New Books

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Knihy došlé do redakce (Books received)

Jaroslav Starý: Mikropočítač a jeho programování. SNTL, Praha 1984. 224 stran; 70 obr., 20 tab.; Kčs 45,—.

Klaus Mätzel, Klaus Nehrkorn: Formelmanipulation mit dem Computer-Systeme und Algorithmen. Akademie-Verlag, Berlin 1985. 188 Seiten; M 38,—.

Michael Jünger: Polyhedral Combinatorics and the Acyclic Subdigraph Problem. (Research and Exposition in Mathematics 7.) Heldermann Verlag, Berlin 1985. 128 pages; DM 36,—.

Gerhard Fuchs: Einführung in Btx Anwendungen — mit einem Lexikon der wesentlichen Begriffe und Btx-Kontaktanschriften. Carl Hanser Verlag, München—Wien 1985. 264 Seiten; 118 Abbildungen; DM 68,—.

ROBERT KALABA, KARL SPINGARN

Control, Identification, and Input Optimization

Plenum Press, New York—London 1982.
xi + 431 pages; 39,50 $.

Input signal optimization is important for costly identification experiments or for cases where the highest precision of identified parameters is required.

This book is a self-contained text to the numerical determination of optimal inputs for system identification. It presents the current state of optimal inputs with extensive background material on optimization and system identification. Optimal inputs are determined such that the sensitivity of the system output to an unknown parameters are maximized. A quadratic performance criterion subject to input energy constraint is used and two-point boundary-value problem is solved for its maximization.

The determination of optimal inputs for system identification requires a knowledge of dynamic system optimization techniques, numerical methods of solution and methods of system identification. All these topics are covered in the text. The book consists of elevent chapters grouped to five parts.

The first part gives a brief outline of the three major topics in the book: optimal control, dynamic system identification and optimal inputs for identification.

The second part called "Optimal Control and Methods for Numerical Solutions" consists of three chapters. In the Chapter 2 "Optimal Control" the derivation of the equations used in optimal control theory are given. The Euler-Lagrange equations are derived using the classical calculus of variation approach. The equations are then rederived using dynamic programing and The Pontryagin's maximum principal is introduced. Chapter 3 "Numerical Solutions for Linear Two-Point Boundary-Value Problems" includes the numerical solution of matrix Riccati equation, the method of complementary function and invariant imbedding. The advantages and disadvantages of these methods are discussed and results of a selected example are compared on the basis of numerical accuracy. Invariant imbedding is shown to be the most precise, however, computationally most time consuming. Chapter 4 "Numerical Solutions for Nonlinear Two-Point Boundary-Value problems" deals with iterative methods. The method of quasilinearization and the Newton-Raphson method are presented. These methods can also be used for linear or nonlinear optimal control problem subject to integral constraints. Some examples when nonlinear two-point boundary-value problems occur not only in optimization problem are presented. Namely, the determination of the buckling loads of columns, nonlinear filtering etc. are solved via integral equations and imbedding method.

Part III "System Identification" consists of three chapters. Chapter 5 "Gauss-Newton Method for System Identification" briefly discusses least-squares estimation, maximum likelihood method and the Cramer-Rao lower bounds, following by the Gauss-Newton iterative method. Chapter 6 is called "Quasi-

linearization Method for System Identification". The method of quasilinearization introduced in Chapter 4 is used here for system identification using the measurements to formulate the problem as a multi-point boundary-value problem. General formulation of the problem is given here while some detailed examples are presented for first and second order systems in Chapter 7 entitled "Applications of System Identification".

Part IV "Optimal Inputs for System Identification" consists of three chapters. Chapter 8 "Optimal Inputs" gives a historical background of optimal inputs and the design of optimal inputs for linear and nonlinear systems. The approach is based on maximizing of the sensitivity of the system output to an unknown parameter. Examples of the first and second order systems with one unknown parameter are presented. Chapter 9 "Additional Topics for Optimal Inputs" considers an improved method for the numerical determination of optimal inputs in which the Lagrange multiplier is evaluated simultaneously with the optimal input. The trace of the information matrix is used as the criterion in multiparameter optimal inputs. Then the observability, controllability and identifiability are defined. The optimal inputs for system with process noise and eigenvalues problems are briefly discussed. Two applications of optimal inputs are presented in Chapter 10. The first one is for blood glucose regulation parameter and the second one is for aircraft parameter estimation.

In the part V, Chapter 11 "Computer Programs for the Solution of Boundary-Value and Identification Problems" consists of several program listings. The programs are written in the BASIC language and are divided into two sections. The two-point boundary-value problems include examples from the linear first-order system state-regulator problem, optimal inputs for estimating one of the parameters of a nonlinear first-order system and optimal inputs for estimating one of the parameter of the blood glucose regulation two-compartement model. The system identification problems include examples for estimating a parameter of a first-order linear system and for estimating the four parameters of the blood glucose model.

The desired purpose of this book is to provide readers the analytical and computational tools required to compute the optimal inputs for system identification. The topics are explained in such a way that no previous knowledge of optimal control theory, numerical methods or system identification is assumed, however, the book should not be recommended for introductory study.

The book is written clearly with a couple of demonstrating examples, deals with nonlinear problems rather than linear ones and presents simultaneously the theory and the computational tools for it. It can be recommended to readers interested in the optimal input design for identification purposes from different branches.

Josef Böhm

HEINZ-ERICH ERBS, OTTO STOLZ

Einführung in die Programmierung mit Pascal

2. přepracované a rozšířené vydání.

B. G. Teubner, Stuttgart 1984.

Stran 240; řada obrázků, příkladů a cvičení; cena DM 24,80.

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Karel Šmuk