Optimal Networked Control Systems With Matlab Automation And Control Engineering | eb321856502e5de630efe86c8b65c93a

Packet-Based Control for Networked Control SystemsOptimization of the Communication System for Networked Control SystemsCo-design Approaches to Dependable Networked Control SystemsOptimal Sequence-Based Control of Networked Linear SystemsNetworked Control SystemsStochastic Networked Control SystemsNetworked Control SystemsNonlinear and Optimal Control SystemsControl Strategies and Co-Design of Networked Control SystemsPacket-Based Control for Networked Control SystemsNetworked Control Systems with Intermittent FeedbackOptimal and Robust Scheduling for Networked Control SystemsOptimal Routing for Networked Control Systems Using OpenFlowAnalysis and Synthesis of Networked Control SystemsHybrid Systems: Computation and ControlCloud Control SystemsCooperative Control of Multi-Agent SystemsNetworked Control Systems with Intermittent FeedbackAnalysis and Design of Networked Control Systems Under AttacksNeural Systems for ControlEstimation and Control of Large-Scale Networked SystemsAnalysis and Design of Networked Control Systems under AttacksOptimal Networked Control Systems with MatlabOptimal and Robust Scheduling for Networked Control SystemsOptimization-based Approach to Cross-layer Resource Management in Wireless Networked Control SystemsModel-Based Control of Networked SystemsRobust Receding Horizon Control for Networked and Distributed Nonlinear SystemsNeural Network Control of Nonlinear Discrete-Time SystemsDelays and Networked Control SystemsOptimal and Robust Scheduling for Networked Control SystemsEstimation and Control for Networked Systems with Packet Losses without AcknowledgementControl Theory of Digitally Networked Dynamic SystemsNetworked and Distributed Predictive ControlNetworked Control SystemsOptimal and Robust Scheduling for Networked Control SystemsOptimal Networked Control Systems with MATLABControl of Complex SystemsNetworked Control SystemsHandbook of Networked and Embedded Control SystemsEstimation and Control over Communication Networks

Packet-Based Control for Networked Control Systems

Optimization of the Communication System for Networked Control Systems This book adopts a systematic view of the control systems in cyber-physical systems including the security control of the optimal control system, security control of the non-cooperative game system, quantify the impact of the Denial-of-Service attacks on the optimal control system, and the adaptive security control of the networked control systems. Because the cyber-physical system is a hybrid system, it adopts cross layer approach to handle the security control of the CPS. It presents a number of attack models according to the attack scenario and defense facilities, and a number of cross-layer co-design methodologies to secure the control of CPS.

Co-design Approaches to Dependable Networked Control Systems The vast majority of control systems built today are embedded; that is, they rely on built-in, special-purpose digital computers to close their feedback loops. Embedded systems are common in aircraft, factories, chemical processing plants, and even in cars-a single high-end automobile may contain over eighty different computers. The design of embedded controllers and of the intricate, automated communication networks that support them raises many new questions—practical, as well as theoretical—about network protocols, compatibility of operating systems, and ways to maximize the effectiveness of the embedded hardware. This handbook, the first of its kind, provides engineers, computer scientists, mathematicians, and students a broad, comprehensive source of information and technology to address many questions and aspects of embedded and networked control. Separated into six main sections—Fundamentals, Hardware, Software, Theory, Networking, and Applications—this work unifies into a single reference many scattered articles, websites, and specification sheets. Also included are case studies, experiments, and examples that give a multifaceted view of the subject, encompassing computation and communication considerations.

Optimal Sequence-Based Control of Networked Linear Systems 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.

Networked Control Systems This book discusses recent advances in the estimation and control of networked systems with unacknowledged packet losses: systems usually known as user-datagram-protocol-like. It presents both the optimal and sub-optimal solutions in the form of algorithms, which are designed to be implemented easily by computer routines. It also provides MATLAB® routines for the key algorithms. It shows how these methods and algorithms can solve estimation and control problems effectively, and identifies potential research directions and ideas to help readers grasp the field more easily. The novel auxiliary estimator method, which is able to deal with estimators that consist of exponentially increasing terms, is developed to analyze the stability and convergence of the optimal estimator. The book also explores the structure and solvability of the optimal control, i.e. linear quadratic Gaussian control. It develops various sub-optimal but efficient solutions for estimation and control for industrial and practical applications, and analyzes their stability and performance. This is a valuable resource for researchers studying networked control systems, especially those related to non-TCP-like networks. The practicality of the ideas included makes it useful for engineers working with networked control.

Stochastic Networked Control Systems This book presents Networked Control System (NCS) as a particular kind of a real-time distributed system (RTDS), composed of a set of nodes, interconnected by a network, and able to develop a complete control process. It describes important parts of the control process such as sensor and actuator activities, which rely on a real-time operating system, and a real-time communication network. As the use of common bus network architecture introduces different forms of uncertainties between sensors, actuators, and controllers, several approaches such as reconfigurable systems have been developed to tackle this problem. Moreover, modeling NCS is a challenging procedure, since there are several non-linear situations, like local saturations, uncertain time delays, dead-zones, or local situations, it is necessary to deal with. The book describes a novel strategy for modelling and control based on a fuzzy control approach and codesign strategies.

Networked Control Systems Networked and Distributed Predictive Control presents rigorous, yet practical, methods for the design of networked and distributed predictive control systems – the first book to do so. The design of model predictive control systems using Lyapunov-based techniques accounting for the influence of asynchronous and delayed measurements is followed by a treatment of networked control architecture development. This shows how networked control can augment dedicated control systems in a natural way and takes advantage of additional, potentially asynchronous and delayed measurements to maintain closed loop stability and significantly to improve closed-loop performance. The text then shifts focus to the design of distributed predictive control systems that cooperate efficiently in computing optimal manipulated input trajectories that achieve desired stability, performance and robustness specifications but spend a fraction of the time required by centralized control systems. Key features of this book include: • new techniques for networked and distributed control system design; • insight into issues associated with networked and distributed predictive control and their solution; • detailed appraisal of industrial relevance using computer simulation of nonlinear chemical process networks and wind- and solar-energy-generation systems; and • integrated exposition of novel research topics and rich resource of references to significant recent work. A full understanding of Networked and Distributed Predictive Control requires a basic knowledge of differential equations, linear and nonlinear control theory and optimization methods and the book is intended for academic researchers and graduate students studying control and for process control engineers. The constant attention to practical matters associated with implementation of the theory discussed will help each of these groups understand the application of the book's methods in greater depth.

Nonlinear and Optimal Control Systems 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.

Control Strategies and Co-Design of Networked Control Systems

Packet-Based Control for Networked Control Systems This book nds its origin in the WIDE PhD School on Networked Control Systems, which we organized in July 2009 in Siena, Italy. Having gathered experts on all the aspects of networked control systems, it was a small step to go from the summer school to the book, certainly given the enthusiasm of the lecturers at the school. We felt that a book collecting overviewson the important developmentsand open pr- lems in the eld of networked control systems could stimulate and support future research in this appealing area. Given the tremendouscurrentinterests in distributed control exploiting wired and wireless communication networks, the time seemed to be right for the book that lies now in front of you. The goal of the book is to set out the core techniques and tools that are ava- able for the modeling, analysis and design of networked control systems. Roughly speaking, the book consists of three parts. The rst part presents architectures for distributed control systems and models of wired and wireless communication n- works. In particular, in the rst chapter important technological and architectural aspects on distributed control systems are discussed. The second chapter provides insight in the behavior of communication channels in terms of delays, packet loss and information constraints leading to suitable modeling paradigms for commu- cation networks.

Networked Control Systems with Intermittent Feedback Control problems offer an industrially important application and a guide to understanding control systems for those working in Neural Networks. Neural Systems for Control represents the most up-to-date developments in the rapidly growing aplication area of neural networks and focuses on research in natural and artifical neural systems directly applicable to control or making use of modern control theory. The book covers such important new developments in control systems such as intelligent sensors in semiconductor wafer manufacturing; the relation between muscles and cerebral neurons in speech recognition; online compensation of reconfigurable control for spacecraft aircraft and other systems; applications to rolling mills, robotics and process control; the usage of past output data to identify nonlinear systems by neural networks; neural approximate optimal control; model-free nonlinear control; and neural control based on a regulation of physiological investigation/blood pressure control. All researchers and students dealing with control systems will find the fascinating Neural Systems for Control of immense interest and assistance. Focuses on research in natural and artifical neural systems directly applicable to contol or making use of modern control theory Represents the most up-to-date developments in this rapidly growing application area of neural networks Takes a new and novel approach to system identification and synthesis

Optimal and Robust Scheduling for Networked Control Systems 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.

Optimal Routing for Networked Control Systems Using OpenFlow Networked control systems (NCS) confer advantages of cost reduction, system diagnosis and flexibility, minimizing wiring and simplifying the addition and replacement of individual elements; efficient data sharing makes taking globally intelligent control decisions easier with NCS. The applications of NCS range from the large scale of factory automation and plant monitoring to the smaller networks of computers in modern cars, places and autonomous robots. Networked Control Systems presents recent results in stability and robustness analysis and new developments related to networked fuzzy and optimal control. Many chapters contain case-studies, experimental, simulation or other application-related work showing how the theories put forward can be implemented. The state-of-the art research reported in this volume by an international team of contributors makes it an essential reference for researchers and postgraduate students in control, electrical, computer and mechanical engineering and computer science.

Analysis and Synthesis of Networked Control Systems 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.

Hybrid Systems: Computation and Control Networked Control Systems are control systems, where the feedback loop is closed by a communication system. Within the past decades, the effects of the properties of the communication system, like loss, delay, or bandwidth constraints, on the control performance have been studied thoroughly. Since the properties of the communication system depend on the design of the communication system and its usage, the goal of this thesis is to work towards a joint design of the controller and the communication system for networked control systems. To achieve this goal, the thesis builds upon previous works from the field of networked control systems, where controller design methods for a communication system with given properties are developed, but takes into account that these properties depend on the design of the communication system and its usage. Based on well known ideas from communication theory, several methods to improve the control performance by optimizing the communication system are presented.

Cloud Control Systems This book adopts a systematic view of the control systems in cyber-physical systems including the security control of the optimal control system, security control of the non-cooperative game system, quantify the impact of the Denial-of-Service attacks on the optimal control system, and the adaptive security control of the networked control systems. Because the cyber-physical system is a hybrid system, it adopts cross layer approach to handle the security control of the CPS. It presents a number of attack models according to the attack scenario and defense facilities, and a number of cross-layer co-design methodologies to secure the control of CPS.

Cooperative Control of Multi-Agent Systems

Networked Control Systems with Intermittent Feedback Networked control systems (NCS) confer advantages of cost reduction, system diagnosis and flexibility, minimizing wiring and simplifying the addition and replacement of individual elements; efficient data sharing makes taking globally intelligent control decisions easier with NCS. The applications of NCS range from the large scale of factory automation and plant monitoring to the smaller networks of computers in modern cars, places and autonomous robots. Networked Control Systems presents recent results in stability and robustness analysis and new developments related to networked fuzzy and optimal control. Many chapters contain case-studies, experimental, simulation or other application-related work showing how the theories put forward can be implemented. The state-of-the art research reported in this volume by an international team of contributors makes it an essential reference for researchers and postgraduate students in control, electrical, computer and mechanical engineering and computer science.

Analysis and Design of Networked Control Systems Under Attacks 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.

Neural Systems for Control Optimal Networked Control Systems with MATLAB® discusses optimal controller design in discrete time for networked control systems (NCS). The authors apply several powerful modern control techniques in discrete time to the design of intelligent controllers for such NCS. Detailed derivations, rigorous stability proofs, computer simulation examples, and downloadable MATLAB® codes are included for each case. The book begins by providing background on NCS, networked imperfections, dynamical systems, stability theory, and stochastic optimal adaptive controllers in discrete time for linear and nonlinear systems. It lays the foundation for reinforcement learning-based optimal adaptive controller use for finite and infinite horizons. The text then: Introduces quantization effects for linear and nonlinear NCS, describing the design of stochastic adaptive controllers for a class of linear and nonlinear systems Presents two-player zero-sum game-theoretic formulation for linear systems in input-output form enclosed by a communication network Addresses the stochastic optimal control of nonlinear NCS by using neuro dynamic programming Explores stochastic optimal design for nonlinear two-player zero-sum games under communication constraints Treats an event-sampled distributed NCS to minimize transmission of state and control signals within the feedback loop via the communication network Covers distributed joint optimal network scheduling and control design for wireless NCS, as well as the effect of network protocols on the wireless NCS controller design An ideal reference for graduate students, university researchers, and practicing engineers, Optimal Networked Control Systems with MATLAB® instills a solid understanding of neural network controllers and how to build them.

Estimation and Control of Large-Scale Networked Systems This book constitutes the refereed proceedings of the 12th International Conference on Hybrid Systems: Computation and Control, HSCC 2009, held in San Francisco, CA, USA, in April 2009. The 30 revised full papers and 10 revised short papers presented were carefully reviewed and selected from numerous submissions for inclusion in the book. The papers focus on research in embedded reactive systems involving the interplay between symbolic/discrete and continuous dynamical behaviors and feature the latest developments of applications and theoretical advancements in the analysis, design, control, optimization, and implementation of hybrid systems.

Analysis and Design of Networked Control Systems under Attacks Designed for one-semester introductory senior-or graduate-level course, the authors provide the student with an introduction of analysis techniques used in the design of nonlinear and optimal feedback control systems. There is special emphasis on the fundamental topics of stability, controllability, and optimality, and on the corresponding geometry associated with these topics. Each chapter contains several examples and a variety of exercises.

Optimal Networked Control Systems with Matlab The book gives an introduction to networked control systems and describes new modeling paradigms, analysis methods for event-driven, digitally networked systems, and design methods for distributed estimation and control. Networked model predictive control is developed as a means to tolerate time delays and packet loss brought about by the communication network. In event-based control the traditional periodic sampling is replaced by state-dependent triggering schemes. Novel methods for multi-agent systems ensure complete or clustered synchrony of agents with identical or with individual dynamics. The book includes numerous references to the most recent literature. Many methods are illustrated by numerical examples or experimental results.

Optimal and Robust Scheduling for Networked Control Systems

Optimization-based Approach to Cross-layer Resource Management in Wireless Networked Control Systems This book offers a comprehensive, easy-to-understand overview of receding-horizon control for nonlinear networks. It presents novel general strategies that can simultaneously handle general nonlinear dynamics, system constraints, and disturbances arising in networked and large-scale systems and which can be widely applied. These receding-horizon-control-based strategies can achieve sub-optimal control performance while ensuring closed-loop stability: a feature attractive to engineers. The authors address the problems of networked and distributed control step-by-step, gradually increasing the level of challenge presented. The book first introduces the state-feedback control problems of nonlinear networked systems and then studies output feedback control problems. For large-scale nonlinear systems, disturbance is considered first, then communication delay separately, and lastly the simultaneous combination of delays and disturbances. Each chapter of this easy-to-follow book not only proposes and analyzes novel control algorithms and/or strategies, but also rigorously develops provably correct design conditions. It also provides concise, illustrative examples to demonstrate the implementation procedure, making it invaluable both for academic researchers and engineering practitioners.

Model-Based Control of Networked Systems Analysis and Synthesis of Networked Control Systems focuses on essential aspects of this field, including quantization over networks, data fusion over networks, predictive control over networks and fault detection over networks. The networked control systems have led to a complete new range of real-world applications. In recent years, the techniques of Internet of Things are developed rapidly, the research of networked control systems plays a key role in Internet of Things. The book is self-contained, providing sufficient mathematical foundations for understanding the contents of each chapter. It will be of significant interest to scientists and engineers engaged in the field of Networked Control Systems. Dr. Yuanqing Xia, a professor at Beijing Institute of

Technology, has been working on control theory and its applications for over ten years.

Robust Receding Horizon Control for Networked and Distributed Nonlinear Systems Cooperative Control of Multi-Agent Systems extends optimal control and adaptive control design methods to multi-agent systems on communication graphs. It develops Riccati design techniques for general linear dynamics for cooperative state feedback design, cooperative observer design, and cooperative dynamic output feedback design. Both continuous-time and discrete-time dynamical multi-agent systems are treated. Optimal cooperative control is introduced and neural adaptive design techniques for multi-agent nonlinear systems with unknown dynamics, which are rarely treated in literature are developed. Results spanning systems with first-, second- and on up to general high-order nonlinear dynamics are presented. Each control methodology proposed is developed by rigorous proofs. All algorithms are justified by simulation examples. The text is self-contained and will serve as an excellent comprehensive source of information for researchers and graduate students working with multi-agent systems.

Neural Network Control of Nonlinear Discrete-Time Systems Networked control systems are increasingly ubiquitous today, with applications ranging from vehicle communication and adaptive power grids to space exploration and economics. The optimal design of such systems presents major challenges, requiring tools from various disciplines within applied mathematics such as decentralized control, stochastic control, information theory, and quantization. A thorough, self-contained book, Stochastic Networked Control Systems: Stabilization and Optimization under Information Constraints aims to connect these diverse disciplines with precision and rigor, while conveying design guidelines to controller architects. Unique in the literature, it lays a comprehensive theoretical foundation for the study of networked control systems, and introduces an array of concrete tools for work in the field. Salient features included: · Characterization, comparison and optimal design of information structures in static and dynamic teams. Operational, structural and topological properties of information structures in optimal decision making, with a systematic program for generating optimal encoding and control policies. The notion of signaling, and its utilization in stabilization and optimization of decentralized control systems. · Presentation of mathematical methods for stochastic stability of networked control systems using random-time, state-dependent drift conditions and martingale methods. · Characterization and study of information channels leading to various forms of stochastic stability such as stationarity, ergodicity, and quadratic stability; and connections with information and quantization theories. Analysis of various classes of centralized and decentralized control systems. · Jointly optimal design of encoding and control policies over various information channels and under general optimization criteria, including a detailed coverage of linear-quadratic-Gaussian models. · Decentralized agreement and dynamic optimization under information constraints. This monograph is geared toward a broad audience of academic and industrial researchers interested in control theory, information theory, optimization, economics, and applied mathematics. It could likewise serve as a supplemental graduate text. The reader is expected to have some familiarity with linear systems, stochastic processes, and Markov chains, but the necessary background can also be acquired in part through the four appendices included at the end. · Characterization, comparison and optimal design of information structures in static and dynamic teams. Operational, structural and topological properties of information structures in optimal decision making, with a systematic program for generating optimal encoding and control policies. The notion of signaling, and its utilization in stabilization and optimization of decentralized control systems. · Presentation of mathematical methods for stochastic stability of networked control systems using random-time, state-dependent drift conditions and martingale methods. · Characterization and study of information channels leading to various forms of stochastic stability such as stationarity, ergodicity, and quadratic stability; and connections with information and quantization theories. Analysis of various classes of centralized and decentralized control systems. · Jointly optimal design of encoding and control policies over various information channels and under general optimization criteria, including a detailed coverage of linear-quadratic-Gaussian models. · Decentralized agreement and dynamic optimization under information constraints. This monograph is geared toward a broad audience of academic and industrial researchers interested in control theory, information theory, optimization, economics, and applied mathematics. It could likewise serve as a supplemental graduate text. The reader is expected to have some familiarity with linear systems, stochastic processes, and Markov chains, but the necessary background can also be acquired in part through the four appendices included at the end.

Delays and Networked Control Systems This edited monograph includes state-of-the-art contributions on continuous time dynamical networks with delays. The book is divided into four parts. The first part presents tools and methods for the analysis of time-delay systems with a particular attention on control problems of large scale or infinite-dimensional systems with delays. The second part of the book is dedicated to the use of time-delay models for the analysis and design of Networked Control Systems. The third part of the book focuses on the analysis and design of systems with asynchronous sampling intervals which occur in Networked Control Systems. The last part of the book exposes several contributions dealing with the design of cooperative control and observation laws for networked control systems. The target audience primarily comprises researchers and experts in the field of control theory, but the book may also be beneficial for graduate students.

Optimal and Robust Scheduling for Networked Control Systems Estimation and Control of Large Scale Networked Systems is the first book that systematically summarizes results on large-scale networked systems. In addition, the book also summarizes the most recent results on structure identification of a networked system, attack identification and prevention. Readers will find the necessary mathematical knowledge for studying large-scale networked systems, as well as a systematic description of the current status of this field, the features of these systems, difficulties in dealing with state estimation and controller design, and major achievements. Numerical examples in chapters provide strong application backgrounds and/or are abstracted from actual engineering problems, such as gene regulation networks and electricity power systems. This book is an ideal resource for researchers in the field of systems and control engineering. Provides necessary mathematical knowledge for studying large scale networked systems Introduces new features for filter and control design of networked control systems Summarizes the most recent results on structural identification of a networked system, attack identification and prevention

Estimation and Control for Networked Systems with Packet Losses without Acknowledgement This book describes co-design approaches, and establishes the links between the QoC (Quality of Control) and QoS (Quality of Service) of the network and computing resources. The methods and tools described in this book take into account, at design level, various parameters and properties that must be satisfied by systems controlled through a network. Among the important network properties examined are the QoC, the dependability of the system, and the feasibility of the real-time scheduling of tasks and messages. Correct exploitation of these approaches allows for efficient design, diagnosis, and implementation of the NCS. This book will be of great interest to researchers and advanced students in automatic control, real-time computing, and networking domains, and to engineers tasked with development of NCS, as well as those working in related network design and engineering fields.

Control Theory of Digitally Networked Dynamic Systems 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.

Networked and Distributed Predictive Control This book introduces a unique, packet-based co-design control framework for networked control systems. It begins by providing a comprehensive survey of state-of-the-art research on networked control systems, giving readers a general overview of the field. It then verifies the proposed control framework both theoretically and experimentally - the former using multiple control methodologies, and the latter using a unique online test rig for networked control systems. The framework investigates in detail the most common, communication constraints, including network-induced delays, data packet dropout, data packet disorders, and network access constraints, as well as multiple controller design and system analysis tools such as model predictive control, linear matrix inequalities and optimal control. This unique and complete co-design framework greatly benefits researchers, graduate students and engineers in the fields of control theory and engineering.

Networked Control Systems

Optimal and Robust Scheduling for Networked Control Systems This book introduces a unique, packet-based co-design control framework for networked control systems. It begins by providing a comprehensive survey of state-of-the-art research on networked control systems, giving readers a general overview of the field. It then verifies the proposed control framework both theoretically and experimentally - the former using multiple control methodologies, and the latter using a unique online test rig for networked control systems. The framework investigates in detail the most common, communication constraints, including network-induced delays, data packet dropout, data packet disorders, and network access constraints, as well as multiple controller design and system analysis tools such as model predictive control, linear matrix inequalities and optimal control. This unique and complete co-design framework greatly benefits researchers, graduate students and engineers in the fields of control theory and engineering.

Optimal Networked Control Systems with MATLAB This book presents a systematic theory of estimation and control over communication networks. It develops a theory that utilizes communications, control, information and dynamical systems theory motivated and applied to advanced networking scenarios. The book establishes theoretically rich and practically important connections among modern control theory, Shannon information theory, and entropy theory of dynamical systems originated in the work of Kolmogorov. This self-contained monograph covers the latest achievements in the area. It contains many real-world applications and the presentation is accessible.

Control of Complex Systems Cloud Control Systems: Analysis, Design and Estimation introduces readers to the basic definitions and various new developments in the growing field of cloud control systems (CCS). The book begins with an overview of cloud control systems (CCS) fundamentals, which will help beginners to better understand the depth and scope of the field. It then discusses current techniques and developments in CCS, including event-triggered cloud control, predictive cloud control, fault-tolerant and diagnosis cloud control, cloud estimation methods, and secure control/estimation under cyberattacks. This book benefits all researchers including professors, postgraduate students and engineers who are interested in modern control theory, robust control, multi-agents control. Offers insights into the innovative application of cloud computing principles to control and automation systems Provides an overview of cloud control systems (CCS) fundamentals and introduces current techniques and developments in CCS Investigates distributed denial of service attacks, false data injection attacks, resilient design under cyberattacks, and safety assurance under stealthy cyberattacks

Networked Control Systems This monograph introduces a class of networked control systems (NCS) called model-based networked control systems (MB-NCS) and presents various architectures and control strategies designed to improve the performance of NCS. The overall performance of NCS considers the appropriate use of network resources, particularly network bandwidth, in conjunction with the desired response of the system being controlled. The book begins with a detailed description of the basic MB-NCS architecture that provides stability conditions in terms of state feedback updates. It also covers typical problems in NCS such as network delays, network scheduling, and data quantization, as well as more general control problems such as output feedback control, nonlinear systems stabilization, and tracking control. Key features and topics include: Time-triggered and event-triggered feedback updates Stabilization of uncertain systems subject to time delays, quantization, and extended absence of feedback Optimal control analysis and design of model-based networked systems Parameter identification and adaptive stabilization of systems controlled over networks The MB-NCS approach to decentralized control of distributed systems Model-Based Control of Networked Systems will appeal to researchers, practitioners, and graduate students interested in the control of networked systems, distributed systems, and systems with limited feedback.

Handbook of Networked and Embedded Control Systems Networked Control Systems: Cloud Control and Secure Control explores new technological developments in networked control systems (NCS), including new techniques, such as event-triggered, secure and cloud control. It provides the fundamentals and underlying issues of networked control systems under normal operating environments and under cyberphysical attack. The book includes a critical examination of the principles of cloud computing, cloud control systems design, the available techniques of secure control design to NCS's under cyberphysical attack, along with strategies for resilient and secure control of cyberphysical systems. Smart grid infrastructures are also discussed, providing diagnosis methods to analyze and counteract impacts. Finally, a series of practical case studies are provided to cover a range of NCS's. This book is an essential resource for professionals and graduate students working in the fields of networked control systems, signal processing and distributed estimation. Provides coverage of cloud-based approaches to control systems and secure control methodologies to protect cyberphysical systems against various types of malicious attacks Provides an overview of control research literature and explores future developments and solutions Includes case studies that offer solutions for issues with modeling, quantization, packet dropout, time delay and communication constraints

Estimation and Control over Communication Networks In the era of cyber-physical systems, the area of control of complex systems has grown to be one of the hardest in terms of algorithmic design techniques and analytical tools. The 23 chapters, written by international specialists in the field, cover a variety of interests within the broader field of learning, adaptation, optimization and networked control. The editors have grouped these into the following 5 sections: "Introduction and Background on Control Theory", "Adaptive Control and Neuroscience", "Adaptive Learning Algorithms", "Cyber-Physical Systems and Cooperative Control", "Applications". The diversity of the research presented gives the reader a unique opportunity to explore a comprehensive overview of a field of great interest to control and system theorists. This book is intended for researchers and control engineers in machine learning, adaptive control, optimization and automatic control systems, including Electrical Engineers, Computer Science Engineers, Mechanical Engineers, Aerospace/Automotive Engineers, and Industrial Engineers. It could be used as a text or reference for advanced courses in complex control systems. • Collection of chapters from several well-known professors and researchers that will showcase their recent work • Presents different state-of-the-art control approaches and theory for complex systems • Gives algorithms that take into consideration the presence of modelling uncertainties, the unavailability of the model, the possibility of cooperative/non-cooperative goals and malicious attacks compromising the security of networked teams • Real system examples and figures throughout, make ideas concrete Includes chapters from several well-known professors and researchers that showcases their recent work Presents different state-of-the-art control approaches and theory for complex systems Explores the presence of modelling uncertainties, the unavailability of the model, the possibility of cooperative/non-cooperative goals, and malicious attacks compromising the security of networked teams Serves as a helpful reference for researchers and control engineers working with machine learning, adaptive control, and automatic control systems