methods are discussed in Chapter 3. The crux of this chapter is the extension of the work of Popov for nonlinear differential feedback systems. Chapter 4 deals with Wiener-Hopf equations and includes some nonlinear variations. Several topics related to nonlinear equations are presented in the final chapter, as well as the only application contained in the book, that of the dynamics of a continuous-medium nuclear reactor. A point of particular interest to this reviewer was an energy method, developed by Levin, which is similar to the Liapunov function approach for differential equations. This method is illustrated in the study of the nuclear reactor.

Special mention should be made of Professor Corduneanu's bibliographical notes which follow each chapter. In these he abandons the formality of the body of the text, and gives historical background, clarifies concepts and injects bits of related theory. The extensive list of references at the end of the book also should be of great value to researchers in this area.

In spite of the high quality of the book, the mathematical background required to understand Professor Corduneanu's theorems and proofs will restrict its use by the engineering community. As a text, it is suited to a mathematics seminar on integral equations. Selected topics possibly could be treated in an engineering seminar on the stability of nonlinear systems, and it is recommended as a reference for workers in this field.

SYSTEM SENSITIVITY ANALYSIS: BENCHMARK PAPERS IN ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, Ed. by José Cruz, Jr., Dowden, Hutchinson and Ross, Inc., 1973, 428 pp.

REVIEWED BY S. H. JOHNSON[1]

Forty-five papers spanning the past decade have been assembled into this first volume of a new series. The purpose of the series is threefold as stated by the series editor:

1 to serve as a convenient and time-saving means of study
2 to provide a compact collection of major works underlying present research; and
3 to provide a practical point of entry into a given area.

This first volume is not as effective a means of study as a good text would be. As a collection of major contributions to sensitivity analysis, the value of the book would diminish with time. However, it is the third purpose which more than justifies the existence of this book. The reader is left with the impression that the editor has chosen papers which transmit useful information. Only a few papers appear limited to the development of historical perspective.

For the engineer with a design problem, for the analyst wishing to establish confidence in numerical results, for anyone seeking analytical proof of the benefits of feedback this book will be of interest. Simply as a sourcebook for sensitivity analysis recipes this book is useful.

The papers are grouped into ten categories: sensitivity function generation; automatic optimization; eigenvalue sensitivity; terminal sensitivity; comparison sensitivity; trajectory sensitivity minimization; singular perturbations; performance sensitivity and invariance; and expansions for near-optimum control. Also included are three survey papers from 1965, 1968 and 1971.

Each category begins with an extremely brief introduction by the editor. The major weakness of the book is the failure of the editor to provide more background and continuity.

Twenty of the papers were originally published in the *IEEE Transactions on Automatic Control*, the remaining were extracted from various other sources.

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ROBOTICS, J. F. Young, New York, Wiley-Halsted Press, 1974, 303 pp. $18.95.

REVIEWED BY JOHN R. SESAK[1]

The book is devoted entirely to robotics: all aspects of robotics are detailed with the exception of the controlling brain; thus the book can be considered a companion volume to Young's earlier book, *Cybernetic Engineering*.[2] Even a casual glance at the preface, contents, and extensive references will indicate to the reader that the prime purpose of the author is to present a unified account of the principles and practice of robotics. This commendable objective is well-achieved, indeed.

Among the diverse topics discussed are robot senses, robot muscles, robot limbs, robot stability, robot mobility, robot reliability, robot vision, robot hearing, and robot speech.

The chapter on robot limbs also deals briefly with nuclear manipulators, prosthetic devices, and practical walking machines.

Various industrial robots (such as the Planobot, the Unimate, and the Versatram) are discussed in the chapter on practical robots. Also practical circuits used in industrial robots are interspersed throughout the book.

To enhance reader understanding of robot methods of perception, the characteristics of human sense organs are discussed at suitable points throughout the book.

Taken in its entirety, the book is written in a lively, interesting fashion and is at times entertaining—a feature which is certainly rare in a survey text of this type.

As the level of the text is introductory, very little previous background is required of the reader. Accordingly, beginning researchers just entering the field should experience no difficulty in becoming acquainted with this interesting new discipline.

For those readers desiring deeper coverage of certain topics, the book contains a large number of references, 904.

The reviewer recommends the book to all those who wish to become acquainted with the fascinating field of robotics.

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[2]Young, J. F., *Cybernetic Engineering*, London, Butterworths, 1973.

THE FINITE ELEMENT METHOD, by Douglas H. Norrie and Gerald de Vries, Academic Press, 1973, 322 pp.

REVIEWED BY PETER D. HILTON[1]

This book can be divided into four main parts. The first portion of the book characterizes the various types of mathematical equations and describes the known approximate solution procedures. The finite element method is shown to be a special case of trial function solution procedures. An unnecessarily detailed derivation of variational calculus follows. The second major section of the book describes the finite element displacement method. Comments on force and hybrid finite element approaches are not included. The third portion of the book includes descriptions of the types of equations and related physical problems which can be treated by the finite element method. Emphasis is placed on the harmonic and bi harmonic equations with examples from solids, fluids, heat transfer, electrostatics, etc. In the last few sections of the text some more recent works by individual researchers in the areas of viscous flow, compressible flow, etc. are briefly summarized.

In the reviewer's opinion, this book presents an over view of the finite element field which lacks the details necessary for complete understanding and implementation. It is not recommended as the primary text in a finite element course.

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