987. It contains eight papers, some followed by a discussion, and a one-page general discussion at the end of the book. The authors and their titles are: H. T. Kung, "Computational models for parallel computers"; L. G. Valiant, "Optimally universal parallel computers"; D. May, "The influence of VLSI technology on computer architecture"; A. J. G. Hey, "Reconfigurable transputer networks: practical concurrent computation"; G. C. Fox and W. Furmanski, "The physical structure of concurrent problems and concurrent computers"; E. Clementi, "Global scientific and engineering simulations on scalar, vector, and parallel LCAP-type supercomputers"; C. J. Elliott, "Very-high-performance multiple-instruction multiple-data applications"; D. J. Wallace, "Scientific computation on SIMD and MIMD machines".

W. G.