J. Indian Inst. Sci., Jan.–Feb. 1995, 75, 137-139.

BOOK REVIEWS

Neutral networks and simulations methods by Jian-Kang Wu, Marcel Dekker, Inc., 270, Madison Avenue, New York 10016, 1994, pp. 431, price not mentioned.

When the attention of a large number of researchers began to be focussed on artificial neutral networks (ANNs) in the mid-80s, there were few books on the subject. For quite some time the two volumes on Parallel Distributed Processing (popularly known as PDP)[1] formed the only material in book form. The literature in the area has continued to grow since then and several books are now available. The book under review has the aim of providing readers with essential concepts, the state of the art, simulation methods, and a flavour of applications.

Books on ANNs can be broadly divided into two categories. One of these follows the physics approach of a stochastic treatment of large aggregates of artificial neurons through spin glass and related models[2]. The second category of books takes the engineering approach of starting from the individual neuron and building up a network of such neurons[3,4]. The overall model could be deterministic or stochastic. The book under review belongs to the latter category.

The contents of the book can be broadly grouped into three areas. After the general introduction in Chapter 1, Chapters 2 to 6 deal with feedforward networks, Chapters 7 and 8 describe self-organization networks and Chapters 9 and 10 discuss feedback networks.

Chapter 1 sets the subject of artificial neural networks (ANN) in a perspective by listing the common features, giving a little history, an outline of the natural neural network as well as the basic building blocks of ANNs and a skeleton program for computer simulation.

Chapters 2 to 5 deal with material on feedforward ANNs which has become nearly standard in comparable books. These are on the architecture of such networks, the backpropagation algorithm and applications involving pattern recognition and functional approximation. Specific applications to adaptive signal processing, image compression and handwritten numerical recognition are discussed in some detail.

Chapter 6 refers to a novel type of feedforward networks based on fuzzy sets. The chapter gives a neat description of such networks built using the concept of a fuzzy associative memory and concludes with applications to the problem of backing up a truck and of financial prediction.

Chapter 7 is concerned with competitive learning and self-organizing neural networks. These make use of clustering concepts from pattern recognition and are regarded as similar to long-term memory (LTM). The well-known work of Kohonen on the spatial self-organization map is discussed along with some applications such as indexing and retrieval of facial images.

Chapter 8 is devoted to adaptive resonance theory (ART) of Carpenter and Grossberg dealing with self-organization of time-varying patterns. A fuzzy version of ART is also described. Much attention is given to a model called LEP developed by the author and its application to forest inventory.

Chapter 9 deals with Hopfield networks, Boltzmann machines and bidirectional associative memories. Chapter 10 describes the application of neural networks to optimization problems. Identification and control of dynamic systems, the travelling salesman problem and image recognition are handled under this framework.

In summary, the book is written in a lucid manner. It gives the basic ideas leading to each model and illustrates the applicability of each model to some significant problems which are, however, biased towards the author's contributions. Most of the chapters also contain methods of programming the concerned networks. The only shortfall that this reviewer found was a lack of mathematical development of most of the models. This ommission appears deliberate, judging from the author's preface. Although the author does not

intend this book to be a textbook, it could be used as one if mathematical derivations and students exercises are supplemented from other books. Overall, it is a good book for the user.

References

1. RUMELHART, D. R., MCLELLAND, J. L. and PDP Research Group — *Parallel distributed processing*, Vols I and II, 1986, The MIT Press.
2. AMIT, D. J. — *Modeling the brain function, the world of attractor neural networks*, 1989, Cambridge University Press.
3. WASSERMAN, P.D. — *Neural computing*, 1989, Van Nostrand.
4. KOSKO, B. — *Neural networks and fuzzy systems*, 1992, Prentice-Hall.

Department of Electrical Engineering
Indian Institute of Science
Bangalore 560 012.

M. A. L. THATHACHAR

Markovian queues by O. P. Sharma, Prentice-Hall, 66, Wood Lane End, Hemel Hempstead, Hertfordshire, HP2 4RG, England, 1990, pp. 84, $66.95.

In recent years the interest in queuing theory has been greatly enhanced because of the explosion in research on communication networks and manufacturing systems. In spite of thousands of papers published, closed-form formulae or even computable expressions are rarely available for queuing systems. Therefore, considerable effort has been expended on obtaining approximations and bounds for the performance parameters. But most of these studies are limited to obtaining results for the stationary probabilities. Hence the results for transient analysis, which are certainly of great practical interest, are not available in easily computable form even for the simplest queuing system, the M/M/1, queue.

This book is on transient analysis of Markovian queuing systems—M/M/1, M/M/1/N, M/M/C/N and tandem queues. In addition, transient analysis of M/M/r machine interference model and some reliability problems are also studied. All the random variables are independent with exponential distributions. The author presents only the results obtained by him and his students in the last decade. The general approach is to write the Chapman–Kolmogorov equations of the Markov processes of interest and then solve them *via* Laplace transform techniques. A desirable feature of the expressions obtained (as against the classical results available in the literature) is that the time varying probability distributions of the queue length process, etc., are obtained as the sum of the stationary distribution and an exponentially decaying parameter. The solution techniques are quite elementary and have been well presented.

There are several other studies available in the literature on the above problem. The author provides two lists of references. The first which he actually quotes in the text has only seven references. The second list contains a rather arbitrary collection of references, some of them on transient analysis. An annotated, more uptodate bibliography would have been much more useful. Also a price of US $66.95 for a book of 73 pages (excluding references) is rather steep.

Department of Electrical Engineering
Indian Institute of Science
Bangalore 560 012.

VINOD SHARMA

Stochastic processes (2nd edition) by J. Medhi, Wiley Eastern Limited, 4835/24, Ansari Road, Daryaganj, New Delhi, 1993, pp. 598, Rs 150.

The book under review is the second revised and enlarged edition of a popular text on stochastic processes. It follows the same format as the earlier edition, but contains some new material. A basic course in probability

and statistics is a prerequisite for this course. After a very brief overview of probability distributions and basics of random processes, it gives an extended treatment of discrete and continuous time Markov chains and processes. This covers the first five chapters. The remaining five chapters deal with more specialized topics; renewal processes, semi-Markov processes, stationary processes, branching processes and queueing models. A brief appendix surveys mathematical prerequisites and other appendices give resp. answers to exercises, glossary of notations and some useful tables.

The organization and presentation of the book are in the classical 'textbook' style and the slant is clearly towards operations research/social sciences/engineering audience. Thus mathematical background needed to read this book is quite tame. In particular, the formal measure theoretic framework is not used anywhere. This makes the book much more accessible to the mathematically ill-equipped audience from engineering and social sciences, but has its price. Thus continuous time and state space processes like Brownian motion and diffusions have got a bare nod in their direction, as has the theory of martingales. The latter in particular is a major tool these days in the analysis of stochastic recursive algorithms and one would have liked to see more of it. To be fair, this is easier said than done, since combining the two sides of stochastic process theory in a single book is no mean task. The book, as it stands, is certainly an excellent text for the subjects it covers, highly accessible to the novice as well as a comprehensive source book for the seasoned worker because of its extensive coverage, at least in passing, of many current topics, accompanied by an extensive bibliography. Another highlight is the occasional incursions into statistical aspects, not very common in recent books on these topics, which render this book some added value. A large number of exercises add to its pedagogical value. Overall, a superb first course in random processes.

Department of Electrical Engineering
Indian Institute of Science
Bangalore 560 012.

V. S. BORKAR

Computational optimal control by R. Bulirsch and D. Kraft, Birkhauser Verlag AG, Klosterberg 23, CH-4010 Basel, Switzerland, 1994, pp. 392, SFr. 128.

The volume under review is a collection of selected papers from a workshop on control applications of optimization held at Munich is September 1992. It contains a total of thirty papers, subclassified under five different headings. These are: surveys in computational optimal control, theoretical aspects of optimal control and nonlinear programming, algorithms for optimal control calculations, software for optimal control calculations and applications of optimal control. The survey section contains four surveys, resp. on transcription of control problems into sparse nonlinear programmes, optimization in robot control, sequential quadratic programming methods for trajectory optimization and solution techniques for control and persuit–evasion games of high complexity. The 'theory' section contains papers on continuation methods in boundary value problems, optimality conditions for singular extremals, synthesis of adaptive controls, control applications of reduced SQP method and time optimal control of mechanical systems. The 'algorithms' section contains papers on nonlinear programming algorithms applied to time optimal control of linear systems, control of systems with constraints and uncertainty, differential-algebraic systems, differential games, etc. The software section has four papers on control-related software. Two important instances are ANDECS for multiobjective control and OCCAL for mixed symbolic-numeric techniques. The final section on 'applications' contains control applications in robotics, aerospace engineering, power systems and biological systems.

On the whole, this is a well-organised and well-focused collection. One notices omissions such as 'H^{∞}' or stochastic control, but this very fact makes for a sharp focus. The latter, in brief, is 'on conversion of optimal control problems to nonlinear programmes amenable to algorithmic solutions'. The flavour is heavily applied, with 'state-of-the-art' reports from active groups in these areas from Europe. The book should provide a useful source of ideas and reference material for researchers in computational optimal control and its applications.

Department of Electrical Engineering
Indian Institute of Science
Bangalore 560 012.

V. S. BORKAR

Published by N. M. Malwad, Executive Editor, Journal of the Indian Institute of Science, Bangalore 560 012.
Typeset by Creative Literati Pvt. Ltd., Bangalore, Tel.-cum-Fax: 546 2698; Printed at Lotus Printers,
Bangalore, Tel.: 338 0167