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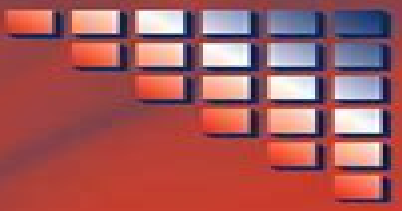

Frank L. Lewis
Hongwei Zhang
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Cooperative Control of Multi-Agent Systems

Optimal and Adaptive Design Approaches

Springer

Cooperative Control Of Multi Agent Systems Optimal And Adaptive Design Approaches Communications And Control Engineering

Hongjing Liang,Huaguang Zhang

Cooperative Control Of Multi Agent Systems Optimal And Adaptive Design Approaches Communications And Control Engineering:

Cooperative Control of Multi-Agent Systems Frank L. Lewis,Hongwei Zhang,Kristian Hengster-Movric,Abhijit Das,2013-12-31 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 *RETRACTED BOOK: Control Design of Multiagent Discrete-Time Systems* MagdiSadek Mahmoud,Bilal J. Karaki,2022-03-16 This book describes an effective approach to the cooperative and coordinated control of multivehicle systems This rigorous analytic approach guarantees the stability of coordinated and cooperating vehicles using distributed protocols and uses low energy event triggered mechanisms for networked vehicle control The text covers design of a cooperative protocol to achieve consensus for multivehicle systems allowing cooperation that is resistant to the effects of packet loss and or adversarial attack analysis and synthesis of an event triggering mechanism for cooperative multivehicle systems over uncertain networks and the problem of distributed leader following consensus and methods for compelling multivehicle systems to reach consensus Throughout the book cooperation problems are transformed into stability problems Lyapunov theory is used to guarantee cooperation among agents The distributed approach is applied to triggering mechanisms the cooperation process and the impact of cyber attacks Discrete time analysis shows how the event based structure can be designed to match the performance of continuous time counterparts The book details applications and computer simulation with several practical examples This book is of interest to a wide audience from the graduate student through the academic researcher to the industrial practitioner all of them sharing a common interest in the stability and security of multiagent systems *Distributed Cooperative Control and Communication for Multi-agent Systems* Dong Yue,Huaipin Zhang,Shengxuan Weng,2021-02-15 This book investigates distributed cooperative control and communication of MASs including linear systems nonlinear systems and multiple rigid body systems The model based and data driven control method are employed to design the optimal cooperative control protocol The approaches of this book consist of model based and data driven control such as predictive control event triggered control optimal control adaptive dynamic programming etc From this book readers can learn about distributed cooperative control methods data driven

control finite time stability analysis cooperative attitude control of multiple rigid bodies Some fundamental knowledge prepared to read this book is finite time stability theory event triggered sampling mechanism adaptive dynamic programming and optimal control Advanced Analytics for Industry 4.0 Ali Soofastaei,2025-07-17 The evolution of modern technology has affected all the industry dimensions Mother industries play a critical role in providing the precursor materials for other industries and a small improvement in these can make a big change in others This book covers the analytics revolution in Industry 4 0 for the mother industries such as mining oil and gas and steel It focuses on the use of advanced analytics and artificial intelligence to improve the business decisions aimed at increasing the quality and quantity of mother industries products It helps to design and implement their digital transformation strategies in these industries Key Features Provides a concise overview of state of the art for mother industries executives and managers Highlights and describes critical opportunity areas for industry operations optimization Explains how to implement advanced data analytics through case studies and examples Provides approaches and methods to improve data driven decision making Brings experience and learning in digital transformation from adjacent sectors This book is aimed at researchers professionals and graduate students in data science manufacturing automation and computer engineering **Cooperative Control of Multi-Agent Systems** Zhongkui Li,Zhisheng Duan,2017-03-29 Distributed controller design is generally a challenging task especially for multi agent systems with complex dynamics due to the interconnected effect of the agent dynamics the interaction graph among agents and the cooperative control laws Cooperative Control of Multi Agent Systems A Consensus Region Approach offers a systematic framework for designing distributed controllers for multi agent systems with general linear agent dynamics linear agent dynamics with uncertainties and Lipschitz nonlinear agent dynamics Beginning with an introduction to cooperative control and graph theory this monograph Explores the consensus control problem for continuous time and discrete time linear multi agent systems Studies the H and H2 consensus problems for linear multi agent systems subject to external disturbances Designs distributed adaptive consensus protocols for continuous time linear multi agent systems Considers the distributed tracking control problem for linear multi agent systems with a leader of nonzero control input Examines the distributed containment control problem for the case with multiple leaders Covers the robust cooperative control problem for multi agent systems with linear nominal agent dynamics subject to heterogeneous matching uncertainties Discusses the global consensus problem for Lipschitz nonlinear multi agent systems Cooperative Control of Multi Agent Systems A Consensus Region Approach provides a novel approach to designing distributed cooperative protocols for multi agent systems with complex dynamics The proposed consensus region decouples the design of the feedback gain matrices of the cooperative protocols from the communication graph and serves as a measure for the robustness of the protocols to variations of the communication graph By exploiting the decoupling feature adaptive cooperative protocols are presented that can be designed and implemented in a fully distributed fashion Advances in Security, Networks, and

Internet of Things Kevin Daimi,Hamid R. Arabnia,Leonidas Deligiannidis,Min-Shiang Hwang,Fernando G. Tinetti,2021-07-10 The book presents the proceedings of four conferences The 19th International Conference on Security Includes the tracks on security Features papers from SAM 20 ICWN 20 ICOMP 20 and ESCS 20 **Cooperative Control Design** He Bai,Murat Arcak,John Wen,2011-06-03 Cooperative Control Design A Systematic Passivity Based Approach discusses multi agent coordination problems including formation control attitude coordination and synchronization The goal of the book is to introduce passivity as a design tool for multi agent systems to provide exemplary work using this tool and to illustrate its advantages in designing robust cooperative control algorithms The discussion begins with an introduction to passivity and demonstrates how passivity can be used as a design tool for motion coordination Followed by the case of adaptive redesigns for reference velocity recovery while describing a basic design a modified design and the parameter convergence problem Formation control is presented as it relates to relative distance control and relative position control The coverage is concluded with a comprehensive discussion of agreement and the synchronization problem with an example using attitude coordination UAV Swarm Networks: Models, Protocols, and Systems Fei Hu,DongXiu Ou,Xin-lin Huang,2020-12-28 UAV swarm network has been used in many critical applications such as disaster recovery area surveillance weather monitoring and military communications There are many challenging R 2 college graduate students or researchers who may want to pursue some advanced research on large scale UAV swarming and networking technologies 3 government agencies that determine the future society development in this exciting field and 4 other interested readers with a strong desire to understand the challenges of designing a QoS oriented UAV network The book editors are Dr Fei Hu Professor in Electrical and Computer Engineering at University of Alabama Tuscaloosa Alabama USA Dr Xin Lin Huang Professor in Information and Communication Engineering Tongji University Shanghai China and Dr DongXiu Ou Professor in Transportation Information Institute at Tongji University Shanghai China **Cooperative Control of Multi-agent Systems** Guanglei Zhao,Hailong Cui,Changchun Hua,Shuang Liu,2024-03-23 This book focuses on stability analysis and control design approaches for multi agent systems under network induced constraints A hybrid system approach is introduced to address the cooperative control problem of networked multi agent systems and several important topics such as asynchronous sampled data cooperative control hybrid event triggered cooperative control and reset based cooperative control are studied under the hybrid system framework The special feature of this book is that a hybrid systems approach is proposed for the cooperative control of multi agent systems which is beneficial for relaxing the conservativeness of stability analysis and network parameter computation Interested readers can learn a novel approach to cooperative control of multi agent systems and this book can benefit researchers engineers and graduate students in the fields of multi robot cooperation unmanned aerial vehicle formation control engineering etc **Cooperative Control of Multi-Agent Systems** Jianan Wang,Chunyan Wang,Ming Xin,Zhengtao Ding,Jiayuan Shan,2020-03-25 Cooperative Control of Multi Agent Systems An Optimal and Robust

Perspective reports and encourages technology transfer in the field of cooperative control of multi agent systems The book deals with UGVs UAVs UUVs and spacecraft and more It presents an extended exposition of the authors recent work on all aspects of multi agent technology Modelling and cooperative control of multi agent systems are topics of great interest across both academia research and education and industry for real applications and end users Graduate students and researchers from a wide spectrum of specialties in electrical mechanical or aerospace engineering fields will use this book as a key resource Helps shape the reader s understanding of optimal and robust cooperative control design techniques for multi agent systems Presents new theoretical control challenges and investigates unresolved open problems Explores future research trends in multi agent systems Offers a certain amount of analytical mathematics practical numerical procedures and actual implementations of some proposed approaches **Optimal Adaptive Cooperative Control for Nonlinear Multiagent Systems** Xin Wang,Huaqing Li,Tingwen Huang,2025-11-18 This book provides a systematic and in depth introduction to distributed optimal adaptive cooperative control for multiagent systems from a theoretical perspective The major research topics include adaptive neural networks based control schemes under multiconstraints adaptive optimal control event triggered adaptive optimal control and data based reinforcement learning control The comprehensive and systematic treatment of adaptive optimal control in multiagent systems is one of the major features of the book which is particularly suitable for readers who are interested in learning principles and methods for dealing with control resource constraints in multiagent systems and designing energy saving control protocols The book can benefit researchers engineers and graduate students in the fields of complex networks smart grids applied mathematics electrical and electronic engineering computer engineering etc *Scientific and Technical Aerospace Reports* ,1995 Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database **Fixed-Time Cooperative Control of Multi-Agent Systems** Zongyu Zuo,Qing-Long Han,Boda Ning,2019-05-28 This monograph presents new theories and methods for fixed time cooperative control of multi agent systems Fundamental concepts of fixed time stability and stabilization are introduced with insightful understanding This book presents solutions for several problems of fixed time cooperative control using systematic design methods The book compares fixed time cooperative control with asymptotic cooperative control demonstrating how the former can achieve better closed loop performance and disturbance rejection properties It also discusses the differences from finite time control and shows how fixed time cooperative control can produce the faster rate of convergence and provide an explicit estimate of the settling time independent of initial conditions This monograph presents multiple applications of fixed time control schemes including to distributed optimization of multi agent systems making it useful to students researchers and engineers alike *Robust Cooperative Control of Multi-Agent Systems* Chunyan Wang,Zongyu Zuo,Jianan Wang,Zhengtao Ding,2021-05-18 This book presents a concise introduction to the latest advances in robust cooperative

control design for multi agent systems with input delay and external disturbances especially from a prediction and observation perspective The volume covers a wide range of applications such as the trajectory tracking of quadrotors formation flying of multiple unmanned aerial vehicles UAVs and fixed time formation of ground vehicles Robust cooperative control means that multi agent systems are able to achieve specified control tasks while remaining robust in the face of both parametric and nonparametric model uncertainties In addition the authors cover a wide range of key issues in cooperative control such as communication and input delays parametric model uncertainties and external disturbances Moving beyond the scope of existing works a systematic prediction and observation approach to designing robust cooperative control laws is presented About the Authors Chunyan Wang is an Associate Professor in the School of Aerospace Engineering at Beijing Institute of Technology China Zongyu Zuo is a full Professor with the School of Automation Science and Electrical Engineering Beihang University China Jianan Wang is an Associate Professor in the School of Aerospace Engineering at Beijing Institute of Technology China Zhengtao Ding is a Professor in the Department of Electrical and Electronic Engineering at University of Manchester U K *Cooperative Control of Multi-Agent Systems* Yue Wang,Eloy Garcia,David Casbeer,Fumin Zhang,2017-03-20 A comprehensive review of the state of the art in the control of multi agent systems theory and applications The superiority of multi agent systems over single agents for the control of unmanned air water and ground vehicles has been clearly demonstrated in a wide range of application areas Their large scale spatial distribution robustness high scalability and low cost enable multi agent systems to achieve tasks that could not successfully be performed by even the most sophisticated single agent systems Cooperative Control of Multi Agent Systems Theory and Applications provides a wide ranging review of the latest developments in the cooperative control of multi agent systems theory and applications The applications described are mainly in the areas of unmanned aerial vehicles UAVs and unmanned ground vehicles UGVs Throughout the authors link basic theory to multi agent cooperative control practice illustrated within the context of highly realistic scenarios of high level missions without losing site of the mathematical background needed to provide performance guarantees under general working conditions Many of the problems and solutions considered involve combinations of both types of vehicles Topics explored include target assignment target tracking consensus stochastic game theory based framework event triggered control topology design and identification coordination under uncertainty and coverage control Establishes a bridge between fundamental cooperative control theory and specific problems of interest in a wide range of applications areas Includes example applications from the fields of space exploration radiation shielding site clearance tracking classification surveillance search and rescue and more Features detailed presentations of specific algorithms and application frameworks with relevant commercial and military applications Provides a comprehensive look at the latest developments in this rapidly evolving field while offering informed speculation on future directions for collective control systems The use of multi agent system technologies in both everyday commercial use and national defense is certain to

increase tremendously in the years ahead making this book a valuable resource for researchers engineers and applied mathematicians working in systems and controls as well as advanced undergraduates and graduate students interested in those areas **Cooperative Control of Multi-agent Systems** He Cai,Youfeng Su,Jie Huang,2022-05-31 The main focus of this book is a pair of cooperative control problems consensus and cooperative output regulation Its emphasis is on complex multi agent systems characterized by strong nonlinearity large uncertainty heterogeneity external disturbances and jointly connected switching communication topologies The cooperative output regulation problem is a generalization of the classical output regulation problem to multi agent systems and it offers a general framework for handling a variety of cooperative control problems such as consensus formation tracking and disturbance rejection The book strikes a balance between rigorous mathematical proof and engineering practicality Every design method is systematically presented together with illustrative examples and all the designs are validated by computer simulation The methods presented are applied to several practical problems among them the leader following consensus problem of multiple Euler Lagrange systems attitude synchronization of multiple rigid body systems and power regulation of microgrids The book gives a detailed exposition of two approaches to the design of distributed control laws for complex multi agent systems the distributed observer and distributed internal model approaches Mastering both will enhance a reader s ability to deal with a variety of complex real world problems Cooperative Control of Multi agent Systems can be used as a textbook for graduate students in engineering sciences and mathematics and can also serve as a reference book for practitioners and theorists in both industry and academia Some knowledge of the fundamentals of linear algebra calculus and linear systems are needed to gain maximum benefit from this book Advances in Industrial Control reports and encourages the transfer of technology in control engineering The rapid development of control technology has an impact on all areas of the control discipline The series offers an opportunity for researchers to present an extended exposition of new work in all aspects of industrial control

Cooperative Control of Nonlinear Networked Systems Yongduan Song,Yujuan Wang,2019-01-01 Cooperative Control of Nonlinear Networked Systems is concerned with the distributed cooperative control of multiple networked nonlinear systems in the presence of unknown non parametric uncertainties and non vanishing disturbances under certain communication conditions It covers stability analysis tools and distributed control methods for analyzing and synthesizing nonlinear networked systems The book presents various solutions to cooperative control problems of multiple networked nonlinear systems on graphs The book includes various examples with segments of MATLAB codes for readers to verify validate and replicate the results The authors present a series of new control results for nonlinear networked systems subject to both non parametric and non vanishing uncertainties including the cooperative uniformly ultimately bounded CUUB result finite time stability result and finite time cooperative uniformly ultimately bounded FT CUUB result With some mathematical tools such as algebraic graph theory and certain aspects of matrix analysis theory introduced by the authors the readers can obtain a

deeper understanding of the roles of matrix operators as mathematical machinery for cooperative control design for multi agent systems Cooperative Control of Nonlinear Networked Systems is a valuable source of information for researchers and engineers in cooperative adaptive control as its technical contents are presented with examples in full analytical and numerical detail and graphically illustrated for easy to understand results Scientists in research institutes and academics in universities working on nonlinear systems adaptive control and distributed control will find the book of interest as it contains multi disciplinary problems and covers different areas of research Cooperative Tracking Control and Regulation for a Class of Multi-agent Systems Hongjing Liang,Huaguang Zhang,2019-05-28 This book focuses on the characteristics of cooperative control problems for general linear multi agent systems including formation control air traffic control rendezvous foraging role assignment and cooperative search On this basis and combined with linear system theory it introduces readers to the cooperative tracking problem for identical continuous time multi agent systems under state coupled dynamics the cooperative output regulation for heterogeneous multi agent systems and the optimal output regulation for model free multi agent systems In closing the results are extended to multiple leaders and cooperative containment control for uncertain multi agent systems is addressed Given its scope the book offers an essential reference guide for researchers and designers of multi agent systems as well as a valuable resource for upper level undergraduate and graduate students **Cooperative Control of Distributed Multi-Agent Systems** Jeff Shamma,2008-02-28 The paradigm of multi agent cooperative control is the challenge frontier for new control system application domains and as a research area it has experienced a considerable increase in activity in recent years This volume the result of a UCLA collaborative project with Caltech Cornell and MIT presents cutting edge results in terms of the dimensions of cooperative control from leading researchers worldwide This dimensional decomposition allows the reader to assess the multi faceted landscape of cooperative control Cooperative Control of Distributed Multi Agent Systems is organized into four main themes or dimensions of cooperative control distributed control and computation adversarial interactions uncertain evolution and complexity management The military application of autonomous vehicles systems or multiple unmanned vehicles is primarily targeted however much of the material is relevant to a broader range of multi agent systems including cooperative robotics distributed computing sensor networks and data network congestion control Cooperative Control of Distributed Multi Agent Systems offers the reader an organized presentation of a variety of recent research advances supporting software and experimental data on the resolution of the cooperative control problem It will appeal to senior academics researchers and graduate students as well as engineers working in the areas of cooperative systems control and optimization *Cooperative Control of Multi-Agent Systems* James Cooper,2017-09-19 Cooperative Control of Multi Agent Systems provides a novel approach to designing distributed cooperative protocols for multi agent systems with complex dynamics The proposed consensus region decouples the design of the feedback gain matrices of the cooperative protocols from the communication graph and serves as a measure for the

robustness of the protocols to variations of the communication graph By exploiting the decoupling feature adaptive cooperative protocols are presented that can be designed and implemented in a fully distributed fashion

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