Book Reviews

Concepts and Methods in Discrete Event Digital Simulation—George S. Fishman (New York: Wiley-Interscience, 1973, 385 pp.). *Reviewed by Donald Gross, Department of Operations Research, The George Washington University, Washington, DC 20006.*

This book may serve both as a reference work for practitioners and as a text for an undergraduate or graduate course in digital-computer Monte Carlo simulation techniques.

The first third of the book (Chapters 1–5) treats system modeling methodology with particular attention to modeling systems on digital computers. Two chapters are devoted to computer programming considerations and programming languages, with one of these completely devoted to the three most popular special purpose simulation languages, GPSS, SIMSCRIPT, and SIMULA.

The middle portion of the book deals with the generation of pseudo-random numbers and random variates. These chapters are extremely useful for the practitioner because of the comprehensive treatment. Flow charts are given for generating random variates from almost any probability distribution one might desire.

The final third of the book treats the *very important* topics of statistical analyses, which includes statistical analysis of input and output, statistical effects of starting and stopping conditions, and variance reduction. These portions vary in the depth of statistical knowledge required on the part of the reader, some topics (such as time-series analyses) requiring a rather deep statistical background (even beyond the level of that presented in the review chapter on statistics). However, from a teaching point of view, the instructor can adjust the level of presentation somewhat by adding and/or deleting material. From a practical viewpoint, the value to the practitioner will vary directly with his knowledge of statistics (or his access to a staff statistician). All in all, this book presents a well-balanced treatment of the topic and is a useful addition to the library of the practitioner, student, and instructor.

Sisteme Automate: Analiza Si Sinteza Prin Matrice Specifice (Automatic Control Systems: The Specific-Matrix Approach)—D. Teodorescu (Timisoara, Romania: Editura Facla, 1974, 511 pp.). *Reviewed by George M. Siouris, Aerospace Guidance and Metrology Center, Newark Air Force Station, Newark, OH 43055.*

The present book is a sequel to Professor Teodorescu's research into the synthesis of linear and nonlinear automatic control systems using the specific-matrix approach. This concept was first introduced by the author in his original work (*Proc. Inst. Elec. Eng.*, vol. 118, no. 11, 1971, pp. 1655–1660). In this work, the specific matrix has been introduced in terms of the nonlinear vector **z**, whose components are equal to the nonlinear function $N(x)$ at positive, equal, and consecutive intervals Δx. The vector **z** is related to the gain vector **n** by the linear transformation $\mathbf{z} = \mathbf{H}^{-1}\mathbf{n}$, where **H** is a matrix with known tabulated numerical values. Several theorems are stated and proved concerning transformations in the matrix plane, leading to a general computer-oriented solution.

For linear systems, the specific-matrix concept can be generalized by the introduction of a new vector **a**, called the step-response-vector. This vector has components equal to the values of the step-response function $a(t)$ at equal consecutive time-intervals Δt. Vector **a** is related to the real-frequency vector **u** by the relation $\mathbf{a} = \mathbf{Au}$ and with the "polar vector" **I** by the expression $\mathbf{I} = (\mathbf{A}^{-1} + j\mathbf{B})\mathbf{a}$. Matrices **A** and **B** are invariant with respect to both time and frequency and are tabulated in Appendix 1. Specifically, vector **a** contains nearly the same information about the dynamical process as the differential equation. That is, given a plant with unknown mathematical model, defined only by the vector **a**, determine the structure of the feedback controller which ensures a time-optimal system response subject to certain constraints. For nonlinear cases with unknown mathematical models, optimization can be realized using absolute stability constraints of the form

$$\mathbf{A}^{-1}(u_0\mathbf{i} - \bar{\varepsilon}) > -\eta, \qquad \bar{\varepsilon} \geq 0.$$

Several examples illustrate the theory presented.

The book is divided into three chapters. Chapter 1 deals with introductory material on linear transfer functions, characteristic equations, differential equations, the Laplace and Fourier transforms, state variables, matrix correlations between the frequency and time domains, convolution matrices, stochastic signals and systems, describing-function series, and nonlinear systems. Under the nonlinear systems section, the author presents the ideas of his latest research, which include such topics as nonlinearity spectra and nonlinearity vector approach for dual input and noise-perturbed nonlinearities.

Chapter 2 treats the analysis and synthesis of automatic linear systems. Among the topics covered are representation of linear systems, parameter-plane methods, state–space representation, the optimal control problem, canonical state equations, stability, the Hurwitz criterion, systems with dead-time, Hamilton's optimality principle, the method of gradients, synthesis and analysis methods based upon the specific-vector approach, synthesis of time-optimal systems with unknown mathematical models, systems with time-variable parameters, multivariable control system synthesis, and the concepts of controllability and observability.

Chapter 3 is devoted to the analysis and synthesis of automatic nonlinear systems. Here the author covers the stability of automatic nonlinear systems, local and global stability, the theorem of Lyapunov, Popov's criterion, the Lurie problem, exponential stability, hyperstability, algebraic criteria of absolute stability, oscillatory processes in nonlinear systems, synthesis methods based upon the specific-vector approach, the matrix plane, noise-perturbed nonlinear systems, and synthesis of nonlinear systems with unknown mathematical models. Part of the work in Chapter 3 is based on the author's other book *Entwurf nichtlinearer Regelsysteme mittels Abtastmatrizen.*

The book concludes with eleven appendices containing numerical values for the solution of nonlinear specific matrices and 211 literature sources. A synopsis in both English and German is included. By way of criticism, some of the figures are not of high quality; in several instances, subscripts are indistinguishable. Typographical errors are few.

In summary, it is with regret that I must conclude that since this excellent text is written in Romanian, and because of its relatively limited circulation outside Romania, few readers will share Professor Teodorescu's ideas. The specialist who can struggle through it will certainly find this text very useful. Also, the designer of automatic control systems will find this book an excellent reference.

Solution of Large Networks by Matrix Methods—Homer E. Brown (New York: Wiley-Interscience, 1975, 258 pp.). *Reviewed by Stephen A. Sebo, Department of Electrical Engineering, Ohio State University, Columbus, OH 43210.*

This text covers, in nine chapters, matrix methods related to the solution of large electric power networks. The objective of the book is to discuss and describe the methods now used in the electric power

industry to electrical engineering students at the graduate level. The text material was given in lectures at three universities in the United States and Brazil.

Chapter 1 contains general background information: review of early computation methods, development of computer facilities, and different approaches to power-flow problems and short-circuit studies.

Chapter 2 is concerned with the matrix algebra topics that are required for the understanding of the subsequent chapters. Matrix inversion methods, i.e., classical matrix inversion and Shipley's inversion utilizing the pivoting operation, are treated in particular detail. The details of the Kron-reduction of a matrix can be found in Chapter 3.

The next three chapters are devoted to short-circuit calculations. Chapter 3 introduces the bus impedance matrix concept and illustrates its use through a simple power network. Bus impedance matrix building algorithms are given for three specific cases, where there is no inductive coupling between the line to be added to the network and any other line of the network. A comprehensive example demonstrates algorithms and short-circuit analysis (currents, voltages), including opening a line during a fault study.

Chapter 4 covers techniques of the extension of the bus impedance short-circuit program to very large (in excess of, e.g., 2500 buses) systems, such as line reordering routine, processing lines of infinite impedance, and system reduction to an equivalent network.

Chapter 5 presents single-phase short circuits; then the handling of symmetrical component sequence networks is introduced. The balance of the chapter analyzes cases where there is inductive coupling between the line to be added to the network and any other line in the zero sequence network, and gives modified algorithms for building the bus impedance matrix.

Chapters 6 and 7 describe solutions of the power-flow problem. Chapter 6 is concerned with power-flow solutions using the Gauss–Seidel algorithm, the Newton–Raphson method, and the bus impedance matrix method. Memory requirements, convergence considerations, exploitation of the sparsity of matrixes (e.g., the Jacobian matrix), and refinements in the Newton–Raphson method are also discussed.

Chapter 7 is devoted to high-speed reduced accuracy power-flow calculations. The following techniques are reviewed: axis-discarding in the bus impedance matrix, bus impedance matrix contingency evaluation, multiple contingency evaluation, interchange capability evaluation, maximum interchange determination, decoupling of the Newton–Raphson equations, development of the real and reactive power models, and the method of distribution factors.

Chapter 8 examines transient stability studies. Development of the techniques and details in the representation of system elements, such as generators, loads, exciters, and voltage regulators are introduced. Distribution factors are covered to determine equivalent networks.

Chapter 9 presents three additional topics. The first is an analysis for eigenvalues and eigenvectors, including quadratic forms, the process of shifting, and the *LR*-transformation. The second is linear programming, equality and inequality contraints, objective functions. The third is a review of the optimization problem applied to the cost of generation, and finally, the treatment of the Lagrangian and gradient methods.

The style of the book is clear. There is a large number of references presented at the end of each chapter. Illustrative examples are used. The book emphasizes two areas (short circuits and power flows, with the handling of the bus impedance matrix, are discussed in five chapters) at the expense of, e.g., transient stability studies. New areas of handling large systems, such as power system dynamics, decomposition techniques, state estimation, and security evaluation are missing. Instructors will miss homework problems too: there are only three exercises listed in the book.

In summary, the text is a very good addition to the small number of books that is available for the teaching of computer methods related to large electric power systems. The book can be used for graduate courses and for reference purposes as well.