interplay of division of control and information flow between several agents. The reader will also find a useful introduction to the notion of "value of information" and some very suggestive relations between this notion and the concepts of channel capacity and rate distortion theory.

In summary, this book is an extremely significant addition to the literature on hierarchical control. It sets a high standard in terms of originality, clarity, and analytical rigor. One final word about the limitations of the class of systems being considered may be in order. Recall that the coupling constraints (3) are *linear*. This will be the case if, as in the chemical process examples considered in the book, the $y_i$ and $u_i$ represent material flows and (3) is simply a conservation of flow equation. However, in many interconnected systems such a relation will not hold. For instance, in a power system, the flow of power between two buses is a *nonlinear* function of the bus voltage angles, and a relation like (3) would not hold. It would be an important contribution to extend the methods presented in this book to such interconnections.

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Reprinted from *IEEE Transactions on Automatic Control.*, vol. AC-27, no. 1, pp. 285-286, February 1982.

**Microprogrammed Control and Reliable Design of Small Computers**—George D. Kraft and Wing N. Toy (Englewood Cliffs, NJ: Prentice Hall, 1981, 428 pp.). *Reviewed by Michael Sievers, California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA.*

Described in its preface as a "cookbook" of microprogramming and reliability techniques, Kraft and Toy's text should be useful to practicing engineers as well as students interested in the design of highly reliable microprogrammed small computer systems.

The book is a detailed exposition of the methods and philosophies of Bell Laboratories in the two areas indicated by the title: microprogramming and reliable design techniques. After an introductory chapter devoted to the differences between conventional and microprogrammed control units that includes basic architectures, control store organization, emulation, and nanoprogramming concepts, the real meat of the text begins with the discussion of internal processor control in the second chapter. Included in this chapter are vertical and horizontal microprogramming, various techniques for generating microprogram store addresses, including conditional branching instructions, microsubroutines, functional branching, microprogram loops, interrupts, and microprogram sequencing. Numerous examples and options are provided for each of these topics.

The first section continues with consideration of the control of main storage operations. A summary of memory technology and communication leads to the presentation of various synchronous and asynchronous busing schemes and memory options. Direct memory access techniques for these buses and memories are also detailed. The first section concludes with a discussion of control of input/output operations, including the general I/O structure, fixed and variable timing signals, programmed I/O, partial microprogrammed control, and synchronization.

The mathematics and basic concepts of redundancy, reliability, and maintainability open the book's second section. Such classical reliability measures as mean time between failures, availability, mean time to failure, and mean time to repair are defined. The authors also consider fault characteristics, assumptions, and basic approaches to improving reliability before going on to present a large collection of existing and proposed fault-detection techniques. In the collection are discussions of coding techniques, data path checking, control path checking, echo checking, problems in checking decoders, totally self-checking circuits, control store checking, error detection in arithmetic and logic operations, and hardware checks for software bugs.

Kraft and Toy also treat fault diagnosis. After introducing basic concepts, they delve into microprogram diagnostics. Following this is a presentation of fault indication, diagnostic observation points, marginal circuit diagnostics and external control of diagnostics.

The book concludes with a discussion of the design of Ma Bell's fault-tolerant ESS processors. This is an excellent chapter because it provides a case history that is relevant to the material in the other chapters of the book. Indeed, *Microprogrammed Control and Reliable Design of Small Computers* might have been both better and more understandable had the authors presented parts of this chapter as an introduction to the text. I suggest this particular revision because a reader must immediately understand that the design of a fault-tolerant computer system involves many issues that must be considered together.

Overall, I would rate this text highly as a handbook. My only significant objection to it is that the detail in which the material is presented makes for some extremely tedious reading. As I have noted, however, the book is intended as a "cookbook," and cookbooks, by their very nature, need to be detailed.

Reprinted from *Computer*, vol. 15, no. 4, p. 132, April 1982.

**Adjustable Speed AC Drive Systems**—B. K. Bose, Ed. (New York: IEEE Press, 1981, 460 pp., $26.95 cloth (M), $17.95 paper (M), $35.95 cloth only (NM)). *Reviewed by Peter Wood, Westinghouse Electric Corp., Pittsburgh, PA.*

Practicing engineers and researchers in the ac-drive field can broaden their horizons with this extraordinary collection of reprinted papers, one in a series of IEEE Press reprints. The editor has balanced the test remarkably well with papers from all the major U.S. corporations active in the field and from the more prominent academic sources. His book is uncommonly well organized and cohesive. With its extensive and well-selected bibliography, it is also a valuable reference.

Dr. Bose claims the text is useful for graduate-level teaching, but I would caution prospective lecturers that the material will need to be interpreted a good deal for classroom use. Since much of it is rather arcane, the book will probably be more useful as a reference than as a textbook.

Dr. Bose has written a good though rudimentary introductory overview of the field. However, he is not quite critical enough of what has been published before on the topic and may mislead the student. An example is his treatment of pulsewidth modulation, an unpopular scheme for any but low-power drives, the literature about which seems to have unduly impressed him.

Two other deficiencies in the introduction are worth noting. First, the summary table given at the end is very difficult to follow and contains a number of not completely accurate generalizations. For example, the author states that static Scherbius drives exhibit poor line-power factor; this is true if the converter-inverter is used for power processing, but not necessarily true if a cycloconverter is used. Second, a brief critical review of the material presented in each section would have benefited the student. Such additions are uncommon in books in this series, but they might, in fact, improve many.

As it is, the student may have great difficulty perceiving the various papers in their proper relationship because of differences in style and terminology.

Reprinted from *IEEE Spectrum*, vol. 19, no. 6, p. 78, June 1982.

**Two-Dimensional Digital Signal Processing II: Transforms and Median Filters**—T. S. Huang, Ed. (Berlin, Germany: Springer, 1981, 222 pp.) *Reviewed by P. Kariaratha Rajan, Department of Electrical and Electronics Engineering, North Dakota State University, Fargo, ND 58105.*

This book presents an in-depth tutorial treatment of a limited number of discrete topics in the two-dimensional digital signal processing area. It is the second volume in a series which the editor plans to publish on various topics in this rapidly growing area. This set of publications is very timely and will be highly useful to both research workers and practicing engineers. This volume mainly treats two major topics—transforms and median filters. It consists of six chapters.

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The first, written by the editor, provides a very short introduction to the topics discussed in this book. The remaining five chapters have been written by well known authors who have made significant contributions in their fields. The various topics discussed are as follows: chapter 2, "Efficient matrix transposition alogrithms" by J. O. Eklundth; chapter 3, "Two-dimensional convolution and DFT computation" by H. J. Nussbaumer, is a detailed development of two-dimensional polynomial transforms starting from one-dimensional polynomial algebra; chapter 4, "Winograd's discrete fourier transform algorithm" by S. Zohar, is a purely one-dimensional discussion in nature–however, the treatment is quite illuminating; chapter 5, "Median filtering: statistical properties" by B. I. Justusson; and chapter 6, "Median filtering: deterministic properties" by S. G. Tyan. Chapters 5 and 6 present a fairly detailed development of the theory of median filtering and its application in the two-dimensional signal processing field. A number of new results are discussed in these chapters. This may be the first time that median filters have been discussed so thoroughly. The value of these chapters would have been greatly enhanced if the experimental results on median filters in Chapter 1 had been included and elaborated on here.

Each of the above mentioned topics is discussed in a comprehensive and lucid manner so that each chapter can be read independently. Because of the nature and scope of the book, there is not much coordination between the various chapters. In this sense, chapters 2, 3, and 4 are more like invited papers on the particular topics. However, the last two chapters have been well co-ordinated and present results in a unified manner. Each chapter in this book lists about 20 references.

This book is a timely publication which presents the latest materials which are scattered in a number of journals. This will serve the research community and applications engineers in the two-dimensional digital signal processing area by providing them with a detailed development of the theory of transforms and median filters.

Reprinted from *IEEE Circuits and Systems Magazine*, vol. 4, no. 2, p. 21, June. 1982.

**Linear Integrated Circuits**–Thomas Young (New York: Wiley, 1981, 495 pp.) *Reviewed by David T. Tuma, Carnegie-Mellon University, Pittsburgh, PA.*

The author declares in the preface to his book that it is intended as a textbook for students in two-year technical institutes and in bachelor of technology programs, practicing electronic engineers, and students in four-year undergraduate electrical engineering programs. The author may have succeeded in meeting the needs of the first three clients, but certainly not the last.

The author has been quite successful in putting together a compendium of the popular linear integrated circuits (LIC's) used today. He has also treated, in some detail, the operating characteristics of the most common LIC's (such as op-amps, regulators, amplifiers, etc.) and included many application circuits for these LIC's. Each application circuit is followed by an example which illustrates the determination of the LIC operating point and the values of any external components that may be needed to properly operate the LIC.

The instructional objectives and self-evaluation questions at the beginning of each chapter are of substantial value, particularly for those who plan to use the book in a self-study mode.

This book, however, falls short of the needs of a textbook intended for a four-year electrical engineering curriculum, the main fault being the purely "how to" approach adopted by the author in his presentation of the material. The student is rarely challenged throughout the book. The fundamental concepts underlying the operation of the LIC's are treated cursorily; some of the esoteric aspects of the LIC's are either glossed over or not well addressed. The examples that are worked out, while clarifying the application of an LIC, do not explore the rich potential of these devices or induce the student to think of extensions to new applications. The lack of challenging problems at the end of each chapter is most important. The serious electrical engineering student may still be able to use this book as a reference, but the need for a textbook on LIC's in the style of Millman or Schilling and Belove has not yet been filled.

Reprinted from *IEEE Circuits and Systems Magazine*, vol. 4, no. 2, p. 22, June 1982.

**Graphs, Networks, and Algorithms**–M.N.S. Swamy and K. Thulasiraman (New York: Wiley, 1981, 592 pp.) *Reviewed by Basil R. Myers, Department of Electrical Engineering, University of Maine, Orono, ME 00469.*

This substantial book is broken up as follows: Part I–chapters 1–10, 300 pp.–graph theory; Part II–chapters 11–13–electrical network theory; Part III–chapters 14–15, 153 pp.–algorithmic theory.

Part I gives a broader, more aesthetic introduction to the theory of finite graphs than is usually found in textbooks which, like this one, include electrical engineers among their intended readers. Part I constitutes an admirable textbook in itself on finite graph theory, which should be acceptable to the purist as well as the reader who is not. As noted by the authors in their preface, it includes presentations (along classical, well-developed lines) on trees, Hamiltonian and Euler graphs, planarity, connectivity, matching and coloring, and an introduction to the rapidly expanding theory of matroids and its applications to electrical network theory and combinational optimization problems. Part I is particularly easy to read, understand, and absorb. Hence, it can be highly recommended as course material for students and as a personal library reference source for those who have any interest in or curiosity about graph theory and its application to electrical engineering and computer science.

Notation is standard, and the authors do a superb job of blending engineering terminology with the mathematics, without blemish to the mathematics, when called for in reference to applications. At the outset in chapter 1, for example, they have defined the engineering term "short-circuiting" or "identifying" in graph-theoretic terms, as an operation on a graph, thus eliminating the sort of fuzzinesses that can arise in thinking of such an operation in physical terms. The text is not flawless; for example the authors' definition of a circuit, p. 10, allows circuits of order 1 (that is, trivial graphs with one edge) and 2 (that is, two parallel edges), whereas it is generally more convenient and more often the case to restrict the order of a circuit to be at least 3.

Each chapter in this book ends in a section which recommends articles and topics for further reading and study, followed by a wealth of exercises and a list of both the important classical references and those of recent years which dictate the present state of the art. The exercises generally range in difficulty and challenge from the routine to those that are anything but. The authors have also used some of the exercises very effectively as vehicles to introduce further concepts or results not discussed in the text. For example, the concepts of a transversal matroid, a Fano matroid, and a gammoid are all introduced in chapter 10's exercises, rather than in the text.

A hypercritic might complain that there is no treatment of probabilistic graphs in the book, and that Ramsey's name is noticeably absent from the list of references. Many of the results from Ramsey's theory are, in fact, interspersed throughout the book, and so this reviewer does not find that the book is of less consequence because of such omissions.

Part II is a concise presentation of classical, basic electrical network theory which every serious student of circuits and systems should have at his fingertips. Topics include the application of the principal partition of a graph to mixed-variable analysis, the no-gain property of resistance networks, realization of circuit and outset matrices of resistance networks, topological (graph-theoretic) formulas for network functions, and Tellegen's important theorem and the beauty of its application to the computation of network sensitivities. This material will be perhaps the least stirring of the three parts of the book to those who do not have much interest in or passion for electrical network theory, more so because it is unavoidably heavy on matrix theory. This material does, however, bring out the beauty of the well-known matrix-tree theorem of graph theory in facilitating the derivation of network functions. The authors have noted in their preface that "Tellegen's theorem ... is essentially graph-theoretic in nature, .... It is surprising that such an important theorem lay dormant for so many years ...."

Part II, algorithmic graph theory, though only two chapters, constitutes an important feature of this book, and is what makes it different from others which deal with graph theory and its applications. This material is of primary interest to the computer scientist. But today's practical problems are generally complex; when formulated on a graph-theoretic basis, the extraction of useful solutions depends upon the efficiency of the computer algorithms used to obtain them. Thus, this material is requisite to the background of those concerned with applications, and therefore very much a part of the compass of this book.

As stated in the preface, chapter 14 is given to algorithms for the analysis of graphs and chapter 15 to optimization problems. Topics include algorithms for reducibility of flow graphs, dominators, shortest

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