

Quantitative Feedback Theory Fundamentals And Applications Second Edition Automation And Control Engineering

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Quantitative Feedback Theory - Constantine H. Houppis 2005-12-09

The first edition of Quantitative Feedback Theory gained enormous popularity by successfully bridging the gap between theory and real-world engineering practice. Avoiding mathematical theorems, lemmas, proofs, and correlaries, it boiled down to the essential elements of quantitative feedback theory (QFT) necessary to readily analyze, develop, and implement robust control systems. Thoroughly updated and expanded, Quantitative Feedback Theory: Fundamentals and Applications, Second Edition continues to provide a platform for intelligent decision making and design based on knowledge of the characteristics and operating scenario of the plant. Beginning with the fundamentals, the authors build a background in analog and discrete-time multiple-input-single-output (MISO) and multiple-input-multiple-output (MIMO) feedback control systems along with the fundamentals of the QFT technique. The remainder of the book links these concepts to practical applications. Among the many enhancements to this edition are a new section on large wind turbine control system, four new chapters, and five new appendices. The new chapters cover non-diagonal compensator design for MIMO systems, QFT design involving Smith predictors for time delay systems with uncertainty, weighting matrices and control authority, and QFT design techniques applied to real-world industrial systems. Quantitative Feedback Theory: Fundamentals and Applications, Second Edition includes new and revised examples and end-of-chapter problems and offers a companion CD that supplies MIMO QFT computer-aided design (CAD) software. It is the perfect guide to effectively and intuitively implementing QFT control.

The Control Handbook - William S. Levine 1996-02-23

This is the biggest, most comprehensive, and most prestigious compilation of articles on control systems imaginable. Every aspect of control is expertly covered, from the mathematical foundations to applications in robot and manipulator control. Never before has such a massive amount of authoritative, detailed, accurate, and well-organized information been available in a single volume. Absolutely everyone working in any aspect of systems and controls must have this book!

Linear Control Theory - Shankar P. Bhattacharyya 2018-10-03

Successfully classroom-tested at the graduate level, Linear Control Theory: Structure, Robustness, and Optimization covers three major areas of control engineering (PID control, robust control, and optimal control). It provides balanced coverage of elegant mathematical theory and useful engineering-oriented results. The first part of the book develops results relating to the design of PID and first-order controllers for continuous and discrete-time linear systems with possible delays. The second section deals with the robust stability and performance of systems under parametric and unstructured uncertainty. This section describes several elegant and sharp results, such as Kharitonov's theorem and its extensions, the edge theorem, and the mapping theorem. Focusing on the optimal control of linear systems, the third part discusses the standard theories of the linear quadratic regulator, H ∞ and l_1 optimal control, and associated results. Written by recognized leaders in the field, this book explains how control theory can be applied to the design of real-world systems. It shows that the techniques of three term controllers, along

with the results on robust and optimal control, are invaluable to developing and solving research problems in many areas of engineering.

Introduction to Linear Control Systems - Yazdan Bavafa-Toosi 2017-09-19

Introduction to Linear Control Systems is designed as a standard introduction to linear control systems for all those who one way or another deal with control systems. It can be used as a comprehensive up-to-date textbook for a one-semester 3-credit undergraduate course on linear control systems as the first course on this topic at university. This includes the faculties of electrical engineering, mechanical engineering, aerospace engineering, chemical and petroleum engineering, industrial engineering, civil engineering, bio-engineering, economics, mathematics, physics, management and social sciences, etc. The book covers foundations of linear control systems, their *raison detre*, different types, modelling, representations, computations, stability concepts, tools for time-domain and frequency-domain analysis and synthesis, and fundamental limitations, with an emphasis on frequency-domain methods. Every chapter includes a part on further readings where more advanced topics and pertinent references are introduced for further studies. The presentation is theoretically firm, contemporary, and self-contained. Appendices cover Laplace transform and differential equations, dynamics, MATLAB and SIMULINK, treatise on stability concepts and tools, treatise on Routh-Hurwitz method, random optimization techniques as well as convex and non-convex problems, and sample midterm and endterm exams. The book is divided to the sequel 3 parts plus appendices. PART I: In this part of the book, chapters 1-5, we present foundations of linear control systems. This includes: the introduction to control systems, their *raison detre*, their different types, modelling of control systems, different methods for their representation and fundamental computations, basic stability concepts and tools for both analysis and design, basic time domain analysis and design details, and the root locus as a stability analysis and synthesis tool. PART II: In this part of the book, Chapters 6-9, we present what is generally referred to as the frequency domain methods. This refers to the experiment of applying a sinusoidal input to the system and studying its output. There are basically three different methods for representation and studying of the data of the aforementioned frequency response experiment: these are the Nyquist plot, the Bode diagram, and the Krohn-Manger-Nichols chart. We study these methods in details. We learn that the output is also a sinusoid with the same frequency but generally with different phase and magnitude. By dividing the output by the input we obtain the so-called sinusoidal or frequency transfer function of the system which is the same as the transfer function when the Laplace variable s is substituted with $j\omega$. Finally we use the Bode diagram for the design process. PART III: In this part, Chapter 10, we introduce some miscellaneous advanced topics under the theme fundamental limitations which should be included in this undergraduate course at least in an introductory level. We make bridges between some seemingly disparate aspects of a control system and theoretically complement the previously studied subjects. Appendices: The book contains seven appendices. Appendix A is on the Laplace transform and differential equations. Appendix B is an introduction to dynamics. Appendix C is an introduction to MATLAB, including SIMULINK. Appendix D is a survey on stability concepts and tools. A glossary and road

map of the available stability concepts and tests is provided which is missing even in the research literature. Appendix E is a survey on the Routh-Hurwitz method, also missing in the literature. Appendix F is an introduction to random optimization techniques and convex and non-convex problems. Finally, appendix G presents sample midterm and endterm exams, which are class-tested several times.

Stochastic Hybrid Systems - Christos G. Cassandras 2018-10-03

Because they incorporate both time- and event-driven dynamics, stochastic hybrid systems (SHS) have become ubiquitous in a variety of fields, from mathematical finance to biological processes to communication networks to engineering. Comprehensively integrating numerous cutting-edge studies, Stochastic Hybrid Systems presents a captivating treatment of some of the most ambitious types of dynamic systems. Cohesively edited by leading experts in the field, the book introduces the theoretical basics, computational methods, and applications of SHS. It first discusses the underlying principles behind SHS and the main design limitations of SHS. Building on these fundamentals, the authoritative contributors present methods for computer calculations that apply SHS analysis and synthesis techniques in practice. The book concludes with examples of systems encountered in a wide range of application areas, including molecular biology, communication networks, and air traffic management. It also explains how to resolve practical problems associated with these systems. Stochastic Hybrid Systems achieves an ideal balance between a theoretical treatment of SHS and practical considerations. The book skillfully explores the interaction of physical processes with computerized equipment in an uncertain environment, enabling a better understanding of sophisticated as well as everyday devices and processes.

Robust Control Engineering - Mario Garcia-Sanz 2017-06-26

This book thoroughly covers the fundamentals of the QFT robust control, as well as practical control solutions, for unstable, time-delay, non-minimum phase or distributed parameter systems, plants with large model uncertainty, high-performance specifications, nonlinear components, multi-input multi-output characteristics or asymmetric topologies. The reader will discover practical applications through a collection of fifty successful, real world case studies and projects, in which the author has been involved during the last twenty-five years, including commercial wind turbines, wastewater treatment plants, power systems, satellites with flexible appendages, spacecraft, large radio telescopes, and industrial manufacturing systems. Furthermore, the book presents problems and projects with the popular QFT Control Toolbox (QFTCT) for MATLAB, which was developed by the author.

Applied Mechanics Reviews - 1991

Tensor Product Model Transformation in Polytopic Model-Based Control - Péter Baranyi 2018-09-03

Tensor Product Model Transformation in Polytopic Model-Based Control offers a new perspective of control system design. Instead of relying solely on the formulation of more effective LMIs, which is the widely adopted approach in existing LMI-related studies, this cutting-edge book calls for a systematic modification and reshaping of the polytopic convex hull to achieve enhanced performance. Varying the convexity of the resulting TP canonical form is a key new feature of the approach. The book concentrates on reducing analytical derivations in the design process, echoing the recent paradigm shift on the acceptance of numerical solution as a valid form of output to control system problems. The salient features of the book include: Presents a new HOSVD-based canonical representation for (qLPV) models that enables trade-offs between approximation accuracy and computation complexity Supports a conceptually new control design methodology by proposing TP model transformation that offers a straightforward way of manipulating different types of convexity to appear in polytopic representation Introduces a numerical transformation that has the advantage of readily accommodating models described by non-conventional modeling and identification approaches, such as neural networks and fuzzy rules Presents a number of practical examples to demonstrate the application of the approach to generate control system design for complex (qLPV) systems and multiple control objectives. The authors' approach is based on an extended version of singular value decomposition applicable to hyperdimensional tensors. Under the approach, trade-offs between approximation accuracy and computation complexity can be performed through the singular values to be retained in the process. The use of LMIs enables the incorporation of multiple performance objectives into the control design problem and assurance of a solution via convex optimization if feasible. Tensor Product

Model Transformation in Polytopic Model-Based Control includes examples and incorporates MATLAB® Toolbox TPool. It provides a reference guide for graduate students, researchers, engineers, and practitioners who are dealing with nonlinear systems control applications.

Analysis and Synthesis of Fuzzy Control Systems - Gang Feng 2018-09-03

Fuzzy logic control (FLC) has proven to be a popular control methodology for many complex systems in industry, and is often used with great success as an alternative to conventional control techniques. However, because it is fundamentally model free, conventional FLC suffers from a lack of tools for systematic stability analysis and controller design. To address this problem, many model-based fuzzy control approaches have been developed, with the fuzzy dynamic model or the Takagi and Sugeno (T-S) fuzzy model-based approaches receiving the greatest attention. Analysis and Synthesis of Fuzzy Control Systems: A Model-Based Approach offers a unique reference devoted to the systematic analysis and synthesis of model-based fuzzy control systems. After giving a brief review of the varieties of FLC, including the T-S fuzzy model-based control, it fully explains the fundamental concepts of fuzzy sets, fuzzy logic, and fuzzy systems. This enables the book to be self-contained and provides a basis for later chapters, which cover: T-S fuzzy modeling and identification via nonlinear models or data Stability analysis of T-S fuzzy systems Stabilization controller synthesis as well as robust H_∞ and observer and output feedback controller synthesis Robust controller synthesis of uncertain T-S fuzzy systems Time-delay T-S fuzzy systems Fuzzy model predictive control Robust fuzzy filtering Adaptive control of T-S fuzzy systems A reference for scientists and engineers in systems and control, the book also serves the needs of graduate students exploring fuzzy logic control. It readily demonstrates that conventional control technology and fuzzy logic control can be elegantly combined and further developed so that disadvantages of conventional FLC can be avoided and the horizon of conventional control technology greatly extended. Many chapters feature application simulation examples and practical numerical examples based on MATLAB®.

Intelligent Freight Transportation - Petros A. Ioannou 2008-03-24

Increasing capacity at ports and goods movement in the supply chain in general, while also satisfying environmental, economic, political, labor union, and other constraints is, arguably, the greatest challenge of modern transportation. With space at a premium and costs through the roof, it is increasingly obvious that the traditional solutions are

Discrete-Time Recurrent Neural Control - Edgar N. Sanchez 2018-09-03

The book presents recent advances in the theory of neural control for discrete-time nonlinear systems with multiple inputs and multiple outputs. The simulation results that appear in each chapter include rigorous mathematical analyses, based on the Lyapunov approach, to establish its properties. The book contains two sections: the first focuses on the analyses of control techniques; the second is dedicated to illustrating results of real-time applications. It also provides solutions for the output trajectory tracking problem of unknown nonlinear systems based on sliding modes and inverse optimal control scheme. "This book on Discrete-time Recurrent Neural Control is unique in the literature, with new knowledge and information about the new technique of recurrent neural control especially for discrete-time systems. The book is well organized and clearly presented. It will be welcome by a wide range of researchers in science and engineering, especially graduate students and junior researchers who want to learn the new notion of recurrent neural control. I believe it will have a good market. It is an excellent book after all." — Guanrong Chen, City University of Hong Kong "This book includes very relevant topics, about neural control. In these days, Artificial Neural Networks have been recovering their relevance and well-established importance, this due to its great capacity to process big amounts of data. Artificial Neural Networks development always is related to technological advancements; therefore, it is not a surprise that now we are being witnesses of this new era in Artificial Neural Networks, however most of the developments in this research area only focuses on applicability of the proposed schemes. However, Edgar N. Sanchez author of this book does not lose focus and include both important applications as well as a deep theoretical analysis of Artificial Neural Networks to control discrete-time nonlinear systems. It is important to remark that first, the considered Artificial Neural Networks are development in discrete-time this simplify its implementation in real-time; secondly, the proposed applications ranging from modelling of unknown discrete-time on linear systems to control electrical machines with an emphasize to renewable energy systems. However, its applications are

not limited to these kind of systems, due to their theoretical foundation it can be applicable to a large class of nonlinear systems. All of these is supported by the solid research done by the author." — Alma Y. Alanis, University of Guadalajara, Mexico "This book discusses in detail; how neural networks can be used for optimal as well as robust control design. Design of neural network controllers for real time applications such as induction motors, boost converters, inverted pendulum and doubly fed induction generators has also been carried out which gives the book an edge over other similar titles. This book will be an asset for the novice to the experienced ones." — Rajesh Joseph Abraham, Indian Institute of Space Science & Technology, Thiruvananthapuram, India

Wind Energy Systems - Mario Garcia-Sanz 2012-02-02

Presenting the latest developments in the field, Wind Energy Systems: Control Engineering Design offers a novel take on advanced control engineering design techniques for wind turbine applications. The book introduces concurrent quantitative engineering techniques for the design of highly efficient and reliable controllers, which can be used to solve the most critical problems of multi-megawatt wind energy systems. This book is based on the authors' experience during the last two decades designing commercial multi-megawatt wind turbines and control systems for industry leaders, including NASA and the European Space Agency. This work is their response to the urgent need for a truly reliable concurrent engineering methodology for the design of advanced control systems. Outlining a roadmap for such a coordinated architecture, the authors consider the links between all aspects of a multi-megawatt wind energy project, in which the wind turbine and the control system must be cooperatively designed to achieve an optimized, reliable, and successful system. Look inside for links to a free download of QFTCT—a new interactive CAD tool for QFT controller design with MATLAB® that the authors developed with the European Space Agency. The textbook's big-picture insights can help students and practicing engineers control and optimize a wind energy system, in which large, flexible, aerodynamic structures are connected to a demanding variable electrical grid and work automatically under very turbulent and unpredictable environmental conditions. The book covers topics including robust QFT control, aerodynamics, mechanical and electrical dynamic modeling, economics, reliability, and efficiency. It also addresses standards, certification, implementation, grid integration, and power quality, as well as environmental and maintenance issues. To reinforce understanding, the authors present real examples of experimentation with commercial multi-megawatt direct-drive wind turbines, as well as on-shore, offshore, floating, and airborne wind turbine applications. They also offer a unique in-depth exploration of the quantitative feedback theory (QFT)—a proven, successful robust control technique for real-world applications—as well as advanced switching control techniques that help engineers exceed classical linear limitations.

Wireless Ad hoc and Sensor Networks - Jagannathan Sarangapani 2017-12-19

With modern communication networks continuing to grow in traffic, size, complexity, and variety, control systems are critical to ensure quality and effectively manage network traffic. Providing a thorough and authoritative introduction, Wireless Ad hoc and Sensor Networks: Protocols, Performance, and Control examines the theory, architectures, and technologies needed to implement quality of service (QoS) in a wide variety of communication networks. Based on years of research and practical experience, this book examines the technical concepts underlying the design, implementation, research, and invention of both wired and wireless networks. The author builds a strong understanding of general concepts and common principles while also exploring issues that are specific to wired, cellular, wireless ad hoc, and sensor networks. Beginning with an overview of networks and QoS control, he systematically explores timely areas such as Lyapunov analysis, congestion control of high-speed networks, admission control based on hybrid system theory, distributed power control of various network types, link state routing using QoS parameters, and predictive congestion control. The book also provides a framework for implementing QoS control using mote hardware. Providing a deeply detailed yet conveniently practical guide to QoS implementation, Wireless Ad hoc and Sensor Networks: Protocols, Performance, and Control is the perfect introduction for anyone new to the field as well as an ideal reference guide for seasoned network practitioners.

Feedback Systems - Karl Johan Åström 2021-02-02

The essential introduction to the principles and applications of feedback systems—now fully revised and expanded This textbook covers the mathematics needed to model, analyze, and design feedback systems.

Now more user-friendly than ever, this revised and expanded edition of Feedback Systems is a one-volume resource for students and researchers in mathematics and engineering. It has applications 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. Features a new chapter on design principles and tools, illustrating the types of problems that can be solved using feedback Includes a new chapter on fundamental limits and new material on the Routh-Hurwitz criterion and root locus plots Provides exercises at the end of every chapter Comes with an electronic solutions manual An ideal textbook for undergraduate and graduate students Indispensable for researchers seeking a self-contained resource on control theory

Applications of Robust Control to Nonlinear Systems - Richard Dean Colgren 2004

This book offers a three-step approach to generating a robust nonlinear controller: modeling, synthesis, and robustness analysis. The publication is targeted to practicing engineers and graduate-level students working in guidance, information command and control systems, and CAD/CAM. The methods covered in this book allow the user to design and analyze nonlinear controllers for nonlinear systems with several important and unique characteristics: the ability to specify the closed loop systems frequency response via requirements on the sensitivity (S) and complementary sensitivity (T), the ability to directly minimize an undesirable resonance or peak in the frequency response while simultaneously closing all loops from the input to the output vector in essentially one single design step, and the ability to analyze the stability characteristics for multiple independent and dependent problem variables. The approach uniquely allows the user to achieve stable and robust performance for systems which are both unstable and contain discontinuous nonlinearities using adaptive nonlinear controllers.

Advances in Wind Energy Conversion Technology - Mathew Sathyajith 2011-04-29

With an annual growth rate of over 35%, wind is the fastest growing energy source in the world today. As a result of intensive research and developmental efforts, the technology of generating energy from wind has significantly changed during the past five years. The book brings together all the latest aspects of wind energy conversion technology - right from the wind resource analysis to grid integration of the wind generated electricity. The chapters are contributed by academic and industrial experts having vast experience in these areas. Each chapter begins with an introduction explaining the current status of the technology and proceeds further to the advanced level to cater for the needs of readers from different subject backgrounds. Extensive bibliography/references appended to each chapter give further guidance to the interested readers.

Fuzzy Controller Design - Zdenko Kovacic 2018-10-08

Fuzzy control methods are critical for meeting the demands of complex nonlinear systems. They bestow robust, adaptive, and self-correcting character to complex systems that demand high stability and functionality beyond the capabilities of traditional methods. A thorough treatise on the theory of fuzzy logic control is out of place on the design bench. That is why Fuzzy Controller Design: Theory and Applications offers laboratory- and industry-tested algorithms, techniques, and formulations of real-world problems for immediate implementation. With surgical precision, the authors carefully select the fundamental elements of fuzzy logic control theory necessary to formulate effective and efficient designs. The book supplies a springboard of knowledge, punctuated with examples worked out in MATLAB®/SIMULINK®, from which newcomers to the field can dive directly into applications. It systematically covers the design of hybrid, adaptive, and self-learning fuzzy control structures along with strategies for fuzzy controller design suitable for on-line and off-line operation. Examples occupy an entire chapter, with a section devoted to the simulation of an electro-hydraulic servo system. The final chapter explores industrial applications with emphasis on techniques for fuzzy controller implementation and different implementation platforms for various applications. With proven methods based on more than a decade of experience, Fuzzy Controller

Design: Theory and Applications is a concise guide to the methodology, design steps, and formulations for effective control solutions.

Optimal and Robust Scheduling for Networked Control Systems - Stefano Longo 2018-09-03

Optimal and Robust Scheduling for Networked Control Systems tackles the problem of integrating system components—controllers, sensors, and actuators—in a networked control system. It is common practice in industry to solve such problems heuristically, because the few theoretical results available are not comprehensive and cannot be readily applied by practitioners. This book offers a solution to the deterministic scheduling problem that is based on rigorous control theoretical tools but also addresses practical implementation issues. Helping to bridge the gap between control theory and computer science, it suggests that the consideration of communication constraints at the design stage will significantly improve the performance of the control system. Technical Results, Design Techniques, and Practical Applications The book brings together well-known measures for robust performance as well as fast stochastic algorithms to assist designers in selecting the best network configuration and guaranteeing the speed of offline optimization. The authors propose a unifying framework for modelling NCSs with time-triggered communication and present technical results. They also introduce design techniques, including for the codesign of a controller and communication sequence and for the robust design of a communication sequence for a given controller. Case studies explore the use of the FlexRay TDMA and time-triggered control area network (CAN) protocols in an automotive control system. Practical Solutions to Your Time-Triggered Communication Problems This unique book develops ready-to-use engineering tools for large-scale control system integration with a focus on robustness and performance. It emphasizes techniques that are directly applicable to time-triggered communication problems in the automotive industry and in avionics, robotics, and automated manufacturing.

Journal of Guidance, Control, and Dynamics - 2007

Electric and Plug-in Hybrid Vehicle Networks - Emanuele Crisostomi 2017-10-30

This book explores the behavior of networks of electric and hybrid vehicles. The topics that are covered include: energy management issues for aggregates of plug-in vehicles; the design of sharing systems to support electro-mobility; context awareness in the operation of electric and hybrid vehicles, and the role that this plays in a Smart City context; and tools to test and design massively large-scale networks of such vehicles. The book also introduces new and interesting control problems that are becoming prevalent in the EV-PHEV's context, as well as identifying some open questions. A particular focus of the book is on the opportunities afforded by networked actuation possibilities in electric and hybrid vehicles, and the role that such actuation may play in air-quality and emissions management.

Lyapunov-Based Control of Robotic Systems - Aman Behal 2009-12-17

Lyapunov-Based Control of Robotic Systems describes nonlinear control design solutions for problems that arise from robots required to interact with and manipulate their environments. Since most practical scenarios require the design of nonlinear controllers to work around uncertainty and measurement-related issues, the authors use Lyapunov's direct

System Modeling and Control with Resource-Oriented Petri Nets - MengChu Zhou 2018-09-03

Petri nets are widely used in modeling, analysis, and control of discrete event systems arising from manufacturing, transportation, computer and communication networks, and web service systems. However, Petri net models for practical systems can be very large, making it difficult to apply such models to real-life problems. System Modeling and Control with Resource-Oriented Petri Nets introduces a new resource-oriented Petri net (ROPN) model that was developed by the authors. Not only does it successfully reduce model size, but it also offers improvements that facilitate effective modeling, analysis, and control of automated and reconfigurable manufacturing systems. Presenting the latest research in this novel approach, this cutting-edge volume provides proven theories and methodologies for implementing cost and time-saving improvements to contemporary manufacturing systems. It provides effective tools for deadlock avoidance—deadlock-free routing and deadlock-free scheduling. The authors supply simple and complex industrial manufacturing system examples to illustrate time-tested concepts, theories, and approaches for solving real-life application problems. Written in a clear and concise manner, the text covers applications to

automated and reconfigurable manufacturing systems, automated guided vehicle (AGV) systems, semiconductor manufacturing systems, and flexible assembly systems. Explaining complex concepts in a manner that is easy to understand, the authors provide the understanding and tools needed for more effective modeling, analysis, performance evaluation, control, and scheduling of engineering processes that will lead to more flexible and efficient manufacturing systems.

Networked Control Systems with Intermittent Feedback - Domagoj Tolić 2017-03-31

Networked Control Systems (NCSs) are spatially distributed systems for which the communication between sensors, actuators and controllers is realized by a shared (wired or wireless) communication network. NCSs offer several advantages, such as reduced installation and maintenance costs, as well as greater flexibility, over conventional control systems in which parts of control loops exchange information via dedicated point-to-point connections. The principal goal of this book is to present a coherent and versatile framework applicable to various settings investigated by the authors over the last several years. This framework is applicable to nonlinear time-varying dynamic plants and controllers with delayed dynamics; a large class of static, dynamic, probabilistic and priority-oriented scheduling protocols; delayed, noisy, lossy and intermittent information exchange; decentralized control problems of heterogeneous agents with time-varying directed (not necessarily balanced) communication topologies; state- and output-feedback; off-line and on-line intermittent feedback; optimal intermittent feedback through Approximate Dynamic Programming (ADP) and Reinforcement Learning (RL); and control systems with exogenous disturbances and modeling uncertainties.

Sliding Mode Control in Electro-Mechanical Systems - Vadim Utkin 2017-12-19

Apply Sliding Mode Theory to Solve Control Problems Interest in SMC has grown rapidly since the first edition of this book was published. This second edition includes new results that have been achieved in SMC throughout the past decade relating to both control design methodology and applications. In that time, Sliding Mode Control (SMC) has continued to gain increasing importance as a universal design tool for the robust control of linear and nonlinear electro-mechanical systems. Its strengths result from its simple, flexible, and highly cost-effective approach to design and implementation. Most importantly, SMC promotes inherent order reduction and allows for the direct incorporation of robustness against system uncertainties and disturbances. These qualities lead to dramatic improvements in stability and help enable the design of high-performance control systems at low cost. Written by three of the most respected experts in the field, including one of its originators, this updated edition of Sliding Mode Control in Electro-Mechanical Systems reflects developments in the field over the past decade. It builds on the solid fundamentals presented in the first edition to promote a deeper understanding of the conventional SMC methodology, and it examines new design principles in order to broaden the application potential of SMC. SMC is particularly useful for the design of electromechanical systems because of its discontinuous structure. In fact, where the hardware of many electromechanical systems (such as electric motors) prescribes discontinuous inputs, SMC becomes the natural choice for direct implementation. This book provides a unique combination of theory, implementation issues, and examples of real-life applications reflective of the authors' own industry-leading work in the development of robotics, automobiles, and other technological breakthroughs.

Quantitative Feedback Theory - Constantine H. Houppis 2018-10-03

The first edition of Quantitative Feedback Theory gained enormous popularity by successfully bridging the gap between theory and real-world engineering practice. Avoiding mathematical theorems, lemmas, proofs, and correlaries, it boiled down to the essential elements of quantitative feedback theory (QFT) necessary to readily analyze, develop, and implement robust control systems. Thoroughly updated and expanded, Quantitative Feedback Theory: Fundamentals and Applications, Second Edition continues to provide a platform for intelligent decision making and design based on knowledge of the characteristics and operating scenario of the plant. Beginning with the fundamentals, the authors build a background in analog and discrete-time multiple-input-single-output (MISO) and multiple-input-multiple-output (MIMO) feedback control systems along with the fundamentals of the QFT technique. The remainder of the book links these concepts to practical applications. Among the many enhancements to this edition are a new section on large wind turbine control system, four new chapters, and five new appendices. The new chapters cover non-

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Quantitative Feedback Theory - Steven J. Rasmussen 1999-08-27

"Containing over 500 equations, useful appendices with case studies, ample end-of-chapter problems, and a comprehensive glossary of QFT symbols and terminology, Quantitative Feedback Theory is an indispensable reference for electrical, electronics, mechanical, chemical, astronautical, and aeronautical engineers, and an ideal text for upper-level undergraduate and graduate students in these disciplines."--BOOK JACKET

Quantitative Feedback Theory - Constantine H. Houppis 1999-08-27

An investigation of the interface between the technical literature's theoretical results and the problems that practising engineers face - and that engineering students will face - every day on the job. It demonstrates the extensive applications of quantitative feedback theory and seeks to bridge the gap between theory and practice. The book contains a user's manual and QFT design program on CD-ROM, to provide faster, easier access to design applications.

Fundamentals in Modeling and Control of Mobile Manipulators - Zhijun Li 2016-04-19

Mobile manipulators combine the advantages of mobile platforms and robotic arms, extending their operational range and functionality to large spaces and remote, demanding, and/or dangerous environments. They also bring complexity and difficulty in dynamic modeling and control system design. However, advances in nonlinear system analysis and control system design offer powerful tools and concepts for the control of mobile manipulator systems. Fundamentals in Modeling and Control of Mobile Manipulators presents a thorough theoretical treatment of several fundamental problems for mobile robotic manipulators. The book integrates fresh concepts and state-of-the-art results to systematically examine kinematics and dynamics, motion generation, feedback control, coordination, and cooperation. From this treatment, the authors form a basic theoretical framework for a mobile robotic manipulator that extends the theory of nonlinear control and applies to more realistic problems. Drawing on their research over the past ten years, the authors propose novel control theory concepts and techniques to tackle key problems. Topics covered include kinematic and dynamic modeling, control of nonholonomic systems, path planning that considers motion and manipulation, hybrid motion/force control and hybrid position/force control where the mobile manipulator is required to interact with environments, and coordination and cooperation strategies for multiple mobile manipulators. The book also includes practical examples of applications in engineering systems. This timely book investigates important scientific and engineering issues for researchers and engineers working with either single or multiple mobile manipulators for larger operational space, better cooperation, and improved productivity.

Recent Developments in Quantitative Feedback Theory - American Society of Mechanical Engineers. Dynamic Systems and Control Division 1990

Hard Disk Drive - Abdullah Al Mamun 2017-12-19

The hard disk drive is one of the finest examples of the precision control of mechatronics, with tolerances less than one micrometer achieved while operating at high speed. Increasing demand for higher data density as well as disturbance-prone operating environments continue to test designers' mettle. Explore the challenges presented by modern hard disk drives and learn how to overcome them with Hard Disk Drive: Mechatronics and Control. Beginning with an overview of hard disk drive history, components, operating principles, and industry trends, the authors thoroughly examine the design and manufacturing challenges. They start with the head positioning servomechanism followed by the design of the actuator servo controller, the critical aspects of spindle motor control, and finally, the servo track writer, a critical technology in hard disk drive manufacturing. By comparing various design approaches for both single- and dual-stage servomechanisms, the book shows the relative pros and cons of each approach. Numerous examples and figures clarify and illustrate the discussion. Exploring practical issues such as models for

plants, noise reduction, disturbances, and common problems with spindle motors, Hard Disk Drive: Mechatronics and Control avoids heavy theory in favor of providing hands-on insight into real issues facing designers every day.

Intelligent Systems - Yung C. Shin 2017-12-19

Providing a thorough introduction to the field of soft computing techniques, Intelligent Systems: Modeling, Optimization, and Control covers every major technique in artificial intelligence in a clear and practical style. This book highlights current research and applications, addresses issues encountered in the development of applied systems, and describes a wide range of intelligent systems techniques, including neural networks, fuzzy logic, evolutionary strategy, and genetic algorithms. The book demonstrates concepts through simulation examples and practical experimental results. Case studies are also presented from each field to facilitate understanding.

Design, Analysis and Applications of Renewable Energy Systems - Ahmad Taher Azar 2021-09-09

Design, Analysis and Applications of Renewable Energy Systems covers recent advancements in the study of renewable energy control systems by bringing together diverse scientific breakthroughs on the modeling, control and optimization of renewable energy systems as conveyed by leading energy systems engineering researchers. The book focuses on present novel solutions for many problems in the field, covering modeling, control theorems and the optimization techniques that will help solve many scientific issues for researchers. Multidisciplinary applications are also discussed, along with their fundamentals, modeling, analysis, design, realization and experimental results. This book fills the gaps between different interdisciplinary applications, ranging from mathematical concepts, modeling, and analysis, up to the realization and experimental work. Presents some of the latest innovative approaches to renewable energy systems from the point-of-view of dynamic modeling, system analysis, optimization, control and circuit design Focuses on advances related to optimization techniques for renewable energy and forecasting using machine learning methods Includes new circuits and systems, helping researchers solve many nonlinear problems

Autonomous Mobile Robots - Frank L. Lewis 2018-10-03

It has long been the goal of engineers to develop tools that enhance our ability to do work, increase our quality of life, or perform tasks that are either beyond our ability, too hazardous, or too tedious to be left to human efforts. Autonomous mobile robots are the culmination of decades of research and development, and their potential is seemingly unlimited. Roadmap to the Future Serving as the first comprehensive reference on this interdisciplinary technology, Autonomous Mobile Robots: Sensing, Control, Decision Making, and Applications authoritatively addresses the theoretical, technical, and practical aspects of the field. The book examines in detail the key components that form an autonomous mobile robot, from sensors and sensor fusion to modeling and control, map building and path planning, and decision making and autonomy, and to the final integration of these components for diversified applications. Trusted Guidance A duo of accomplished experts leads a team of renowned international researchers and professionals who provide detailed technical reviews and the latest solutions to a variety of important problems. They share hard-won insight into the practical implementation and integration issues involved in developing autonomous and open robotic systems, along with in-depth examples, current and future applications, and extensive illustrations. For anyone involved in researching, designing, or deploying autonomous robotic systems, Autonomous Mobile Robots is the perfect resource.

Internet Based Control Education 2001 (IBCE '01) - S. Dormido 2002

The WWW has revolutionised educational institutions. Control education is an area that has been enhanced through web developments; an initiative to experiment and incorporate web-based technologies led to the birth of Web-Based Simulation (WBS). Control education is typically a domain where Web-Based Simulation successfully shows its potential of how current technology can support the sharing of information amongst large dispersed groups. This book is based around the proceedings of an IFAC meeting specifically devoted to Internet Based Control Education. It provided a forum for discussions around issues such as: remote labs, virtual labs, teleoperation, centralized internet repository for control education, internet based control systems materials, and virtual reality in control education. This book illuminates the most recent developments and advances in the use of the WWW in control education, and presents many open issues for

laboratory control education over the internet.

Neural Network Control of Nonlinear Discrete-Time Systems - Jagannathan Sarangapani 2018-10-03

Intelligent systems are a hallmark of modern feedback control systems. But as these systems mature, we have come to expect higher levels of performance in speed and accuracy in the face of severe nonlinearities, disturbances, unforeseen dynamics, and unstructured uncertainties. Artificial neural networks offer a combination of adaptability, parallel processing, and learning capabilities that outperform other intelligent control methods in more complex systems. Borrowing from Biology Examining neurocontroller design in discrete-time for the first time, *Neural Network Control of Nonlinear Discrete-Time Systems* presents powerful modern control techniques based on the parallelism and adaptive capabilities of biological nervous systems. At every step, the author derives rigorous stability proofs and presents simulation examples to demonstrate the concepts. Progressive Development After an introduction to neural networks, dynamical systems, control of nonlinear systems, and feedback linearization, the book builds systematically from actuator nonlinearities and strict feedback in nonlinear systems to nonstrict feedback, system identification, model reference adaptive control, and novel optimal control using the Hamilton-Jacobi-Bellman formulation. The author concludes by developing a framework for implementing intelligent control in actual industrial systems using embedded hardware. *Neural Network Control of Nonlinear Discrete-Time Systems* fosters an understanding of neural network controllers and explains how to build them using detailed derivations, stability analysis, and computer simulations.

Optimal and Robust Estimation - Frank L. Lewis 2017-12-19

More than a decade ago, world-renowned control systems authority Frank L. Lewis introduced what would become a standard textbook on estimation, under the title *Optimal Estimation*, used in top universities throughout the world. The time has come for a new edition of this classic text, and Lewis enlisted the aid of two accomplished experts to bring the book completely up to date with the estimation methods driving today's high-performance systems. A Classic Revisited *Optimal and Robust Estimation: With an Introduction to Stochastic Control Theory, Second Edition* reflects new developments in estimation theory and design techniques. As the title suggests, the major feature of this edition is the inclusion of robust methods. Three new chapters cover the robust Kalman filter, H-infinity filtering, and H-infinity filtering of discrete-time systems. *Modern Tools for Tomorrow's Engineers* This text overflows with examples that highlight practical applications of the theory and concepts. Design algorithms appear conveniently in tables, allowing students quick reference, easy implementation into software, and intuitive comparisons for selecting the best algorithm for a given application. In addition, downloadable MATLAB® code allows students to gain hands-on experience with industry-standard software tools for a wide variety of applications. This cutting-edge and highly interactive text makes teaching, and learning, estimation methods easier and more modern than ever.

Modeling and Control of Complex Systems - Petros A. Ioannou 2007-12-26

Comprehension of complex systems comes from an understanding of not only the behavior of constituent elements but how they act together to form the behavior of the whole. However, given the multidisciplinary nature of complex systems, the scattering of information across different areas creates a chaotic situation for those trying to understand possible solutions and applications. *Modeling and Control of Complex Systems* brings together a number of research experts to present some of their latest approaches and future research directions in a language accessible to system theorists. Contributors discuss complex systems such as networks for modeling and control of civil structures, vehicles, robots, biomedical systems, fluid flow systems, and home automation systems. Each chapter provides theoretical and methodological descriptions of a specific application in the control of complex systems, including congestion control in computer networks, autonomous multi-robot docking systems, modeling and control in cancer genomics, and backstepping controllers for stabilization of turbulent flow PDEs. With this unique reference, you will discover how complexity is dealt with in different disciplines and learn about the latest methodologies,

which are applicable to your own specialty. The balanced mix of theory and simulation presented by *Modeling and Control of Complex Systems* supplies a strong vehicle for enlarging your knowledge base a fueling future advances and incredible breakthroughs.

The Control Handbook - William S. Levine 2018-10-08

At publication, *The Control Handbook* immediately became the definitive resource that engineers working with modern control systems required. Among its many accolades, that first edition was cited by the AAP as the Best Engineering Handbook of 1996. Now, 15 years later, William Levine has once again compiled the most comprehensive and authoritative resource on control engineering. He has fully reorganized the text to reflect the technical advances achieved since the last edition and has expanded its contents to include the multidisciplinary perspective that is making control engineering a critical component in so many fields. Now expanded from one to three volumes, *The Control Handbook, Second Edition* organizes cutting-edge contributions from more than 200 leading experts. The second volume, *Control System Applications*, includes 35 entirely new applications organized by subject area. Covering the design and use of control systems, this volume includes applications for: Automobiles, including PEM fuel cells Aerospace Industrial control of machines and processes Biomedical uses, including robotic surgery and drug discovery and development Electronics and communication networks Other applications are included in a section that reflects the multidisciplinary nature of control system work. These include applications for the construction of financial portfolios, earthquake response control for civil structures, quantum estimation and control, and the modeling and control of air conditioning and refrigeration systems. As with the first edition, the new edition not only stands as a record of accomplishment in control engineering but provides researchers with the means to make further advances. Progressively organized, the other two volumes in the set include: *Control System Fundamentals* *Control System Advanced Methods*

Optimal Control - Zoran Gajic 2018-10-03

Unique in scope, *Optimal Control: Weakly Coupled Systems and Applications* provides complete coverage of modern linear, bilinear, and nonlinear optimal control algorithms for both continuous-time and discrete-time weakly coupled systems, using deterministic as well as stochastic formulations. This book presents numerous applications to real world systems from various industries, including aerospace, and discusses the design of subsystem-level optimal filters. Organized into independent chapters for easy access to the material, this text also contains several case studies, examples, exercises, computer assignments, and formulations of research problems to help instructors and students.

Deterministic Learning Theory for Identification, Recognition, and Control - Cong Wang 2018-10-03

Deterministic Learning Theory for Identification, Recognition, and Control presents a unified conceptual framework for knowledge acquisition, representation, and knowledge utilization in uncertain dynamic environments. It provides systematic design approaches for identification, recognition, and control of linear uncertain systems. Unlike many books currently available that focus on statistical principles, this book stresses learning through closed-loop neural control, effective representation and recognition of temporal patterns in a deterministic way. *A Deterministic View of Learning in Dynamic Environments* The authors begin with an introduction to the concepts of deterministic learning theory, followed by a discussion of the persistent excitation property of RBF networks. They describe the elements of deterministic learning, and address dynamical pattern recognition and pattern-based control processes. The results are applicable to areas such as detection and isolation of oscillation faults, ECG/EEG pattern recognition, robot learning and control, and security analysis and control of power systems. *A New Model of Information Processing* This book elucidates a learning theory which is developed using concepts and tools from the discipline of systems and control. Fundamental knowledge about system dynamics is obtained from dynamical processes, and is then utilized to achieve rapid recognition of dynamical patterns and pattern-based closed-loop control via the so-called internal and dynamical matching of system dynamics. This actually represents a new model of information processing, i.e. a model of dynamical parallel distributed processing (DPDP).