复杂系统与网络科学研究中心

Research Center for Complex Systems and Network Sciences

第十五届复杂系统与网络科学研究中心论坛

The Fifteenth Workshop of Research Center for Complex Systems and Network Sciences

程序册

论坛资助：国家自然科学基金委（61322302）
东南大学数学系、东南大学江苏省自动化优势学科

主办：复杂系统协同控制实验室
东南大学复杂系统与网络科学研究中心
东南大学数学系
http://math.seu.edu.cn/csns/Seminar/

Inquiry: Wenwu Yu 虞文武 (wwyu@seu.edu.cn) 、Guanghui Wen 温广辉 (wenguanghui@gmail.com)
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Date and Time: Friday, December 11-12 2015
Venue: 东南大学九龙湖校区图书馆 5 楼数学系第一报告厅
开幕辞 曹进德 东南大学
论坛 I（12 月 11 日周五下午）虞文武 东南大学（主持）

SINR-based DoS Attack on Remote State Estimation: A Game-theoretic Approach

施凌

Hong Kong University of Science and Technology **14:00pm – 14:45pm**

New Results on Control of Discrete-time Semi-Markov Jump Linear Systems via Semi-Markov Kernel Approach

张立宪

哈尔滨工业大学 **14:45pm – 15:30pm**

A New Polytopic Approximation Method and Applications to Networked Control Systems with Time-varying Delay

孙键

北京理工大学 **15:30pm – 16:35pm**

论坛 II（12 月 12 日周六上午）温广辉 东南大学（主持）

Fault Tolerant Attitude Control of Spacecraft under Partial Loss of Actuator Effectiveness

胡庆雷

北京航空航天大学 **09:30am – 10:15am**

Coordination of Multi-agent Systems: Theory and Applications

孟子阳

清华大学 **10:15am - 11:00am**

闭幕辞 曹进德 东南大学

Inquiry: Wenwu Yu 虞文武 (wwyu@seu.edu.cn) 、Guanghui Wen 温广辉 (wenguanghui@gmail.com)
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SINR-based DoS Attack on Remote State Estimation: A Game-theoretic Approach

施凌

Hong Kong University of Science and Technology

Abstract

We consider remote state estimation of cyber-physical systems under signal-to-interference-plus-noise ratio (SINR)-based denial-of-service (DoS) attacks. A sensor sends its local estimate to a remote estimator through a wireless network that may suffer interference from an attacker. Both the sensor and the attacker have energy constraints and they need to consider how much transmission power to use and how much interference power to attack. We propose a Markov game framework to model this interactive decision-making process based on the current state and information collected from previous time steps. To solve the associated optimality (Bellman) equations, a modified Nash Q-learning algorithm is applied to obtain the optimal solutions. Numerical examples and simulations are provided to demonstrate our results.

About the Speaker

Ling Shi received the B.S. degree in electrical and electronic engineering from Hong Kong University of Science and Technology, Kowloon, Hong Kong, in 2002 and the Ph.D. degree in control and dynamical systems from California Institute of Technology, Pasadena, CA, USA, in 2008. He is currently an associate professor at the Department of Electronic and Computer Engineering, Hong Kong University of Science and Technology. His research interests include networked control systems, wireless sensor networks, event-based state estimation and sensor scheduling, and smart energy systems. He has been serving as a subject editor for International Journal of Robust and Nonlinear Control from 2015. He also served as an associate editor for a special issue on Secure Control of Cyber Physical Systems in the IEEE Transactions on Control of Network Systems in 2015.

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New Results on Control of Discrete-time Semi-Markov Jump Linear Systems via Semi-Markov Kernel Approach

张立宪

哈尔滨工业大学

Abstract

This talk is concerned with the basic control issues, the stability and stabilization for a class of discrete-time semi-Markov jump linear systems (S-MJLSs). The discrete-time semi-Markov kernel (SMK) is introduced,where the probability density function of sojourn-time is dependent on both current and next system mode. As a consequence, different types of distributions and/or different parameters in a same type of distribution of sojourn-time, depending on the target mode towards which the system jumps, can coexist in each mode of a SMK. The underlying S-MJLSs are therefore more general than those considered in existing studies. A new stability concept generalizing the traditional mean square stability is proposed such that numerically testable criteria on the basis of SMK are obtained. Numerical examples are presented to illustrate the validity and advantage of the developed theoretical results.

About the Speaker

张立宪，哈尔滨工业大学航天学院教授、博士生导师。在“切换系统控制”方向上主持国家、省部级科研项目 20 余项，发表论文 110 余篇，Google 学术引用 5000 余次，SCI 他引 2400 余次。获黑龙江省自然科学奖一等奖 1 项(排名第一)，国家自然科学二等奖 1 项(排名第三)。IEEE 高级会员，IEEE 系统、人、控制论协会哈尔滨分部主席。现为《IEEE 自动控制汇刊》及《IEEE 控制论汇刊》编委；曾任《IEEE 工业信息学汇刊》专刊客座主编等任职。国家优秀青年科学基金、黑龙江省杰出青年科学基金获得者，教育部新世纪优秀人才，2014 及 2015 年度汤森路透全球高被引学者及 2014 年度爱思唯尔中国高被引学者。

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A New Polytopic Approximation Method and Applications to Networked Control Systems with Time-varying Delay

孙键

北京理工大学

Abstract

In discrete-time modeling approaches for linear networked control systems with time-varying delays, one usually arrives at discrete-time models with uncertainties appearing in an exponential form. To deal with such uncertainties, one method is to approximate them as a polytopic model. In this talk, a new polytopic approximation method is proposed. This method is based on the Jordan decomposition of the system matrix and a simplex type of geometrical construction. Relatively fewer polytopic vertices are used to reach lower computing complexity. Meanwhile the new method produces less conservative results than some existing methods. Applications of this method to networked control systems with time-varying delay or event-triggered scheme have also been discussed. Some numerical examples are given to confirm the efficiency of the proposed method.

About the Speaker

孙健，吉林长春人，北京理工大学自动化学院教授，博士生导师。2007 年 7 月毕业于中国科学院自动化研究所获工学博士学位；2007 年 12 月进入北京理工大学从事博士后研究工作；2008 年 4 月至 2009 年 10 月在英国 Glamorgan 大学从事科学研究工作；2010 年 5 月进入北京理工大学自动化学院任教；同年 7 月晋升为副教授；2013 年 7 月晋升为正教授。IEEE 会员，中国自动化学会智能自动化专业委员会委员，中国自动化学会青年工作委员会委员，《Journal of Systems Science and Complexity》编委，《自动化学报》编委。主要研究方向为：网络化控制系统理论及其应用。近年来，以第一作者/通讯作者在国内外高水平学术刊物及会议上发表学术论文 50 余篇，出版学术专著 1 部；获授权发明专利 3 项，受理发明专利 4 项。获 2014 年国家自然科学二等奖 1 项（排名第 4），2013 年教育部自然科学一等奖 1 项（排名第 3），2013 年国防科技进步二等奖 1 项（排名第 2），2012 年国防科技进步二等奖 1 项（排名第 4）。入选北京高等学校“青年英才计划”、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”，获 2015 年国家自然基金委“优秀青年科学基金”。

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Fault Tolerant Attitude Control of Spacecraft under Partial Loss of Actuator Effectiveness

胡庆雷

北京航空航天大学

Abstract

In this paper, we mainly focus on developing a novelty fault tolerant attitude tracking control scheme for the flexible spacecraft under partial loss of actuator effectiveness fault and evenwith explicit consideration of actuator saturation limit. More specifically, a sliding mode attitude controller is derived by using adaptively on-line parameter updating law to estimate the lower bound of this kind of fault such that the real bound value of the fault is not used in advance for the designers. For the synthesis of controller, the fault time, patterns and values are all unknown as motivated from a practical spacecraft control application. This adaptive law also provides the estimates of the external disturbances and such that a prior knowledge of the external disturbances' bound is not required. To further address the actuator saturation problem, a modified attitude tracking controller is then developed, in which an estimate for the domain of attraction is developed based on the input saturation magnitude, and a high gain component is then constructed and augmented to the proposed adaptive fault tolerant controller to ensure that the resulting control signal will never incur saturation. Complete stability and performance analysis are presented and illustrative simulation results of an application to flexible spacecraft show that the high precise attitude tracking control is successfully achieved even in the face of faulty actuator and input saturation.

About the Speaker

胡庆雷，男，1979 年 2 月生，河南省太康县人。现任北京航空航天大学自动化科学与电气工程学院"卓越百人"特聘教授、博士生导师。国家自然科学基金—优秀青年基金获得者、入选中组部"万人计划"青年拔尖人才、英国皇家学会优秀海外学者计划、教育部新世纪优秀人才计划，并入选 2014 年度爱思唯尔中国高被引学者（Most Cited Chinese Researchers）等。发表科研论文 100 余篇，其中发表在国际上公认航空航天制导与控制领域里最有影响力的专业杂志—美国航空航天学会(AIAA JGCD)系列期刊上、国际电气电子工程师协会(IEEE)汇刊、国际自动控制联盟(IFAC)会刊 Automatica 上 80 余篇， SCI 他引 700 余次、H 因子 17；获黑龙江省自然科学奖一等奖、自然科学奖二等奖、科学技术进步二等奖等多项奖励；主持国家自然科学基金(3 项)、英国皇家学会研究基金、教育部新世纪优秀人才计划、"863"子课题、"973"子课题等 20 余项；此外，担任国际 SCI 检索学术期刊 Aerospace Science and Technology 副主编、Journal of Vibration and Control 副主编、Journal of the Franklin Institute 副主编等。

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Coordination of Multi-agent Systems: Theory and Applications

孟子阳

清华大学

Abstract

The study of multi-agent systems attracts much attention due to its scientific values and broad engineering applications. In this talk, we first consider some fundamental issues of multi-agent systems and try to answer the following three questions: (1) how much information exchange is needed for coordination of general coupled dynamical systems? (2) Is this beneficial if we add global information for local-based coordination algorithm? (3) What will happen if there exist relative measurement errors for coordination? For the first question, we propose a weak connectivity condition that guarantees coordination of general dynamical models. For the second question, we show that global information guarantees enlarged set of interactions and fast convergence speed for coordination. For the third question, it is shown that the final formation is distorted from the desired one and not asymptotically stationary if there exist mismatched compasses. In the second part of this talk, we apply coordination algorithms to two particular applications. One is distributed attitude alignment in spacecraft formation flying and another is set aggregation of multi-robot systems.

About the Speaker

孟子阳于 2006 年和 2010 年分别获得华中科技大学学士学位和清华大学博士学位。攻读博士学位期间，于 2008 年 9 月到 2009 年 9 月到美国犹他州立大学访问一年。自 2010 年至 2015 年，先后在中国上海交通大学，瑞典皇家理工学院，德国慕尼黑工业大学任访博士后，研究员，和洪堡学者的职务。其主要研究领域是网络化系统的理论与应用。近些年来，在 SIAM J. on Control and Optimization, IEEE Transactions on Robotics, IEEE Transactions on Automatic control 和 Automatica 等国际期刊和学术会议上发表（包括接受）学术论文 50 余篇。论文累计被引用 1000 余次，单篇最高被引用 200 余次。作为第一作者，两篇论文入选 ESI 高被引用论文。孟子阳为第 11 批国家千人计划“青年人才”入选者，曾获洪堡学者基金，2011-2012 年度 IFAC Automatica 杂志杰出审稿人称号以及 2014 年度 IEEE Transactions on Control of Network Systems 杂志杰出审稿人称号等荣誉奖项。孟子阳于 2015 年 9 月进入清华大学精密仪器系工作，任副教授的职务。

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