



复杂系统与网络科学研究中心  
Research Center for Complex Systems and Network Sciences

第四十一届复杂系统与网络科学研究中心论坛

**The Forty-first Workshop of  
Research Center for Complex Systems and  
Network Sciences**

2020年7月13日 (14:00-18:00)

# 程 序 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: Jianquan Lu 卢剑权 ([jquma@seu.edu.cn](mailto:jquma@seu.edu.cn)); Jinling Liang 梁金玲 ([jinliang@seu.edu.cn](mailto:jinliang@seu.edu.cn))



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Research Center for Complex Systems and Network Sciences

## 第四十一届复杂系统与网络科学研究中心论坛

### The Forty-first Workshop of Research Center for Complex Systems and Network Sciences

时间: 2020年7月13日, 周一 (14:00-18:00)

会议方式: “zoom”平台线上视频会议

会议号: 687 932 83066

会议密码: 863633

会议链接: <https://zoom.com.cn/j/68793283066>

|             |  |        |        |
|-------------|--|--------|--------|
| 14:00-14:05 | 开幕式 致辞   | 曹进德 教授 | (东南大学) |
|             | 主持: 卢剑权 (东南大学)   |        |        |
| 14:05-14:40 | <b>Dimensions of Cross-dimensional Systems and Cheng Projection</b>  | 山东大学   | 冯俊娥    |
| 14:40-15:15 | <b>Delay-dependent stability and hybrid <math>L_2 \times l_2</math>-gain analysis of linear impulsive time-delay systems</b> | 广西大学   | 陈武华    |
|             | 主持: 梁金玲 (东南大学)   |        |        |
| 15:15-15:50 | CPS 安全问题中的形式化分析与控制方法   | 上海交通大学 | 殷翔     |
| 15:50-16:25 | <b>A new verification method for strong detectability of finite-state automata</b>   | 柏林工业大学 | 张奎泽    |
| 16:25-16:35 | 会议休息十分钟  |        |        |
|             | 主持: 刘洋 (浙江师范大学)  |        |        |
| 16:35-17:10 | <b>Stability of Discrete-time Switched Systems under Restricted Switching via STP-based Mergence</b>                         | 中南大学   | 郭宇骞    |
| 17:10-17:45 | <b>Robust Asymptotic Stabilization for a Class of Uncertain Upper-Triangular Systems</b>                                     | 南京师范大学 | 朱建栋    |
| 17:45-17:50 | 闭幕式 致辞   | 虞文武 教授 | (东南大学) |



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## Dimensions of Cross-dimensional Systems and Cheng Projection

冯俊娥  
山东大学

### Abstract

Two problems are mainly discussed in this talk. One is the variance of state dimensions for two kinds of dimension-free systems, which are dimension-bounded and dimension-unbounded discrete linear systems. Another is the property of Cheng projection, which was proposed recently by Prof. Cheng to reduce the dimension of vector. The former one discusses the relationship of time, vector invariant spaces, state dimensions, dimensions of initial value and system matrix. While for the latter one, the matrix representation of Cheng projection is derived. Furthermore, its algebraic properties, product and norm are concerned.

### About the speaker

冯俊娥，现为山东大学数学学院教授，博士生导师。曾先后主持多项省部级以上科研项目，获 2014 年山东省自然科学二等奖（第一位）。山东省自动化学会理事、中国自动化学会“信息物理系统控制与决策专业委员会”委员、《控制与决策》责任编辑、IEEE 控制系统学会编委。主要研究方向为逻辑网络、广义系统、时滞系统等系统的稳定性分析及鲁棒控制等问题的研究。



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## Delay-dependent stability and hybrid $L_2 \times l_2$ -gain analysis of linear impulsive time-delay systems

陈武华

广西大学

### Abstract

In this talk, a new approach for analyzing delay-dependent stability and hybrid  $L_2 \times l_2$ -gain performance of linear impulsive delay systems is presented. The new approach is inspired by the delay-partitioning method, the timer-dependent Lyapunov functional method, and the looped-functional method. In the delay-partitioning framework, a new type of timer-dependent Lyapunov functional is constructed, which depends on the partition on impulse intervals and also on impulse dynamics. Different from the previous discontinuous Lyapunov functionals, the introduced Lyapunov functional is continuous along the trajectories of the considered impulsive delay system. Consequently, two different problems of exponential stability and hybrid  $L_2 \times l_2$ -gain performance are tackled by using the same class of Lyapunov functionals. It is shown that the positive definiteness of this Lyapunov functional inside impulse intervals is not necessary for proving exponential stability. By use of new integral inequalities based techniques, delay-dependent criteria for exponential stability and finite hybrid  $L_2 \times l_2$ -gain are established in terms of linear matrix inequalities. Numerical examples are provided to illustrate the efficiency of the new approach.

### About the speaker

陈武华，广西大学二级教授、博士生导师。近年来，主要从事脉冲混杂系统与奇异摄动系统稳定与控制研究。曾获得第九届广西青年科技奖，先后入选 2012 年湖北省“楚天学者”计划和 2016 年浙江省“钱江学者”特聘教授，以及 2014-2019 年度“控制与系统工程”领域爱思唯尔中国高被引学者榜单。



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CPS 安全问题中的形式化分析与控制方法

殷翔

上海交通大学

## Abstract

信息物理系统（CPS）是集控制、通讯与计算于一体的复杂智能系统，其理论架构广泛运用能源、交通、智能制造等关键基础设施，CPS 安全问题在近年来得到了学术界的广泛关注。本报告首先介绍了基于形式化方法的 CPS 安全分析与控制的基本思想；在此基础上，针对 CPS 控制器中的复杂逻辑功能安全要求，介绍了基于监控理论的安全控制器设计方法；最后，针对 CPS 中的信息安全与恶意入侵问题，进一步介绍了基于形式化方法的动态系统机密防护与入侵检测算法。

## About the speaker

殷翔，上海交通大学自动化系副教授，博士生导师，国家“青年千人计划”入选者。2012 年本科毕业于浙江大学电气工程学院，2017 年于美国密西根大学 EECS 系获得博士学位，随后加入上海交通大学。现任 IEEE 控制系统协会-离散事件系统委员会共同主席。主要从事信息物理系统的分析与控制、工业控制系统安全防护与故障诊断、形式化方法等领域研究。近五年在 IEEE TAC 和 Automatica 两刊发表论文 20 余篇。曾获 IEEE CDC 最佳论文提名奖等荣誉。



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## A new verification method for strong detectability of finite-state automata

张奎泽

柏林工业大学

### Abstract

Detectability is a fundamental property in discrete-event systems. Several other fundamental properties, e.g., observability and diagnosability, can be reduced to variants of strong detectability. In this talk, we firstly review the classical polynomial-time verification algorithm for strong detectability of finite-state automata given by Shu and Lin in 2011 based on two widely-used assumptions of (1) deadlock-freeness and (2) divergence-freeness. We secondly introduce a new polynomial-time verification algorithm, which applies to all finite-state automata.

### About the speaker

Kuize Zhang received the B.S. and Ph.D. degrees in Mathematics and Control Science and Engineering from Harbin Engineering University, China, in 2009 and 2014, respectively. He is now a Humboldt Fellow at Technical University of Berlin, Germany. He held long-term visiting or research positions at KTH Royal Institute of Technology, Sweden (2017-20), Technical University of Munich, Germany (2016-17); Academy of Mathematics and Systems Science (2015-16), the Chinese Academy of Sciences; Nanyang Technological University, Singapore (2013-14); and University of Turku, Finland (2012-13). His current research interests include fundamental topics in discrete-event systems (finite automata and Petri nets, he rewrote the fundamental results of detectability of finite automata), Boolean networks (he solved the observability verification problem and proposed the notion of invertibility) with applications to systems biology, cellular automata, switched systems, etc. Dr. Zhang received the 2016 Chinese Association of Automation (CAA) Outstanding Doctoral Thesis Nomination Award, and the Humboldt Research Fellowship in 2019.

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## Stability of Discrete-time Switched Systems under Restricted Switching via STP-based Mergence

郭宇骞

中南大学

### Abstract

In this study, we propose a novel technique for the stability analysis of discrete-time switched systems under constrained switching based on the semi-tensor product (STP) of matrices and vector-representation of logic. We assume that the admissible switching signals are generated by a logic dynamical system (LDS), referred to as the logic dynamical generator (LDG) of the admissible switching. We demonstrate that switching with minimum dwell-time and restricted successors represent two special cases of this type, by constructing their respective LDGs. First, we transfer the LDG into algebraic form, based on the vector-representation of logic. Next, we merge the logic state of the LDG and the continuous state of the original switched system using the STP and derive the dynamics of the merged state; a switched system without constraints on switching. The stability of the switched system under constrained switching is equivalent to the stability of the merged system under arbitrary switching. Based on this, sufficient conditions for the asymptotical stability of nonlinear switched systems with analytic subsystems under constrained switching are obtained. Specifically, in the case of all subsystems being linear, necessary and sufficient conditions for asymptotical stability under constrained switching are proposed.

### About the speaker

郭宇骞，中南大学自动化学院教授，博士生导师。1995年毕业于长沙学院物理系；2003年毕业于湖南师范大学，获基础数学专业硕士学位；2006年毕业于中国科学院数学与系统科学研究院，获理学博士学位。2006年8月至2009年1月，在新加坡南洋理工大学从事博士后研究，2009年1月加入中南大学。主要研究方向包括混杂系统和逻辑动态网络的分析与控制，发表学术论文30余篇。



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## Robust Asymptotic Stabilization for a Class of Uncertain Upper-Triangular Systems

朱建栋

南京师范大学

### Abstract

Robust asymptotic stabilization of a class of uncertain upper-triangular systems is investigated. It shows that, by appropriately increasing the powers of the states in a linear controller, an uncertain upper-triangular system can be robustly asymptotically stabilized. A nested nonlinear controller is designed by introducing the notion of homogeneity with strictly decreasing degrees. For the stability analysis, a common Lyapunov/Chetaev function is constructed and a necessary and sufficient condition for robust asymptotic stability is established.

### About the speaker

朱建栋，南京师范大学数学科学学院运筹学与控制论教研室，教授，博导。完成和主持多项国家自然科学基金面上项目，在国际权威期刊上发表论文 30 余篇，目前研究兴趣包括：多个体系统，布尔控制系统，非线性系统的稳定性。