复杂系统与网络科学研究中心

Research Center for Complex Systems and Network Sciences

Research Center for Complex Systems and Network Sciences

2021 年 5 月 6 日（Beijing time: 15:00-17:40）

程

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册

论坛资助：国家自然科学基金委
东南大学数学双一流学科建设
东南大学数学学院

主办：东南大学复杂系统与网络科学研究中心
江苏省网络群体智能重点实验室
东南大学数学学院

Inquiry: Simone Baldi (103009004@seu.edu.cn)

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第四十六届复杂系统与网络科学研究中心论坛
The Forty-sixth Workshop of
Research Center for Complex Systems and Network Sciences

时间：2021 年 5 月 6 日，周四(Beijing time: 15:00pm-17:40pm)
Time: May 6th, 2021, Thursday (Europe time: 9:00am-11:40am)

会议方式(Meeting method): Tencent Meeting
会议号(Meeting ID)：236 225 889
会议密码(Meeting password)：147258
会议链接：https://meeting.tencent.com/s/emkKwX8gaIMx

Distributed Constrained Optimization with Application to Cooperative Robotics

Giuseppe Notarstefano, University of Bologna

Beijing time 15:00-15:50 (Europe time 9:00am-9:50am)

End-to-end Approaches for Data-driven Control: From Experiment Design to Closed-loop Guarantees

Henk van Waarde, University of Cambridge,

Beijing time 15:50-16:40 (Europe time 9:50am-10:40am)

Data-driven Output Synchronization of Heterogeneous Leader-follower Multi-agent Systems

Junjie Jiao, Technical University of Munich

Beijing time 16:40-17:10 (Europe time 10:40am-11:10am)

Scalable Controllability Analysis of Structured Networks

Jiajia Jia, Jiangnan University

Beijing time 17:10-17:40 (Europe time 11:10am-11:40am)

Inquiry: Simone Baldi (103009004@seu.edu.cn)

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Distributed Constrained Optimization with Application to Cooperative Robotics

Giuseppe Notarstefano（University of Bologna/博洛尼亚大学）

Abstract

Distributed optimization over networks has gained a lot of attention in the last years, due to the key role that optimization plays in solving complex tasks for large-scale systems. However, most of the attention in the literature has been devoted to the so-called "consensus optimization" framework in which agents optimize a common decision variable. While this framework is particularly suited for data analytics and machine learning applications, it is not able to capture several interesting control scenarios. In this talk I will address a more recent constraint-coupled optimization framework that captures several decision and control problems, and I will present novel distributed algorithms that address this set-up under various challenges on the problem and communication structure. I will then show applications of these approaches to decision and control problems in cooperative robotics, as, e.g. cooperative task allocation and pick-up and delivery. Finally, I will show simulations and experiments carried out by means of two toolboxes for distributed optimization (Disropt) and cooperative robotics (ChoiRbot) that we recently developed. Disropt is a Python package providing full-fledged functionalities for communication and local computation, which can be used to design and implement new distributed optimization algorithms over networks. ChoiRbot is based on the novel Robot Operating System (ROS) 2 and provides a fully-functional toolset to execute complex distributed multi-robot tasks, either in simulation or experimentally, with a particular focus on networks of heterogeneous robots.

About the Speaker

Giuseppe Notarstefano is a Professor in the Department of Electrical, Electronic, and Information Engineering G. Marconi at Alma Mater Studiorum Università di Bologna. He was Associate Professor (from June '16 to June '18) and previously Assistant Professor, Ricercatore, (from February '07) at the Università del Salento, Lecce, Italy. He received the Laurea degree "summa cum laude" in Electronics Engineering from the Università di Pisa in 2003 and the Ph.D. degree in Automation and Operation Research from the Università di Padova in 2007. He has been visiting scholar at the University of Stuttgart, University of California Santa Barbara and University of Colorado Boulder. His research interests include distributed optimization, cooperative control in complex networks, applied nonlinear optimal control, and trajectory optimization and maneuvering of aerial and car vehicles.

He serves as an Associate Editor for *IEEE Transactions on Automatic Control*, *IEEE Transactions on Control Systems Technology* and *IEEE Control Systems Letters*. He has been part of the Conference Editorial Board of IEEE Control Systems Society and EUCA. He is recipient of an ERC Starting Grant.

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End-to-end Approaches for Data-driven Control: From Experiment Design to Closed-loop Guarantees

Henk van Waarde（University of Cambridge/剑桥大学）

Abstract

This talk concerns the direct design of control laws from measured data. Our starting point is an increasingly popular result called Willems' fundamental lemma. This lemma asserts that all trajectories of a linear system can be obtained from a single measured one, assuming that the inputs of the experiment are persistently exciting. We will recall some of the interesting recent control strategies that are based on this result. Subsequently, we discuss an alternative to persistent excitation. In particular, it will be shown that an online input design method can be used to reduce the required number of samples, making the procedure completely sample efficient. We will conclude the talk by providing some strategies for dealing with noisy data.

About the Speaker

Henk van Waarde obtained the master degree summa cum laude and Ph.D. degree cum laude in Applied Mathematics from the University of Groningen in 2017 and 2020, respectively. Currently, he is a postdoctoral researcher at the University of Cambridge. He was a visiting researcher at the University of Washington, Seattle in 2019-2020. His research interests include data-driven control, networks of dynamical systems, system identification and identifiability, robust and optimal control, and the geometric theory of linear systems.

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Data-driven Output Synchronization of Heterogeneous Leader-follower Multi-agent Systems

Junjie Jiao（Technical University of Munich/慕尼黑工业大学）

Abstract

Model-based control and data-driven control are two main paradigms in the field of systems and control. While model-based control requires knowledge of a plant model, data-driven control aims to bypass this knowledge and to design control laws directly on the basis of data. In this presentation, I will focus on the problem of data-driven output synchronization for heterogeneous leader-follower linear multi-agent systems. For a given multi-agent system that consists of one autonomous leader and a number of heterogeneous followers with external disturbances, I will establish necessary and sufficient data-based conditions for output synchronization. I will also provide a design method for obtaining such output synchronizing protocols directly from data. The results are then extended to the special case that the followers are disturbance-free. Finally, a simulation example is provided to illustrate our results.

About the Speaker

Junjie Jiao obtained his B. Eng. degree in Automation from Anhui University of Technology, Anhui, China, in 2013, and his M. Eng. degree in Control Science and Engineering from University of Electronic Science and Technology of China, Chengdu, China, in 2016. In October 2020, he obtained his PhD degree in Systems and Control from University of Groningen (RUG), Groningen, the Netherlands. Since November 2020, he has been a Postdoctoral researcher at the Chair of Information-Oriented Control (ITR), Technical University of Munich (TUM), Munich, Germany. His main research interests include data-driven control, learning-based control, distributed control, distributed estimation, robust and optimal control.

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Scalable Controllability Analysis of Structured Networks

Jiajia Jia（Jiangnan University/江南大学）

Abstract

A structured network is a family of structured systems (called node systems) that are interconnected by means of a structured interconnection law. The node systems and their structured interconnection law are given by pattern matrices. It is shown that a structured network is strongly structurally controllable if and only if an associated structured system is. This structured system will in general have a very large state space dimension, and therefore existing tests for verifying strong structural controllability are not tractable. In this talk, we will show that controllability can be tested by replacing the original network by a new network in which all original node systems have been replaced by (auxiliary) node systems with state space dimensions either 1 or 2. Hence, controllability of the original network can be verified by testing controllability of a structured system with state space dimension at most twice the number of node systems, regardless of the state space dimensions of the original node systems.

About the Speaker

Jiajia Jia is currently a lecturer in the School of Internet of Things , Jiangnan University, Wuxi, China. He received the Ph.D. degree in systems and control from the Bernoulli Institute of Mathematics, Computer Science and Artificial Intelligence, University of Groningen in 2020. His main research interests include structural properties analysis of network systems, data-driven control of nonlinear systems via Koopman operators, analysis of infinite dimensional systems etc.