Multivariable Control Systems An Engineering Approach Free

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SystemsMultivariable ControlControl TheoryControl Systems with Input and Output ConstraintsAdvanced Control EngineeringDecoupling ControlMultivariable Control System Design and Applications

Linear Multivariable Systems

This reference/text discusses the structure and concepts of multivariable control systems, offering a balanced presentation of theory, algorithm development, and methods of implementation.;The book contains a powerful software package - L.A.S (Linear Algebra and Systems) which provides a tool for verifying an analysis technique or control design.;Reviewing the fundamentals of linear algebra and system theory, Algorithms for Computer-Aided Design of Multivariable Control Systems: supplies a solid basis for understanding multivariable systems and their characteristics; highlights the most relevant mathematical developments while keeping proofs and detailed derivations to a minimum; emphasizes the use of computer algorithms; provides special sections of application problems and their solutions to enhance learning; presents a unified theory of linear multi-input, multi-output (MIMO) system models; and introduces new results based on pseudo-controllability and pseudo-observability indices, furnishing algorithms for more accurate internodel conversions.;Illustrated with figures, tables and display equations and containing many previously unpublished results, Algorithms for Computer-Aided Design of Multivariable Control Systems is a reference for electrical and electronics, mechanical and control engineers and systems analysts as well as a text for upper-level undergraduate, graduate and continuing-education courses in multivariable control.

Robust Multivariable Control of Aerospace Systems

The foundation of linear systems theory goes back to Newton and has been followed over the years by many improvements such as linear operator theory, Laplace Transformation etc. After the World War II, feedback control theory has shown a rapid development, and standard elegant analysis and synthesis techniques have been discovered by control system workers, such as root-locus (Evans) and frequency response methods (Nyquist, Bode). These permitted a fast and efficient analysis of simple-loop control systems, but in their original "paper-and-pencil" form were not appropriate for multiple loop high-order systems. The advent of fast digital computers, together with the development of multivariable multi-loop system techniques, have eliminated these difficulties. Multivariable control theory has followed two main avenues; the optimal control approach, and the algebraic and frequency-domain control approach. An important key concept in the whole multivariable system theory is "ob servability and controllability" which revealed the exact relationships between transfer functions and the state variable representations. This has given new insight into the phenomenon of "hidden oscillations" and to the transfer function modelling of dynamic systems. The basic tool in optimal control theory is the celebrated matrix Riccati differential equation which provides the time-varying feedback gains in a linear-quadratic control system cell. Much theory presently exists for the characteristic properties and solution of this Riccati equation.

Multivariable Feedback Control

Textbook Of Control Systems Engineering (Vtu)

"Linear and Nonlinear Multivariable Feedback Control presents a highly original, unified control theory of both linear and nonlinear multivariable (also known as multi-input multi-output (MIMO)) feedback systems as a straightforward extension of classical control theory. It shows how the classical engineering methods look in the multidimensional case and how practising engineers or researchers can apply them to the analysis and design of linear and nonlinear MIMO systems."--BOOK JACKET.

Mono- and Multivariable Control and Estimation

An excellent introduction to feedback control system design, this book offers a theoretical approach that captures the essential issues and can be applied to a wide range of practical problems. Its explorations of recent developments in the field emphasize the relationship of new procedures to classical control theory, with a focus on single input and output systems that keeps concepts accessible to students with limited backgrounds. The text is geared toward a single-semester senior course or a graduate-level class for students of electrical engineering. The opening chapters constitute a basic treatment of feedback design. Topics include a detailed formulation of the control design program, the fundamental issue of performance/stability robustness tradeoff, and the graphical design technique of loopshaping. Subsequent chapters extend the discussion of the loopshaping technique and connect it with notions of optimality. Concluding chapters examine controller design via optimization, offering a mathematical approach that is useful for multivariable systems.

Industrial Digital Control Systems

Multivariable Feedback Control: Analysis and Design

Systems and control theory has experienced significant development in the past few decades. New techniques have emerged which hold enormous potential for industrial applications, and which have therefore also attracted much interest from academic researchers. However, the impact of these developments on the process industries has been limited. The purpose of Multivariable System Identification for Process Control is to bridge the gap between theory and application, and to provide industrial solutions, based on sound scientific theory, to process identification problems. The book is organized in a reader-friendly way, starting with the simplest methods, and then gradually introducing more complex techniques. Thus, the reader is offered clear physical insight without recourse to large amounts of mathematics. Each method is covered in a single chapter or section, and experimental design is explained before any identification algorithms are discussed. The many simulation examples and industrial case studies demonstrate the power and efficiency of process identification, helping to make the theory more applicable. MatlabTM M-files, designed to help the reader to learn identification in a computing environment, are included.

Control System Engineering

Computer Aided Design in Control and Engineering Systems contains the proceedings of the 3rd International Federation of Automatic Control/International Federation for Information Processing Symposium held in Lyngby, Denmark, from July 31 to August 2, 1985. The papers review the state of the art and the trends in development of computer aided design (CAD) of control and engineering systems, techniques, procedures, and concepts. This book is comprised of 74 chapters divided into 17 sections and begins with a description of a prototype computer environment that combines expert control system analysis and design tools. The discussion then turns to decision support systems which could be used to address problems of management and control of large-scale multiproduct multiline batch manufacturing outside the mechanical engineering industries. The following chapters focus on the use of CAD in control education, industrial applications of CAD, and hardware/software systems. Some examples of universal and specialized CAD packages are presented, and applications of CAD in electric power plants, process control systems, and transportation systems are highlighted. The remaining chapters look at CAD/computer aided engineering/computer aided manufacturing systems as well as the use of mathematical methods in CAD. This monograph will be of interest to practitioners in computer science, computer engineering, and industrial engineering.

Control of Polymerization Reactors

Interactive Graphics for Multivariable Control System Design

This book provides an introduction to the mathematics needed to model, analyze, and design feedback systems. It is an ideal textbook for undergraduate and graduate students, and is indispensable for researchers seeking a self-contained reference on control theory. Unlike most books on the subject, Feedback Systems develops transfer functions through the exponential response of a system, and is accessible across a range of disciplines that utilize feedback in physical, biological, information, and economic systems. Karl Åström and Richard Murray use techniques from physics, computer science, and operations research to introduce control-oriented modeling. They begin with state space tools for analysis and design, including stability of solutions, Lyapunov functions, reachability, state feedback observability, and estimators. The matrix exponential plays a central role in the analysis of linear control systems, allowing a concise development of many of the key concepts for this class of models. Åström and Murray then develop and explain tools in the frequency domain, including transfer functions, Nyquist analysis, PID control, frequency domain design, and robustness. They provide exercises at the end of every chapter, and an accompanying electronic solutions manual is available. Feedback Systems is a complete one-volume resource for students and researchers in mathematics, engineering, and the sciences. Covers the mathematics needed to model, analyze, and design feedback systems Serves as an introductory textbook for students and a self-contained resource for researchers Includes exercises at the end of every chapter Features an electronic solutions manual Offers techniques applicable across a range of disciplines

Feedback Control Theory

Includes: Digital signals and systems. Digital controllers for process control applications. Design of digital controllers. Control of time delay systems. State-space concepts. System identification. Introduction to discrete optimal control. Multivariable control. Adaptive control. Computer aided design for industrial control systems. Reliability and redundancy in microprocessor controllers. Software and hardware aspects of industrial controller implementations. Application of distributed digital control algorithms to power stations. An expert system for process control.

Control Systems Theory with Engineering Applications

Classical design and analysis techniques, many of which date back to the 1950's, are still predominantly used in the aerospace industry for the design and analysis of automatic flight control and aero-engine control systems. The continued success and popularity of these techniques is particularly impressive considering the radical advances in aircraft and spacecraft design and avionics technology made over this period. Clearly, an understanding of both the advantages and limitations of these methods is essential in order to properly evaluate the likely usefulness of more modern techniques for the design and analysis of aerospace control systems. One of the themes of this book is that the multivariable robust control methods it describes are logical and natural extensions of the more classical methods, and not replacements for them. It is assumed that readers of this publication are already familiar with classical flight control techniques. Emphasis is on the philosophy, advantages and limitations of the classical approach to flight control system design and analysis. Abstracted in Inspec

Control Systems with Actuator Saturation

The book reviews developments in the following fields: state-space theory; complex variable methods in feedback system analysis and design; robustness in variable control system design; design study using the characteristic locus method; inverse Nyquist array design method; nuclear boiler control scheme analysis and design; optimal control; control system design via mathematical programming; multivariable design optimisation; pole assignment; nonlinear systems; DDC system design; robust controller design; distributed parameter system control; and decentralised control.

Multivariable Predictive Control

This is a textbook designed for an advanced course in control theory. Currently most textbooks on the subject either looks at "multivariate" systems or "non-linear" systems. However, Control Theory is the only textbook available that covers both. It explains current developments in these two types of control techniques, and looks at tools for computer-aided design, for example Matlab and its toolboxes. To make full use of computer design tools, a good understanding of their theoretical basis is necessary, and to enable this, the book presents relevant mathematics clearly and simply. The practical limits of control systems are explored, and the relevance of these to control design are discussed. Control Theory is an ideal textbook for final-year undergraduate and postgraduate courses, and the student will be helped by a series of exercises at the end of each chapter. Professional engineers will also welcome it as a core reference.

Multivariable Control

A Generalized Framework of Linear Multivariable Control

Dynamics systems (living organisms, electromechanical and industrial systems, chemical and technological processes, market and ecology, and so forth) can be considered and analyzed using information and systems theories. For example, adaptive human behavior can be studied using automatic feedback control. As an illustrative example, the driver controls a car changing the speed and steer ing wheels using incoming information, such as traffic and road conditions. This book focuses on the most important and manageable topics in applied multivariable control with application to a wide class of electromechanical dynamic systems. A large spectrum of systems, familiar to electrical, mechanical, and aerospace stu dents, engineers, and scholars, are thoroughly studied to build the bridge between theory and practice as well as to illustrate the practical application of control theory through illustrative examples. It is the author's goal to write a book that can be used to teach undergraduate and graduate classes in automatic control and nonlin ear control at electrical, mechanical, and aerospace engineering departments. The book is also addressed to engineers and scholars, and the examples considered allow one to implement the theory in a great variety of industrial systems. The main purpose of this book is to help the reader grasp the nature and significance of multivariable control.

Multivariable Control Systems

Thereare richtheories and designs for generalcontrolsystems,but usually, they will not lead to PID controllers. Noting that the PID controller has been the most popular one in industry for over ?fty years, we will con?ne our discussion hereto PIDcontrolonly. PID controlhasbeenanimportantresearchtopicsince 1950’s, and causes remarkable activities for the last two decades. Most of the existing works have been on the single variable PID control and its theory and design are well established, understood and practically applied. However, most industrial processes are of multivariable nature. It is not rare that the overall multivariable PID control system could fail although each PID loop may work well. Thus,demandforaddress ingmultivariableinteractionsishighforsuccessful applic ationofPIDcontrolinmultivariableprocessesanditisevide ntfrommajor leading control companies who all rankedthe couplings of multivariable systems as the principal common problem in industry. There have been studies on PID control for multivariable processes and they provide some useful design tools for certaincases. But itis notedthat the existing worksaremainlyfor decentralized form of PID control and based on ad hoc methodologies. Obvious, multivariable PID control is much less understood and developed in comparison with the single variable case and actual need for industrial applications. Better theory and design have to be established for multivariable PID control to reach the same maturity and popularity as the single variable case. The present monograph puts together, in a single volume, a fairly comp- hensive, up-to-date and detailed treatment of PID control for multivariable p- cesses, from paring, gain and phase margins, to various design methods and applications.

PID Control for Multivariable Processes

Decoupling or non-interactive control has attracted considerable research attention since the 1960s when control engineers started to deal with multivariable systems. The theory and design techniques for decoupling control have now, more or less matured for linear time-invariant systems, yet there is no single book which focuses on such an important topic. The present monograph fills this gap by presenting a fairly comprehensive and detailed treatment of decoupling theory and relevant design methods. Decoupling control under the framework of polynomial transfer function and frequency response settings, is included as well as the disturbance decoupling problem. The emphasis here is on special or relatively new compensation schemes such as (true and virtual) feedforward control and disturbance observers, rather than use of feedback control alone. The results are presented in a self-contained way and only the knowledge of basic linear systems theory is assumed of the reader.

Multivariable Control for Industrial Applications

It also presents some related results on systems with state saturation or sensor saturation.".

Multivariable Control System Design Techniques

Multivariable Control Systems' teaches a very important form of control without burdening the subject with an overdependence on heavy and complicated mathematics.

Control Configuration Selection for Multivariable Plants

This book contains a derivation of the subset of stabilizing controllers for analog and digital linear time-invariant multivariable feedback control systems that insure stable system errors and stable controller outputs for persistent deterministic reference inputs that are trackable and for persistent deterministic disturbance inputs that are rejectable. For this subset of stabilizing controllers, the Wiener-Hopf methodology is then employed to obtain the optimal controller for which a quadratic performance measure is minimized. This is done for the completely general standard configuration and methods that enable the trading off of optimality for an improved stability margin and/or reduced sensitivity to plant model uncertainty are described. New and novel results on the optimal design of decoupled (non-interacting) systems are also presented. The results are applied in two examples: the one- and three-degree-of-freedom configurations. These demonstrate that the standard configuration is one encompassing all possible feedback configurations. Each chapter is completed by a group of worked examples, which reveal additional insights and extensions of the theory presented in the chapter. Three of the examples illustrate the application of the theory to two physical cases: the depth and pitch control of a submarine and the control of a Rosenbrock process. In the latter case, designs with and without decoupling are compared. This book provides researchers and graduate students working in feedback control with a valuable reference for Wiener–Hopf theory of multivariable design. Basic knowledge of linear systems and matrix theory is required.

Design of Modern Control Systems

MATLAB Control Systems Engineering

This text was developed over a three year period of time (1971- 1973) from a variety of notes and references used in the presentation of a senior/first year graduate level course in the Division of En gineering at Brown University titled Linear System Theory. The in tent of the course was not only to introduce students to the more modern, state-space approach to multivariable control system analysis and design, as opposed to the classical, frequency domain approach, but also to draw analogies between the two approaches whenever and wherever possible. It is therefore felt that the material presented will have broader appeal to practicing engineers than a text devoted exclusively to the state-space approach. It was assumed that students taking the course had also taken, as a prerequisite, an undergraduate course in classical control theory and also were familiar with certain standard linear algebraic notions as well as the theory of ordinary differential equations, although a substantial effort was expended to make the material as self-contained as possible. In particular, Chapter 2 is employed to familiarize the reader with a good deal of the mathematical material employed through out the remainder of the text. Chapters 3 through 5 were drawn, in part, from a number of contemporary state-space and matrix algebraic references, as well as some recent research of the author, especially those portions which deal with polynomial matrices and the differential operator approach.

Algorithms for Computer-Aided Design of Multivariable Control Systems

Control of multivariable industrial plants and processes has been a challenging and fascinating task for researchers in this field. The analysis and design methodologies for multivariable plants can be categorized as centralized and decentralized design strategies. Despite the remarkable theoretical achievements in centralized multiva- able control, decentralized control is still widely used in many industrial plants. This trend in the beginning of the third millennium is still there and it will be with us for the foreseeable future. This is mainly because of the easy implementation, main- nance, tuning, and robust behavior in the face of fault and model uncertainties, which is reported with the vast number of running decentralized controllers in the industry. The main steps involved in employing decentralized controllers can be summarized as follows: • Control objectives formulation and plant modeling. • Control structure selection. • Controller design. • Simulation or pilot plant experiments and Implementation. Nearly all the textbooks on multivariable control theory deal only with the control system analysis and design. The important concept of control structure selection which is a key prerequisite for a successful industrial control strategy is almost unnoticed. Structure selection involves the following two main steps: • Inputs and outputs selection. • Control configuration selection or the input-output pairing problem. This book focuses on control configuration selection or the input-output pairing problem, which is defined as the procedure of selecting the appropriate input and output pair for the design of SISO (or block) controllers.

Computer Aided Design in Control and Engineering Systems

Frequency domain based techniques are used for analysing and designing multivariable control systems. The focus of this new book centres on two related concepts, that of dominance and the application of ideas from direct methods of matrix inversion to the problems of multivariable and sequential design. Written from a practical perspective, the text highlights several sequential design ideas, including: Developments of a rigorous sequential design methodology and analysis based on Gauss-Jordon concepts Presentation of frequency domain analogies of the direct methods of matrix inversion, obtaining new and exact sequential design and stability results Discussion of procedures for obtaining and optimising dominance criteria, including input/output optimum assignment, optimum scaling and the use of parameterised precompensators This detailed study, written by two well-known researchers in the field, will greatly appeal to practising engineers in process control, chemical and mechanical engineering. Researchers concerned with systems design will also find this an invaluable reference source.

Design of Linear Multivariable Feedback Control Systems

This book focuses on control design with continual references to the practical aspects of implementation. While the concepts of multivariable control are justified, the book emphasizes the need to maintain student interest and motivation over exhaustively rigorous mathematical proof.

Structural Analysis and Design of Multivariable Control Systems

A Generalized Framework of Linear Multivariable Control proposes a number of generalized models by using the generalized inverse of matrix, while the usual linear multivariable control theory relies on some regular models. The book supports that in H-infinity control, the linear fractional transformation formulation is relying on the inverse of the block matrix. If the block matrix is not regular, the H-infinity control does not apply any more in the normal framework. Therefore, it is very important to relax those restrictions to generalize the classical notions and models to include some non-regular cases. This book is ideal for scholars, academics, professional engineer and students who are interested in control system theory. Presents a comprehensive set of numerical procedures, algorithms, and examples on how to deal with irregular models Provides a summary on generalized framework of linear multivariable control that focuses on generalizations of models and notions Introduces a number of generalized models by using the generalized inverse of matrix

Multivariable Control Systems

From the reviews: [The authors] "have succeeded in their intention to produce the first reference in the area that will be available for a broad audience. I think that this book will be a standard reference for a long time." Control Engineering Practice

Multivariable Control Systems

Numerous worked examples, exercises and case studies, which make frequent use of MATLAB, are included. MATLAB files for examples and figures, solutions to selected exercises, extra problems and linear state-space models for the case studies are available on the Internet.

Linear Multivariable Control

Multivariable System Identification For Process Control

This reference and text provides an in-depth description of developments in control techniques and their application to polymerization reactors and offers important introductory background information on polymerization reaction engineering.;Discussing modelling, identification, linear, nonlinear and multivariable schemes, Control of Polymerization Reactors: presents all available techniques that can be used to control reactors properly for optimal performance; shows how to manipulate pivotal variables that affect reactor control; examines methods for deriving dynamic process models to improve reactor efficiency; reviews reactor control problems and points out end-use properties; supplies methods for measuring process variables, and ways to estimate variables that can't be measured; and explains how single-input, single-output (SISO) strategies can be effectively used for control.;Filled with illustrative examples to clarify concepts, including more than 730 figures, tables and equations, Control of Polymerization Reactors is intended for use as a reference for chemical, process development, process design, research and development, control systems, and polymer engineers; and polymer chemists and physicists; as well as a text for upper-level undergraduate and graduate students in polymerization reactor control courses.

Linear and Nonlinear Multivariable Feedback Control

The purpose of this research monograph is to utilize algebraic and systems theory for the structure analysis and design of multivariable control systems described by state-space representations and matrix fraction descriptions. A unified approach characterizing the dynamics of a system through the formulation of the characteristic -matrix of the system is presented. The latent structures, solvents, divisors, and spectral factors of the non-singular characteristic -matrix and their relationships with the respesctive counterparts of the state-space representations are explored. Applications in model reduction, pole assignment design, modal control design for multivariable systems, parallel realizations and cascade realizations of multiport networks are illustrated. Computational algorithms and illustrative numerical examples are presented throughout the monograph. The reader is assumed to have a graduate level background in modern control theory.

Multivariable Control

Advanced Control Engineering provides a complete course in control engineering for undergraduates of all technical disciplines. Included are real-life case studies, numerous problems, and accompanying MatLab programs.

Feedback Systems

A guide to all practical aspects of building, implementing, managing, and maintaining MPC applications in industrial plants Multivariable Predictive Control: Applications in Industry provides engineers with a thorough understanding of all practical aspects of multivariate predictive control (MPC) applications, as well as expert guidance on how to derive maximum benefit from those systems. Short on theory and long on step-by-step information, it covers everything plant process engineers and control engineers need to know about building, deploying, and managing MPC applications in their companies. MPC has more than proven itself to be one the most important tools for optimising plant operations on an ongoing basis. Companies, worldwide, across a range of industries are successfully using MPC systems to optimise materials and utility consumption, reduce waste, minimise pollution, and maximise production. Unfortunately, due in part to the lack of practical references, plant engineers are often at a loss as to how to manage and maintain MPC systems once the applications have been installed and the consultants and vendors' reps have left the plant. Written by a chemical engineer with two decades of experience in operations and technical services at petrochemical companies, this book fills that regrettable gap in the professional literature. Provides a cost-benefit analysis of typical MPC projects and reviews commercially available MPC software packages Details software implementation steps, as well as techniques for successfully evaluating and monitoring software performance once it has been installed Features case studies and real-world examples from industries, worldwide, illustrating the advantages and common pitfalls of MPC systems Describes MPC application failures in an array of companies, exposes the root causes of those failures, and offers proven safeguards and corrective measures for avoiding similar failures Multivariable Predictive Control: Applications in Industry is an indispensable resource for plant process engineers and control engineers working in chemical plants, petrochemical companies, and oil refineries in which MPC systems already are operational, or where MPC implementations are being considering.

Multivariable Control

Control Theory

Control System Analysis Examples of control systems, Open loop control systems, Closed loop control systems. Transfer function. Types of feedback and feedback control system characteristics - Noise rejection; Gain, Sensitivity, Stability. Mathematical Modeling of Systems Importance of a mathematical model, Block diagrams, Signal flow graphs, Masan's gain formula and its application to block diagram reduction. State space method, Solving time-invariant system,Transfer matrix. Transient and Steady State - Response Analysis Impulse response function, First order system, Second order system, Time domain specifications of systems, Analysis of transient-response using second order model.Classification of control systems according to Type of systems, Steady - state errors, Static error constants, Steady - state analysis of different types of systems using step, ramp and parabolic input signals. Stability Analysis Concept of stability, Stability analysis using Routh's stability criterion, Absolute stability, Relative stability, Root-Locus plots, Summary of general rules for constructing Root-Locus, Root-Locus analysis of control systems. Compensation techniques-Log, lead, log-lead. Frequency-Response Analysis Frequency domain specifications, Resonance peak and peak resonating frequency, Relationship between time and frequency domain specification of systems. Bode plots, Polar plots, Log-magnitude Vs phase plots, Nyquist stability criterion, Stability analysis, Relative stability, Gain margin, Phase margin, Stability analysis of system using Bode plots. Closed-loop frequency response-Constant gain and phase loci, Nichol's chart and their use in stability study of systems. Control Components and Controller D.C. and A.C. servomotors, Servoamplifier, Potentiometer, Synchro transmitters, Synchro receivers, Synchro control transformer, Stepper motors. Discontinuous controller modes, Continuous controller modes, Composite controllers.

Control Systems with Input and Output Constraints

Very Good,No Highlights or Markup,all pages are intact.

Advanced Control Engineering

In writing this monograph my objective is to present arecent, 'geometrie' approach to the structural synthesis of multivariable control systems that are linear, time-invariant, and of finite dynamic order. The book is addressed to graduate students specializing in control, to engineering scientists engaged in control systems research and development, and to mathematicians with some previous acquaintance with control problems. The label 'geometrie' is applied for several reasons. First and obviously, the setting is linear state space and the mathematics chiefly linear algebra in abstract (geometrie) style. The basic ideas are the familiar system concepts of controllability and observability, thought of as geometrie properties of distinguished state subspaces. Indeed, the geometry was first brought in out of revulsion against the orgy of matrix manipulation which linear control theory mainly consisted of, not so long ago. But secondlyand of greater interest, the geometrie setting rather quickly suggested new methods of attacking synthesis which have proved to be intuitive and economical; they are also easily reduced to matrix arith metic as soonas you want to compute. The essence of the 'geometrie' approach is just this: instead of looking directly for a feedback laW (say u =

Fx) which would solve your synthesis problem if a solution exists, first characterize solvability as a verifiable property of some constructible state subspace, say J. Then, if all is well, you may calculate F from J quite easily.

Decoupling Control

This book presents the various design methods of a state-feedback control law and of an observer. The considered systems are of continuous-time and of discrete-time nature, monovariable or multivariable, the last ones being of main consideration. Three different approaches are described: • Linear design methods, with an emphasis on decoupling strategies, and a general formula for multivariable controller or observer design; • Quadratic optimization methods: Linear Quadratic Control (LQC), optimal Kalman filtering, Linear Quadratic Gaussian (LQG) control; • Linear matrix inequalities (LMIs) to solve linear and quadratic problems. The duality between control and observation is taken to advantage and extended up to the mathematical domain. A large number of exercises, all given with their detailed solutions, mostly obtained with MATLAB, reinforce and exemplify the practical orientation of this book. The programs, created by the author for their solving, are available on the Internet sites of Springer and of MathWorks for downloading. This book is targeted at students of Engineering Schools or Universities, at the Master’s level, at engineers desiring to design and implement innovative control methods, and at researchers.

Multivariable Control System Design and Applications

MATLAB is a high-level language and environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java. MATLAB Control Systems Engineering introduces you to the MATLAB language with practical hands-on instructions and results, allowing you to quickly achieve your goals. In addition to giving an introduction to the MATLAB environment and MATLAB programming, this book provides all the material needed to design and analyze control systems using MATLAB’s specialized Control Systems Toolbox. The Control Systems Toolbox offers an extensive range of tools for classical and modern control design. Using these tools you can create models of linear time-invariant systems in transfer function, zero-pole-gain or state space format. You can manipulate both discrete-time and continuous-time systems and convert between various representations. You can calculate and graph time response, frequency response and loci of roots. Other functions allow you to perform pole placement, optimal control and estimates. The Control System Toolbox is open and extendible, allowing you to create customized M-files to suit your specific applications.