



# 网络化系统控制与优化研讨会

2018. 4. 19-2018. 4. 21

## 程 序 册

主办单位：浙江大学控制科学与工程学院

浙江大学工业控制研究所

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## 会议日程

- 2018年4月19日（周四） 14:30-22:30 报到
- 2018年4月20日（周五） 9:00 - 16:40 研讨会
- 9:00-11:50 研讨会一

时间	特邀报告人	题目
9:00-9:15		研讨会开幕致辞
9:15-9:50	贾庆山教授	信息物理融合能源系统中的人工智能-事件驱动的学习与优化方法
9:50-10:25	Prof. Keyou You 游科友教授	Distributed Discrete-time Optimization in Multi-agent Networks Using only Sign of Relative State
10:25-10:40		茶歇
10:40-11:15	Prof. Jie Lu 陆隼教授	Fenchel Dual Gradient Methods for Distributed Convex Optimization over Time-varying Networks
11:15-11:50	Prof. Cailian Chen 陈彩莲教授	Joint Design of Distributed Sensing and Transmission for Industrial Network Systems
12:00-14:00		午餐、休息

➤ 14:00-16:40 研讨会二

时间	特邀报告人	题目
14:00-14:35	Dr. Zhiyong Sun 孙志勇博士	Cooperative coordination and collective control of multiple fixed-wing UAVs 固定翼无人机组的协调与集群控制
14:35-15:10	孙健教授	非均匀采样网络化控制系统稳定性分析
15:10-15:30	茶歇	
15:30-16:05	Prof. Shuai Liu 刘帅教授	Iterative Learning Economic Model Predictive Control
16:05-16:40	刘伟博士	基于事件驱动的非线性系统的输出调节问题
17:00-19:00	晚餐、休息	

➤ 2018年4月21日（周六） 10:00-12:00 自由讨论

➤ 研讨会地址：杭州市西湖区浙大路38号浙江大学玉泉校区工控新楼501



### 研讨会一

#### 报告一

题目：信息物理融合能源系统中的人工智能-事件驱动的学习与优化方法

报告人：贾庆山教授

摘要：在以城市能源互联网、智能建筑等为代表的信息物理融合能源系统中，信息流、能源流深度融合。这为实现多种能源综合互补、供需匹配，提高系统的整体能效水平，同时提升用户的舒适体验，均提供了巨大的机遇。但此类系统的综合优化一般涉及在多个时间和空间尺度上的动态过程。比如在城市能源互联网中，在供能一侧，风能与太阳能等新能源的发电量每分钟均可能发生较大幅度的变化，且有逐时、逐日等不同时间尺度的发电预测模型，有单台设备、风电场等不同时间尺度的发电预测模型。在用能一侧，电动汽车的出行需求也有较大的不确定性，有逐时、逐日等不同时间尺度的预测模型，有停车场、城区、城市等不同空间尺度的预测模型。如何综合利用这多个尺度的模型，实现系统整体性能的优化，具有重要的实际意义，也有巨大的科学挑战。本报告简单介绍人工智能在本领域的巨大应用前景，并着重汇报事件驱动的学习与优化方法近期的研究成果，以及应用在多尺度信息物理融合能源系统综合优化中的研究进展。

#### 报告人简介：



贾庆山分别于2002、2006年毕业于清华大学自动化系获得工学学士、博士学位。留校任教，2010年升副教授。2015年任长聘副教授。分别于2006、2010、2013年任哈佛大学博后、香港科技大学和麻省理工学院访问学者。现任 IEEE Transactions on Automatic Control 副编辑，曾任 IEEE Transactions on Automation Science and Engineering、Discrete Event Dynamic Systems – Theory and Applications 副编辑。主要学术方向为网络化信息物理融合能源系统的优化理论与方法，特别在序优化及事件驱动优化方法的应用与发展方面做出了贡献。发表二十余篇 IEEE 汇刊论文。先后获得国家自然科学二等奖（2009年、第四完成人）、国家自然科学基金优秀青年基金（2012年）、教育部自然科学二等奖（2013年、第二完成人）、中国自动化学会自然科学一等奖（2015年、第七完成人）、IEEE 国际自动化科学与工程年会最佳论文奖（2015年）、英国运筹学协会 Tocher 奖（国际期刊 Journal of Simulation 2015年-2016年最佳论文奖）。担任 IEEE Internet of Things Activity Board 委员（2016至今）、IEEE 控制系统协会 Board of Governors 委员（2017）、IEEE 控制系统协会离散事件系统专业委员会主席（2012-2015）、IEEE 控制系统协会北京分会主席（2012至今）、IEEE 机器人与自动化协会智能建筑专业委员会副主席（2012至今）、IFAC 智慧城市控制专业委员会主席（2015至今）。

### 报告二

题目: Distributed Discrete-time Optimization in Multi-agent Networks Using only Sign of Relative State

报告人: Prof. Keyou You (游科友教授)

摘要: We propose distributed discrete-time algorithms to cooperatively solve an additive cost optimization problem in multi-agent networks. The striking feature lies in the use of only the sign of relative state information between neighbors, which substantially differentiates our algorithms from others in the existing literature. We first interpret the proposed algorithms in terms of the penalty method in optimization theory and then perform non-asymptotic analysis to study convergence for static network graphs. Compared with the celebrated distributed subgradient algorithms, which however use the exact relative state information, the convergence speed is essentially not affected by the loss of information. We also study how introducing noise into the relative state information and randomly activated graphs affect the performance of our algorithms. Finally, we validate the theoretical results on a class of distributed quantile regression problems.

### 报告人简介:



Keyou You received the B.S. degree in Statistical Science from Sun Yat-sen University, Guangzhou, China, in 2007 and the Ph.D. degree in Electrical and Electronic Engineering from Nanyang Technological University (NTU), Singapore, in 2012. After briefly working as a Research Fellow at NTU, he joined Tsinghua University in Beijing, China where he is now an Associate Professor in the Department of Automation. He held visiting positions at Politecnico di Torino, The Hong Kong University of Science and Technology, The University of Melbourne and etc. His current research interests include networked control systems, distributed algorithms, and their applications.

Dr. You received the Guan Zhaozhi award at the 29th Chinese Control Conference in 2010 and a CSC-IBM China Faculty Award in 2014. He was selected to the National 1000-Youth Talent Program of China in 2014 and received the National Natural Science Fund for Excellent Young Scholars in 2017.

### 报告三

题目: Fenchel Dual Gradient Methods for Distributed Convex Optimization over Time-varying Networks

报告人: Prof. Jie Lu (陆隽教授)

摘要: In the large collection of existing distributed algorithms for convex multi-agent optimization, only a handful of them provide convergence rate guarantees on agent networks with time-varying topologies, which, however, restrict the problem to be unconstrained. Motivated by this, we develop a family of distributed Fenchel dual gradient methods for solving constrained, strongly convex but not necessarily smooth multi-agent optimization problems over time-varying undirected networks. The proposed algorithms are constructed based on the application of weighted gradient methods to the Fenchel dual of the multi-agent optimization problem, and can be implemented in a fully decentralized fashion. We show that the proposed algorithms drive all the agents to both primal and dual optimality asymptotically under a minimal connectivity condition and at sublinear rates under a standard connectivity condition. We also derive bounds on the convergence rate and the suboptimality when the dual gradient is inexactly evaluated at each iteration.

### 报告人简介:



Jie Lu received her B.S. in Information Engineering from Shanghai Jiao Tong University, China in 2007 and her Ph.D. in Electrical and Computer Engineering from the University of Oklahoma, USA in 2011. From 2012-2015 she was a postdoctoral researcher with the Automatic Control Lab, ACCESS Linnaeus Centre at KTH Royal Institute of Technology, Sweden and with the Department of Signals and Systems at Chalmers University of Technology, Sweden. Since 2015 she has been a tenure-track assistant professor in the School of Information Science and Technology at ShanghaiTech University. Her research interests include distributed optimization algorithms, large-scale optimization, multi-agent coordination, and networked dynamical systems.



### 报告四

题目: Joint Design of Distributed Sensing and Transmission for Industrial Network Systems

报告人: Prof. Cailian Chen (陈彩莲教授)

摘要: Real-time and precise cooperative control of industrial systems relies heavily on the interaction and integration of discrete information systems and continuous physical systems. Industrial network is one of the key enabling ways to quantify the interdependence and reflect evolution of physical systems and information systems. This talk is concerned with the network architecture, reliable transmission and scheduling techniques for wireless control systems. The MicroRF Industrial Wireless Network Protocol Stack with Independent Intellectual Property is to be introduced as well as the related experimental platform and demonstrative applications of industrial network based monitoring systems.

### 报告人简介:



Cailian Chen is currently a Full Professor of Department of Automation, Shanghai Jiao Tong University, Shanghai, P. R. China. She was a senior research associate in City University of Hong Kong (2006) and postdoctoral research associate in University of Manchester, U. K. (2006-2008). She was a Visiting Professor in University of Waterloo, Canada (September 2013-March 2014).

Prof. Chen's research interests include industrial Internet of Things, computational intelligence and distributed situation awareness, and Internet of Vehicles and applications in intelligent transportation. She has authored and/or coauthored 2 research monographs and over 100 referred international journal and conference papers. She is the inventor of more than 20 patents. Dr. Chen received the prestigious "IEEE Transactions on Fuzzy Systems Outstanding Paper Award" in 2008, and "Best Paper Award" of the conference WCSP 2017. She won the First Prize of Natural Science Award twice from The Ministry of Education of China in 2006 and 2016, respectively, and awarded the First Prize of Technological Invention from Science and Technology Commission of Shanghai Municipality, China in 2017. She was honored "Changjiang Young Scholar" by Ministry of Education of China in 2015 and "Excellent Young Researcher" by NSF of China in 2016.

Prof. Chen has been actively involved in various professional services. She serves as Associate Editor of IEEE Transactions on Vehicular Technology, Peer-to-peer Networking and Applications (Springer), The World Scientific Journal: Computer Science, and ISRN Sensor Networks. She also served as Guest Editor of IEEE Transactions on Vehicular Technology, Symposium TPC Co-chair of IEEE Globecom 2016 and VTC2016-fall, Workshop Co-chair of WiOpt'18, and TPC member of many flagship conferences including IEEE Globecom, IEEE ICC, IEEE VTC, ICCVE and IEEE WCCI.

### 研讨会二

#### 报告五

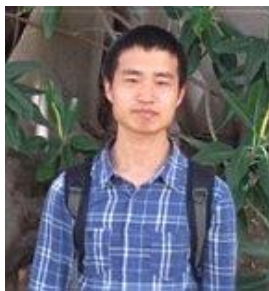
题目: Cooperative coordination and collective control of multiple fixed-wing UAVs

固定翼无人机组的协调与集群控制

报告人: Dr. Zhiyong Sun (孙志勇博士)

摘要: In this talk we consider coordination control of multiple fixed-wing UAVs with constant cruising speeds to achieve a global and collective task, such as formation stabilization and target tracking. We show how to design formation controllers to steer UAVs' orientations with the aim to achieve a desired formation configuration for the UAV group subject to constant-speed constraints. We develop several different formation design approaches in achieving a target formation shape with stable circular motions via limited interactions. We also propose feasible tracking controllers for a group of fixed-wing UAVs to collectively track ground moving targets. In the last part of the talk, we also show experimental verifications involving a group of fixed-wing UAVs to validate the performance of the proposed formation controllers.

#### 报告人简介:



Zhiyong Sun received the Ph.D. degree (under the supervision of Prof. Brian Anderson) at The Australian National University (ANU) in February 2017, while he is currently a Research Fellow/Lecturer at ANU. His research interests include graph rigidity theory, control of autonomous formations, cooperative control and multi-agent systems.

Dr. Zhiyong Sun received the Australian Prime Minister's Endeavor Postgraduate Award in 2013 from the Australian Government, and the Outstanding Oversea Student Award from the Chinese Government in 2016. He was a finalist of Best Student Paper (BSP) Award in the 54th IEEE Conference on Decision and Control (CDC 2015 at Osaka, Japan), a finalist of BSP Award in the 4th Australian Control Conference (AUCC 2014 at Canberra, Australia), and the winner of BSP Award in the 5th Australian Control Conference (AUCC 2015 at Gold Coast, Australia). He had been a visiting student/researcher of several universities, including Yale University (US), University of Wuerzburg (Germany), Purdue University (US), Groningen University (The Netherlands), Ecole Nationale de l'Aviation Civile (France), and GIST (South Korea), etc. Website: <https://sites.google.com/view/zhiyong-sun/>



### 报告六

题目：非均匀采样网络化控制系统稳定性分析

报告人：孙健教授

摘要：本报告探讨了非均匀采样网络化控制系统的稳定性问题。首先，建立了非均匀采样网络化控制系统的离散化模型。由于采样周期的时变性，该模型为具有时变参数的系统。为此，给出了两种稳定性分析方法。一种方法是将时变参数矩阵包含在一个顶点固定的凸多面体内，另一种方法是将时变的参数矩阵表示为恒定参数矩阵与不确定性矩阵之和的形式。应用鲁棒控制的相关理论得到了系统稳定的充分条件。仿真结果验证了所提出方法的有效性。

报告人简介：



孙健，北京理工大学自动化学院教授、博士生导师、副院长。主要研究方向为网络化系统分析、控制及应用，信息物理融合系统安全性等。先后主持承担国家自然科学基金联合基金重点项目、973 子课题、国家自然科学基金青年项目、武器装备预先研究项目、教育部博士点基金等项目 10 余项。发表学术论文 70 余篇，出版学术专著 1 部，获授权发明专利 7 项。获国家自然科学基金二等奖 1 项、教育部自然科学一等奖 1 项、国防科技进步二等奖 2 项。先后入选教育部“新世纪优秀人才支持计划”、中组部“青年拔尖人才支持计划”、教育部“长江学者奖励计划”青年项目，获国家自然科学基金委“优秀青年科学基金”。孙健教授是中国自动化学会控制理论专业委员会副主任、中国自动化学会工业控制系统信息安全专业委员会副秘书长、中国自动化学会控制理论专业委员会委员、中国自动化学会智能自动化专业委员会委员、中国自动化学会环境感知与保护自动化专业委员会委员、中国自动化学会青年工作委员会委员、《Journal of Systems Science and Complexity》编委、《自动化学报》编委、《控制工程》编委。

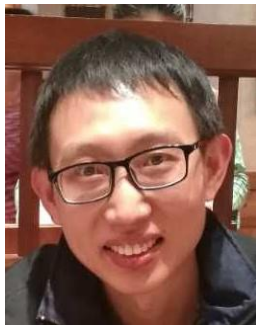
### 报告七

题目: Iterative Learning Economic Model Predictive Control

报告人: Prof. Shuai Liu (刘帅教授)

摘要: In practice, there are many systems whose function is to execute the same task repetitively, for example, robot arms in auto assembly line, batch process in chemical engineering, building HVAC systems and so on. As we know, human beings can learn and improve skills by practicing again and again. This motivates us to think that if we can design a controller which also has such learning capability for repetitive tasks. In this research, we design a controller in the framework of economic model predictive control and give it learning capability by letting it to use data of previous experiences.

### 报告人简介:



刘帅, 山东大学教授, 博士生导师。分别于 2004 年, 2007 年在山东大学获得本科和硕士学位, 2012 年获得新加坡南洋理工大学博士学位。2012 年至 2017 年间在新加坡 - 伯克利 (University of California at Berkeley) 联合研究中心担任高级研究员。2017 年 3 月至今, 山东大学控制科学与工程学院, 齐鲁学者特聘教授, 山东大学杰青, 入选第十四批国家“青年千人”项目。

近年来在时滞系统最优控制, 分布式协同控制, 分布式优化, 智能楼宇, 故障诊断, 系统建模等领域开展研究工作; 负责和参与十四项研究课题; 发表和接收论文七十篇, 其中 SCI 论文三十篇。担任 IEEE CSS 非线性系统与控制委员会

委员会委员, IEEE CSS Conference Editorial Board 编委; 中国科学信息科学 (Science China Information Sciences) 客座主编, 13 个国际会议编委会委员, 第 12 届 IEEE 控制科学与工程国际大会和第 13 届 IEEE 控制与自动化国际大会宣传主席。

### 报告八

题目：基于事件驱动的非线性系统的输出调节问题

报告人：刘伟博士

摘要：自上世纪七十年代以来，输出调节问题一直是控制界研究的一个热点和难点问题。该问题的控制目标是设计反馈控制器，一方面保证闭环系统的稳定性，另一方面实现系统的输出渐近跟踪一类参考信号并渐近抑制一类干扰信号。因此，它包含了渐近跟踪，干扰抑制，镇定等多类控制问题作为特例，更加具有概括性和挑战性。目前对该问题的研究已经取得一系列卓有成效的成果。然而，在实际工业应用中，控制器通常都是在数字平台上来执行，而现有的关于输出调节问题的控制器大多是连续的，因此不利于在数字平台上直接执行。近年来，基于事件驱动的控制方法逐渐成为了一个研究热点，因为该方法能够根据系统的实际状态或输出信号来决定具体的采样时刻和控制器的执行时刻，所以能够有效地降低能源和器件的损耗。本次报告主要探讨基于事件驱动的一类非线性系统的输出调节问题。

### 报告人简介：



刘伟博士分别于 2009 年、2012 年和 2016 年获得了东南大学自动化学院工学学士学位，中国科学技术大学自动化系工学硕士学位和香港中文大学机械与自动化工程学系哲学博士学位。自 2016 年 7 月至今于香港中文大学机械与自动化工程学系从事博士后研究工作。研究方向包括：输出调节，非线性控制，事件驱动控制，多智能体系统协同控制，切换系统稳定性分析。

刘伟博士获得了香港中文大学 2016 年度青年学者优秀博士论文奖和香港中文大学 2016 年度研究生学术成果奖，并且获得了系统与amp;控制研究领域国际权威期刊 *Systems & Control Letters* 和 *Journal of the Franklin Institute* 2016 年度杰出审稿人。

目前已在国内外重要学术期刊与会议上以第一作者身份发表论文 20 余篇，其中在系统与amp;控制研究领域两大国际顶级期刊 *IEEE Transactions on Automatic Control* 和 *Automatica* 上共发表论文 6 篇（含 3 篇长文）。