
REVIEWED BY GEORGE R. SPALDING

This book is the first volume of a Control Theory Series to be published by Marcel Dekker, and edited by Jerry Mendel, and associate editors Michael Athans and David Luenberger. The book should be welcomed by those concerned with system identification. The editing has been well done and the presentation is clear and concise.

Parameter estimation has been treated previously in more extensive works on estimation theory and system identification, and as a result the subject has suffered from a lack of unity. Dr. Mendel has chosen a topic of limited scope and has given it a thorough and cohesive treatment. He considers only the discrete linearized representation of systems and employs the equation error formulation of the estimation problem. Equation error methods have a reputation for producing biased results in the presence of noise. However, biases can be removed, and, as other authors have pointed out, careful treatment of data can produce reliable results with modest computational resources. In this book, Dr. Mendel uses the equation error formulation to provide a basis for the development of four estimation techniques: weighted least-squares, unbiased minimum-variance, deterministic gradient and stochastic gradient.

Much of the book's readability stems from the author's success in organizing the material. Chapter 1 begins with a discussion of the modeling of systems and the definition of parameter estimation. This is followed by the formulation of the discrete problem and the equation error method. The scope and objectives of the succeeding chapters are then outlined.

The four estimation techniques are treated in Chapters 2 through 5. Chapter 2 develops the matrix equations used throughout, introduces the cost functional, and then presents the weighted least-squares procedure for both batch and sequential processing. Minimum variance estimation is contained in Chapter 3. The similarity between the noise covariance matrix and the weighting matrix of least-squares is shown, and minimum-variance estimation is related to maximum-likelihood estimation and Kalman filtering. Chapters 4 and 5 develop, respectively, the deterministic and the stochastic gradient methods.

Chapter 6 deals with time-varying parameters. The author extends the techniques of the preceding chapters to the time-varying case by defining various levels and types of a priori knowledge and showing under what circumstances extensions are permissible.

At the beginning of each chapter the technique to be developed is introduced and a priori knowledge is defined and compared with that of the preceding chapters. The developments are formal and results are presented as theorems. Each section is illustrated with example problems, some of which are continued through the text, heightening the sense of unity. Each chapter concludes with a set of problems which further illustrates and supplements the text.

The level of presentation is about that of the first year of graduate study. Selected material would be appropriate in a general course in system identification, or the entire text could be covered in a course dealing exclusively with discrete techniques.


REVIEWED BY G. F. OSTER

There seems to be two parallel trends in undergraduate engineering education. On the one hand, there is the ongoing tendency to mathematize many courses, introducing more and higher level mathematical concepts at an increasingly earlier level. The merits of this practice may be debated either way; the proponents claim that impetus for this trend comes from the increasing complexity of the problems confronting engineering graduates. On the other hand, it is just such complexity, and cantankerous nonlinearity, that generally defeats traditional analytical approaches. The response to this obstacle is an increasing reliance on computer simulation studies for problem analysis. Accordingly, engineering texts have begun to appear which treat traditional subjects more from the viewpoint of digital and/or analog simulation. The present text represents a "second generation" in this trend. Whereas previous texts have paid some lip service to the existence of the computer, and some may even have included a flowchart or two, the new generation of texts includes detailed program listings of various general purpose subroutines. This practice is bound to stimulate further debate as to the merits of mixing a traditional engineering course with a course in numerical methods and Fortran. My own feeling is that the students are more highly motivated when methods are introduced as they are needed.

The central theme of the book is the development of a general purpose simulation package comprising a library of subroutines for dealing with finite dimensional dynamic systems. (Although there are two chapters on distributed parameter systems, a lumping approach is taken reducing the problems to a finite dimensional system.) The first three chapters deal exclusively with numerical methods for solving algebraic and ordinary differential equations. Numerous subroutines for this purpose are developed, and in Chapter 4 are applied to a set of 10 case studies. These are, for the most part, simple engineering systems, e.g., hydraulic tanks, mixing vessels, etc. Chapters 5, 6,
and / deal, respectively, with multicomponent vapor-liquid equilibria, reaction kinetics and fluid flow, the treatment assumes that the student has encountered such material previously, and emphasis is laid on the simulation aspects. More complicated systems are encountered in Chapter 8 dealing with staged operations, and Chapter 9, distributed systems. Finally, a short chapter on process control is included.

Throughout, the text is liberally illustrated with worked examples and test cases. In many instances program output is given directly. If one agrees with the desirability, yea necessity, of such courses, this text can be highly recommended indeed.


**REVIEWED BY SHIRO KOBAYASHI**

Writt the view that any meaningful attempt to understand our industrial society must include a detailed picture of its technology, the author considers technical development without which the steam engine and the machinery could not have been built, the development without which steel would have been of little significance—the Machine Tool. In the History of the Milling Machine, the purely technical development of the tool itself is emphasized, in the History of the Geometric Machine, the attempt is made to show the relationship between a rather complex theory and the machine designed to embody it in metal. In the History of the Grinding Machine, the historical influence of a given tool on the industrial production is indicated. The technological innovations during the development of the machine tools may perhaps stimulate further imaginations in controlling the machine tools.

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**REVIEWED BY S. H. JOHNSON**

This book is the first of a series entitled, *Benchmark Papers in Human Physiology*, and offers a capsule history of the development of the concept of regulation in biology, i.e., homeostasis. The papers, or extractions from longer documents, span almost 200 years. The earliest, by eighteenth-century English physicians, contain fascinating examples of thermodynamic

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