第六届中国系统科学大会
程序册

主办单位

上海系统科学研究院

中国系统科学大会指导委员会

承办单位

上海理工大学

协办单位

中国科学院数学与系统科学研究院系统科学研究所

北京师范大学系统科学学院

北京交通大学交通系统科学与工程研究院

国防科技大学理学院

同济大学自主智能无人系统科学中心

中国系统工程学会

中国自动化学会控制理论专业委员会

2022 年 11 月 11 – 13 日　中国·上海

目录

欢迎辞

各位专家、学者和同学们：

欢迎大家参加第六届中国系统科学大会！

系统科学的研究对象是“系统”自身，其目的是探索各类系统的结构、环境与功能的普适关系以及演化与调控的一般规律。在钱学森等老一辈专家学者的大力支持和推动下，系统科学在我国形成了良好的学术基础和发展态势。进入 21 世纪以来，系统科学的意义和价值日益凸显。

随着全球化、信息化、网络化、大数据和人工智能等方面的快速发展，复杂系统问题日益凸现。为应对社会和科技发展对系统科学带来的挑战，联合各界人士共同推动系统科学发展，建立一个全国系统科学界学术交流和学科交叉平台，同时吸引更多青年人进入系统科学领域，2017 年由上海系统科学研究院、中国科学院数学与系统科学研究院系统科学研究所、北京师范大学系统科学学院、北京交通大学交通系统科学与工程研究院、中国系统工程学会等单位联合发起。2017 年和 2018 年在北京召开了第一、二届中国系统科学大会，2019 年在长沙召开了第三届中国系统科学大会，2020 年在青岛召开了第四届中国系统科学大会，2021 年在南京召开了第五届中国系统科学大会，均受到与会代表的广泛赞誉，产生了广泛影响。

2022 年，第六届中国系统科学大会在疫情下召开。本次大会得到了广大系统科学及相关领域研究学者的积极响应和大力支持，共收到各类投稿 822 篇。经过评审和大会学术委员会的审定，共有 586 篇论文被录取并编入程序册进行分组报告。会议邀请了 5 位专家做大会报告，2 个专题研讨会共邀请了 8 位专家进行学术交流。

在此，我谨向所有为本届大会顺利召开做出贡献的人士致以我们最真诚的谢意！感谢上海理工大学对本次会议精心的筹备和辛苦的努力！感谢审稿人及程序委员会委员对投稿论文的严谨评审！感谢组委会和志愿者提供的热情服务！感谢大会的报告人和大会专题研讨会的主讲人，感谢你们接受会议邀请，与大家一同分享你们最新的研究成果！感谢所有投稿作者和参会人员对本次会议的支持！

最后，预祝本次大会圆满成功！

郭雷　　丁晓东

第六届中国系统科学大会(CSSC2022)大会主席

组织机构

主办单位：上海系统科学研究院
中国系统科学大会指导委员会
承办单位：上海理工大学
协办单位：中国科学院数学与系统科学研究院系统科学研究所
北京师范大学系统科学学院
北京交通大学交通系统科学与工程研究院
国防科技大学理学院
同济大学自主智能无人系统科学中心
中国系统工程学会
中国自动化学会控制理论专业委员会

指导委员会

主任

郭雷(中国科学院数学与系统科学研究院)

副主任

丁晓东(上海理工大学)
狄增如(北京师范大学)
张纪峰(中国科学院数学与系统科学研究院)

委员

段晓君(国防科技大学)　　高　岩(上海理工大学)
高自友(北京交通大学)　　韩战钢(北京师范大学)
洪奕光(同济大学)　　贾　斌(北京交通大学)
李志斌(华东师范大学)　　杨晓光(中国科学院数学与系统科学研究院)

秘书处

赵来军(秘书长，上海理工大学)　　智路平(秘书，上海理工大学)

会议组织

大会主席

郭　雷(中国科学院数学与系统科学研究院)　　丁晓东(上海理工大学)

大会副主席

顾春华(上海理工大学)　　吴　忠(上海对外经贸大学，上海理工大学)

程序委员会主席

狄增如(北京师范大学)　　顾春华(上海理工大学)

张纪峰(中国科学院数学与系统科学研究院)

程序委员会副主席

(按姓氏拼音排序)

段晓君(国防科技大学)　　高　岩(上海理工大学)

高自友(北京交通大学)　　韩战钢(北京师范大学)

洪奕光(同济大学)　　贾　斌(北京交通大学)

李志斌(华东师范大学)　　杨晓光(中国科学院数学与系统科学研究院)

赵来军(上海理工大学)

邀请组主席

(按单位拼音+姓氏拼音排序)

费为银(安徽工程大学)　　高　见(安庆师范大学)

于重重(北京工商大学)　　赵峙尧(北京工商大学)

贾　斌(北京交通大学)　　李新刚(北京交通大学)

陈清华(北京师范大学)　　韩战钢(北京师范大学)

兰岳恒(北京邮电大学)　　袁健华(北京邮电大学)

宋乾坤(重庆交通大学)　　王其林(重庆交通大学)

周建庭(重庆交通大学)　　杨志春(重庆师范大学)

张新功(重庆师范大学)　　鲜思东(重庆邮电大学)

田　忠(电子科技大学)　　吕琳媛(电子科技大学)

刘洪喆(东南大学)　　王　和(东南大学)

虞文武(东南大学)　　黄文韬(广西师范大学)

邝　华(广西师范大学)　　潘　峰(贵州民族大学)

段晓君(国防科技大学)　　王泽龙(国防科技大学)

晏　良(国防科技大学)　　董　瑞(河南科技大学)

唐明(华东师范大学)　　郑志刚(华侨大学)

葛世伦(江苏科技大学)　　王念新(江苏科技大学)

刘文奇(昆明理工大学)　　李金海(昆明理工大学)

赵　宁(昆明理工大学)　　夏建伟(聊城大学)

陆国平(南通大学)　　张新松(南通大学)

林　崇(青岛大学)　　纪志坚(青岛大学)
顾菊平(苏州科技大学)　　董焕河(山东科技大学)
王　震(山东科技大学)　　顾长贵(上海理工大学)
李军祥(上海理工大学)　　魏国亮(上海理工大学)
杨会杰(上海理工大学)　　洪奕光(同济大学)
梁　舒(同济大学)　　丁义明(武汉科技大学)
冯育强(武汉科技大学)　　陈建华(武汉理工大学)
代　飞(西南林业大学)　　周　华(西南林业大学)
韩　科(西南交通大学)　　穆义芬(中国科学院数学与系统科学研究院)
牟必强(中国科学院数学与系统科学研究院)　　赵文虎(中国科学院数学与系统科学研究院)
张　涛(中山大学)

程序委员会委员

由程序委员会主席、副主席、邀请组主席及部分特邀专家组成

专题研讨会主席

狄增如(北京师范大学)　　贾　斌(北京交通大学)

组织委员会主席

赵来军(上海理工大学)

组织委员会副主席

高　岩(上海理工大学)

组织委员会委员

顾长贵(上海理工大学)　　张　广(上海理工大学)
房志明(上海理工大学)　　黄中意(上海理工大学)
齐洪胜(中国科学院数学与系统科学研究院)　　王海英(上海理工大学)
费　晨(上海理工大学)

秘书长

智路平(上海理工大学)　　李　莹(上海理工大学)
孙　颖(上海理工大学)　　朱　凯(上海理工大学)

重要信息

- 会议时间：2022 年 11 月 12 - 13 日
- 会议地点：上海浦东新区华夏东路 6666 弄上海三甲港绿地国际会议中心
- 会议日程：2022 年 11 月 12 - 13 日 学术报告
- 会议语言：中文
- 报到时间及地点：
  11 月 11 日 12：00–20：00 三甲港绿地国际会议中心一楼序厅
  11 月 12 日 07：00–10：00 三甲港绿地国际会议中心一楼序厅
  11 月 13 日 07：00–10：00 三甲港绿地国际会议中心一楼序厅

会议服务：

- 稿件安排：孙 颖 15618061311
- 分组安排：王海英 18811560398
- 分组安排：顾长贵 13641697344
- 会议注册：朱 凯 17521246496(微信同号)
- 酒店服务：李丁明 13774200007
- 用车服务：冯 晨 18817582986
- 会务服务：李 莹 15921134333
- 会务总揽：智路平 15921630512

大会主办方邮箱：cssc2022@163.com

CSSC2022 网站：https：//sass.usst.edu.cn/cssc2022/main.htm

中国系统科学大会论文管理系统网址：http：//cms.amss.ac.cn

上海理工大学网址：https：//www.usst.edu.cn/

交通与会场信息

交通信息

1、上海虹桥机场及虹桥高铁站至会场（约 54 公里）
线路 1：乘坐地铁二号线至远东大道地铁站乘坐大会专属接驳巴士
线路 2：乘坐出租车，沿中环路转华夏高架路，约 1 小时到达

2、浦东机场至会场（约 10 公里）
线路 1：乘坐地铁二号线至远东大道地铁站乘坐大会专属接驳巴士
线路 2：乘坐出租车，约 15 分钟到达

3、上海站至会场（约 44 公里）
线路 1：乘坐地铁一号线至人民广场转二号线至远东大道地铁站乘坐大会专属接驳巴士
线路 2：乘坐出租车，经南北高架路转中环、华夏高架路，约 50 分钟到达

11 日 12:00-21:00 二号线远东大道地铁站接驳大巴整点发车开往酒店
13 日 18:00-22:00、14 日 08:00-13:00 接驳大巴从铂派酒店开往二号线远东大道地铁站

会场信息

图 1 会场方位图

图 2 酒店鸟瞰图

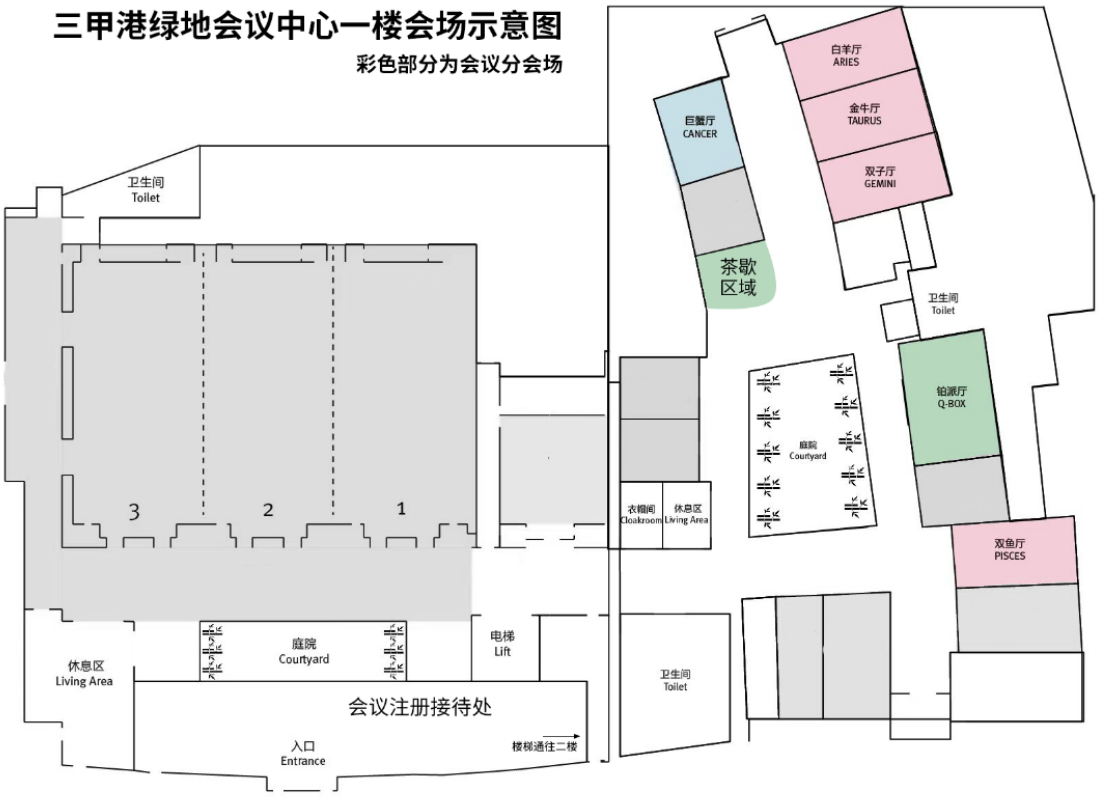

图 3 会议中心一楼会场示意图

图 4 会议中心二楼会场示意图

参会与口头报告要求

参会(Participation)

大会报告及大会专题研讨会采用映目 live 专用会议直播系统，需使用注册时提供的手机号注册登录，以下三条通道任选其一进行收看：

1.微信扫码手机直播平台登录观看

2.复制网址链接前往浏览器直播平台登录观看

https://m.inmuu.com/v1/photolive/news/2312638

3.打开微信小程序链接直播平台登录观看

微信搜索“映目 live”-关注-映目直播-搜索“第六届中国系统科学大会”-点击观看

口头分组报告(Oral Presentation)

请使用 PPT 格式，报告语言为中文，报告时间为 15 分钟（含提问、交流环节）。

线下会场：

1. 请报告人在整个分组报告单元开始前一天到分组主持人处报到并将报告文件拷入计算机；

2. 会议提供计算机 (装有 Microsoft Windows 和 Microsoft PowerPoint)、投影设备和激光笔，同步开通专属腾讯会议室（密码 123456）。

线上会场：

请报告人在整个分组报告单元开始前 10 分钟进入专属腾讯会议室（密码 123456），并使用会议专属虚拟背景。

特别声明：会议期间将统一录制会议全过程，录制文件与作者提交的视频文件只用于会议存档与注册作者会后学习交流，会议承诺不作他用，特此告知。如有异议，请您以邮件的形式于会前告知会务组。

分组会场及秩序联系人信息

类别	分组编号	时间	腾讯会议号	分组秩序联系人	联系电话
线下组	SaA01	周六下午 13：00-15：00	103-775-119	李智楠	19821135518
线下组	SaA02	周六下午 13：00-15：00	150-455-565	杨亮	18296690480

线下组	SaA03	周六下午 13：00-15：00	959-362-817	陈水侠	15755082751
线下组	SaA04	周六下午 13：00-15：00	711-843-223	徐梦婷	18156155752
线下组	SaA05	周六下午 13：00-15：00	564-126-324	云丰泽	13506430126
线下组	SaA06	周六下午 13：00-15：00	565-755-172	孙钰栋	15689716039
线下组	SaB01	周六下午 15：15-17：15	350-682-979	李智楠	19821135518
线下组	SaB02	周六下午 15：15-17：15	698-962-436	杨亮	18296690480
线下组	SaB03	周六下午 15：15-17：15	387-760-271	陈水侠	15755082751
线下组	SaB04	周六下午 15：15-17：15	759-716-436	徐梦婷	18156155752
线下组	SaB05	周六下午 15：15-17：15	980-294-620	云丰泽	13506430126
线下组	SaB06	周六下午 15：15-17：15	969-344-238	孙钰栋	15689716039
线下组	SuA01	周日下午 13：00-15：00	577-423-834	李智楠	19821135518
线下组	SuA02	周日下午 13：00-15：00	709-369-373	杨亮	18296690480
线下组	SuA03	周日下午 13：00-15：00	909-239-094	陈水侠	15755082751
线下组	SuA04	周日下午 13：00-15：00	574-157-906	徐梦婷	18156155752
线下组	SuA05	周日下午 13：00-15：00	756-310-383	云丰泽	13506430126
线下组	SuA06	周日下午 13：00-15：00	773-395-627	孙钰栋	15689716039
线下组	SuB01	周日下午 15：15-17：15	168-314-381	李智楠	19821135518
线下组	SuB02	周日下午 15：15-17：15	213-688-218	杨亮	18296690480
线下组	SuB03	周日下午 15：15-17：15	535-204-470	陈水侠	15755082751
线下组	SuB04	周日下午 15：15-17：15	542-552-880	徐梦婷	18156155752
线下组	SuB05	周日下午 15：15-17：15	553-917-486	云丰泽	13506430126
线下组	SuB06	周日下午 15：15-17：15	956-940-490	孙钰栋	15689716039
线上组	SaA01	周六下午 13：00-15：00	602-343-832	要猛	15938537060
线上组	SaA02	周六下午 13：00-15：00	197-804-905	陈嘉琦	19117199423
线上组	SaA03	周六下午 13：00-15：00	666-623-362	王欣（高见）	15955535232
线上组	SaA04	周六下午 13：00-15：00	611-131-939	杨璐祯	18817801769
线上组	SaA05	周六下午 13：00-15：00	947-476-910	葛静沂	19512291053
线上组	SaA06	周六下午 13：00-15：00	211-318-977	程雅	18225712670
线上组	SaA07	周六下午 13：00-15：00	562-245-152	田赛	18018501068
线上组	SaA08	周六下午 13：00-15：00	129-704-258	孟飞	13917673798
线上组	SaA09	周六下午 13：00-15：00	220-675-723	蔡洁	18816566861
线上组	SaA10	周六下午 13：00-15：00	371-538-685	霍良安	18801970230
线上组	SaA11	周六下午 13：00-15：00	395-150-231	沈雪敏	18717959576

线上组	SaB01	周六下午 15：15-17：15	638-488-140	王欣（高见）	15955535232
线上组	SaB02	周六下午 15：15-17：15	431-379-675	胡紫怡	13016583306
线上组	SaB03	周六下午 15：15-17：15	111-707-071	郭鑫晨	17853333960
线上组	SaB04	周六下午 15：15-17：15	513-690-513	杨璐祯	18817801769
线上组	SaB05	周六下午 15：15-17：15	718-578-046	沈雪敏	18717959576
线上组	SaB06	周六下午 15：15-17：15	149-554-469	程雅	18225712670
线上组	SaB07	周六下午 15：15-17：15	639-713-958	张镭	13647689019
线上组	SaB08	周六下午 15：15-17：15	945-693-627	郑雯欣	15257022582
线上组	SaB09	周六下午 15：15-17：15	882-155-755	付馨懿	19121804390
线上组	SaB10	周六下午 15：15-17：15	159-721-751	季红华	13777825630
线上组	SaB11	周六下午 15：15-17：15	680-545-508	王萍	15517683701
线上组	SaB12	周六下午 15：15-17：15	233-866-778	窦军	18817650551
线上组	SuA01	周日下午 13：00-15：00	660-135-676	张亚萌	15537311987
线上组	SuA02	周日下午 13：00-15：00	243-166-912	王子龙	17530965931
线上组	SuA03	周日下午 13：00-15：00	791-412-733	郝艺琳	15177922442
线上组	SuA04	周日下午 13：00-15：00	854-566-428	曹思琪	18721072060
线上组	SuA05	周日下午 13：00-15：00	550-241-710	张广	18817395086
线上组	SuA06	周日下午 13：00-15：00	358-325-905	刘辉冉	17353556553
线上组	SuA07	周日下午 13：00-15：00	545-850-194	张惠珍	13501609649
线上组	SuA08	周日下午 13：00-15：00	304-388-090	黄永生	18626086010
线上组	SuA09	周日下午 13：00-15：00	721-975-304	陶杰	18302129675
线上组	SuA10	周日下午 13：00-15：00	668-170-040	田赛	18018501068
线上组	SuA11	周日下午 13：00-15：00	621-637-380	杭佳宇	15800912593
线上组	SuA12	周日下午 13：00-15：00	483-667-636	姚天宇	13917222849
线上组	SuB01	周日下午 15：15-17：15	663-542-505	宋雨轩	18955000796
线上组	SuB02	周日下午 15：15-17：15	356-209-161	王子龙	17530965931
线上组	SuB03	周日下午 15：15-17：15	935-712-196	杨雷鑫	18601737405
线上组	SuB04	周日下午 15：15-17：15	918-721-390	孟飞	13917673798
线上组	SuB05	周日下午 15：15-17：15	627-623-776	刘磊	18918082406
线上组	SuB06	周日下午 15：15-17：15	121-492-788	顾雯玮	18816572698
线上组	SuB07	周日下午 15：15-17：15	147-458-474	陈宣羽	17717338566
线上组	SuB08	周日下午 15：15-17：15	559-918-463	山昊	18221682130
线上组	SuB09	周日下午 15：15-17：15	133-246-077	周建	15316061556

线上组	SuB10	周日下午 15：15-17：15	586-885-744	金晓辰	17317187159
线上组	SuB11	周日下午 15：15-17：15	765-187-033	梁荣	18116206229
线上组	SuB12	周日下午 15：15-17：15	538-697-193	窦军	18817650551

大会报告

大会报告 1

11 月 12 日 8：30-9：30

未来战争，将是以认知决策为中心的混合型控制战

——复杂性将成为未来战争的重要武器

刘国治

军事科学院

摘要：基于智能化时代即将到来这一大趋势的科学判断，研究提出未来战争将是以认知决策为中心的混合型控制战，并指出军事智能化发展必将引起重大变革。提出：

1) 制智权将成为核心制权。智力将超越火力、信息力等成为决定战争胜负的最关键因素，智力将主宰火力、机动力、信息力发展和运用。谁具有智力优势，谁将掌握未来战争的主导权、主动权。认知博弈将成为战争的主线，人机混合智能将是未来智能的最高形式；

2)“混合”将成为突出特征。战争力量、作战域、部队编成、作战样式和攻击毁伤方式等均呈现混合特征。但混合决不是不择手段，而是以最小的伤亡和对社会最小破坏为目标，达到使敌人服从己方意志的战争目的；

3) 复杂性将成为重要武器。未来战争将呈现出越来越复杂之态势，复杂系统科学将成为智能化军队建设和驾驭及打赢未来战争之必需；

4) “控制”将成为核心要求。战争任务将由主要歼灭对手向控制对手转变。认知控制是控制战的最高形式，即控制对手认知、操控对手决策和行为；

5) 认知域将成为决胜战场，认知战将成为重要作战样式，“脑”将成为核心作战对象。复杂乱脑、斩首亡脑、设局控脑、舆论迫脑、以快费脑等作战样式将逐渐呈现。

同时，指出为了适应军事智能化发展，必须大力开展有关复杂系统科学、认知博弈科学和能量信息认知综合作用毁伤机理等基础科学研究，并应特别注意向人体这个科学高效的复杂巨系统学习，研究建立国防和军队建设人体模型。

刘国治，教授，中国科学院院士，中央军委科学技术委员会原主任。毕业于清华大学，分别于 1983 年、1986 年和 1992 年获得学士、硕士和博士学位。我国著名应用物理学家。主要科研方向为高功率微波、太赫兹生物物理和军事智能化及复杂系统科学等，并长期从事科研管理。

大会报告 2

11 月 12 日 9：30-10：30

轨迹动力学——贯通整体论与还原论的探索

薛禹胜

国网电力科学研究院

摘要：钱学森先生在 1990 年指出，研究复杂系统要从整体到部分，再由部分到整体，以克服整体论与还原论各自的局限性。遵循此思路，本报告介绍的“轨迹动力学”贯通了整体论与还原论。该研究范式的要点包括：

(1) 相关多领域的建模；

(2) 支持因果模型，多代理模型及真实人参与的混合沙盘推演，获取整体系统在演化过程中的全部信息，从而确保了整体论对信息基础的要求；

(3) 按针对具体问题的理论分析给出的模式定义，将整体系统的轨迹解耦为子系统轨迹；

(4) 从目标子系统的内部变量，与外部子系统交互的边界变量的轨迹中，提取特征指标，从而建立了整体论分析与还原论分析之间信息熵不变的双向贯通；

(5) 采用分段线性化技术将经典还原论方法拓广应用到开放、非平衡的非线性系统；

(6) 将各子系统的特征指标序列聚合，共同刻画整体系统的演化行为及机理。

报告通过在 Lorenz 系统、电力系统稳定性、宽频振荡，及双碳变革路径优化等不同的复杂系统中的应用，说明轨迹动力学如何兼容了整体论的全局观点与还原论的机理观点。

薛禹胜，中国工程院院士，国网电科院名誉院长，SCI 期刊《MPCE》创刊主编及现任主编，中文期刊《电力系统自动化》主编。他是稳定性理论及电力系统自动化专家，提出、设计并成功实施的停电防御系统是首批 243 项国家自主创新产品之一。提出了能源领域的信息-物理-社会系统的研究框架。共获全国科学大会奖 1 项，国家科学技术奖 7 项，国家图书奖提名奖 1 项，中国专利金奖及优秀奖各 1 项，首届江苏省科学技术突出贡献奖 2 名获奖者之一。

大会报告 3

11 月 13 日 8：30-9：30

Systems optimization for smart industry

唐立新

东北大学

摘要：Systems optimization is the core basic theory of decision-making in smart industry, as well as the heart and engine of data analytics. This talk will discuss some systems modeling methods and optimization solution methods we have been working on. The systems modeling methods are to quantitatively describe different practical problems with proper formulations, including set-packing model, space-time network model, and continuous-time based model. The optimization solution methods include: 1) Integer optimization to optimally solve typical combinatorial optimization problems based on mathematical programming. According to the structure features of the problems, different methods are designated including branch-and-price, Lagrangian relaxation, Benders decomposition, outer approximation, and branch-and-cut. 2) Convex optimization is the core of machine learning. It is also used to solve practical continuous optimization problem. Major methods are discussed, such as gradient descent, alternative direction, second order cone, and semidefinite. Additionally, duality theories are used to improve their efficiency. 3) Intelligent optimization to solve the large-scale optimization problems with high non-linearity, dynamics, or multi-objectives. Various intelligent optimization algorithms will be discussed, including incremental dynamic DE algorithm, individual-dependent DE algorithm, and MOEA algorithm. 4) Topology optimization is used to scientifically design material layout within a given physical space, so as to maximize the system performance while satisfying a given set of loads and boundary conditions and constraints. It is widely used in lightweight design for mechanical equipment in smart industry. Major topology optimization solution methods to handle discrete structure and continuum structure are discussed. Overall, systems optimization provides the scientific basis for decision-making and data analytics in smart industry.

唐立新，中国工程院院士，现为东北大学副校长(科技规划、国际合作)，东北大学控制科学与工程(自动化)国家一级重点学科负责人、控制科学与工程国家“双一流”学科建设领导小组组长，智能工业数据解析与优化教育部重点实验室主任、工业智能与系统优化国家级前沿科学中心主任和首席科学家、计算机软件国家工程研究中心工业软件首席设计师。兼任国务院学位委员会第八届控制科学与工程学科评议组成员、教育部科技委人工智能专委会副主任、中国科协优化算法与软件决策咨询首席专家、中国运筹学会副理事长兼智能工业数据解析与优化专业委员会主任。主要研究方向为工业智能与系统优化理论方法，包括工业大数据科学、数据解析与机器学习、深度学习与进化学习、加强学习与动态优化、凸优化与稀疏优化、整数与组合最优化、计算智能优化等理论方法，智能工业全流程生产与库存计划、生产与物流批调度、生产过程操作优化与最优控制等系统优化技术，过程监测、设备诊断、产品质知等质量解析技术，图像理解、语音识别、可视仿真等工业智能技术，以及在钢铁制造、机械制造(装备／芯片制造)、能源工业、物流系统、信息工业中的工程应用。现为 6 个国际工业智能与系统优化领域重要 SCI 期刊 IISE Transactions、IEEE Transactions on Evolutionary Computation、IEEE Transactions on Cybernetics、Journal of Scheduling、International Journal of Production Research、Journal of the Operational Research Society 的 Associate Editor，国际期刊 Annals of Operations Research 编委，国际期刊 Asia-Pacific Journal of Operational Research 区域主编(Area Editor)。发表在国际工业与系统工程旗舰期刊 IISE Transactions 的论文被评为 2017 年度“最佳应用论文奖”(Best Applications Paper Award)。

大会报告 4

11 月 13 日 9：30-10：30

Risk Models for Cybersecurity

David Rios Insua

AXA-ICMAT Chair, ICMAT-CSIC and Spanish Royal Academy of Sciences

摘要：I shall present advances in relation to cyber security risk models with emphasis in cyber insurance. Stemming from an initial reference model for cyber security resource allocation, I shall focus on taking advantage from the system structure (including multiple facilities) and the relevance and risks associated to Artificial Intelligence/Machine Learning tools for cyber security.

David Rios Insua is Research Professor of Risk Analysis and Data Science and AXA Chair at ICMAT-CSIC and Member of the Spanish Royal Academy of Sciences. He has been formerly researcher and or lecturer at Duke, Purdue, Aalto, Paris-Dauphine, UPM, URJC, Leeds, Purdue, CNR-IMATI and USST and scientific director of Aisoy Robotics. He received the DeGroot Prize for his work in adversarial risk analysis and was a finalist of the Edelman Awards for his work in aviation safety risk management.

大会专题研讨会

大会专题研讨会 1

11 月 12 日 10：45-11：45

科学中的系统学

主持人：狄增如 教授 北京师范大学

主讲人：张海涛 教授 (华中科技大学)
严　钢 教授 (同济大学)
李　辉 教授 (北京师范大学)
唐　漾 教授 (华东理工大学)

题目：自主无人艇集群协同围捕理论、技术及应用

时间：10：45-11：00

摘要：本报告从应用角度出发，深入剖析自然界群体智能对于自主无人艇集群协同的涌现机理，揭示集群构型切换相变的规律，为实现从自然群体智能到无人系统集群应用的跨越提供理论与技术的支撑。紧紧围绕自主无人艇集群协同合围理论与技术中存在的“难合围”、“易掉队”以及“易碰撞”等实际科学问题，创新了无人艇集群突变式控制方法，设计了基于构型调控、间断通讯、简单传感、多运动目标的协同合围控制器，突破了无人艇集群协同围捕应对水域突发任务的性能瓶颈。

张海涛，华中科技大学人工智能与自动化学院副院长、教授、博导、国家杰青。2005 年在中国科技大学获得博士学位，2007 年在剑桥大学从事博士后研究，2010 年晋升为教授，同年被评为博士生导师。从事群体智能、自主无人艇集群协同、多机器人协同制造等领域研究，主持国家自然科学基金联合重点(两项)、JKW 主题组项目等国家级项目。在 Nature Machine Intelligence、Nature Communications、National Science Review、Automatica、IEEE TAC 等期刊发表 SCI 论文 118 篇，出版 Springer 英文专著 2 部。群体智能理论成果被 Nature Physics 研究亮点报道、应用成果被国防部和国务院官网报道。授权发明专利 32 件，制定国家标准 1 件，专利在中船重工等转化。牵头获得湖北省自然科学一等奖 2 项和广东省技术发明一等奖 1 项。担任/曾任 IEEE Trans. Systems, Man, and Cybernetics-Systems、IEEE Trans. Circuits and Systems II、中国工程院院刊 Engineering、《控制理论与应用》、《机器人》等刊编委。

题目：复杂系统的结构和动力学推理

时间：11：00-11：15

摘要：复杂系统往往由相互作用的大量节点所形成。随着数字化和微观实验技术的蓬勃发展，诸多学科领域都积累了关于实际复杂系统的观测数据，特别是大量节点的活动序列数据。如何从这些观测数据中发掘复杂系统的底层机理是学界和业界都普遍关心的科学问题。本报告将简单介绍复杂系统推理的发展历程，讲述复杂网络结构和动力学推理的最新进展，并讨论该方向上仍待解决的难点问题。

严钢，自主智能无人系统全国重点实验室、同济大学物理科学与工程学院长聘教授，博士生导师。2005 和 2010 年于中国科学技术大学分别获得理学学士和工学博士学位。主要兴趣为复杂系统与人工智能交叉领域的理论及应用研究，迄今发表国际期刊论文 43 篇，包括第一或通讯作者发表的 Nature，Nature Physics、Nature Computational Science、Physical Review Letters/X、National Science Review、IEEE Trans.等，近五年主持国家级项目 5 项，与同行合作获得省部级自然科学一等奖 2 次。2016 年入选国家高层次青年人才，2022 年获得国家杰出青年科学基金。

题目：生物复杂系统研究

时间：11：15-11：30

摘要：生命是由分子、细胞、组织等不同层次生命物质所构成。细胞作为蛋白质等生物大分子构成的复杂系统，生物大分子在细胞内的运动是代谢、信号传导生命功能的物理基础，揭示它们之间的关系具有极其重要的科学意义。然而，如何精确观测不同层次生命物质的动态过程、刻画其动力学行为、理解其隐藏的功能机理以及多层次间的相互关联，都亟待研究者解决。为此，我们搭建了单分子荧光动态成像平台，提出了特有的测量细胞内扩散、主动运输的动力学研究方法。在分子、细胞尺度开展了一系列复杂动力学研究，发掘其与细胞功能、结构特征以及外界微环境等方面的内在关联，理解生物系统的运行机制。

李辉，北京师范大学教授，博士生导师，国家优青，中科院青促会成员。研究方向为生物复杂系统的动力学，通过发展先进的光学动态成像技术和分析方法，揭示生命系统在纳米、微米、到毫米多个尺度的复杂动力学行为，及其与结构特征、生物功能、以及微环境等方面的关联。已在 PNAS、JACS、Adv.Sci.、Small、iScience、CPL Express Letter 等国内外期刊上发表文章 30 余篇，被 Physics World、ScienceDaily、中国科学院院刊、国家自然科学基金委等专文报道。现担任 CPL、CPB、《物理学报》和《物理》四刊青年编委，主持国家自然科学基金四项。

题目：复杂系统协同与决策

时间：11：30-11：45

摘要：系统性、复杂性已成为信息社会基本特征。经济安全、疾病防控、舆论调控等问题都可建模为复杂系统，具有多样性、记忆性、涌现性等特性。考虑到理论发展和时代特点，开放、对抗和突发已成为必须考虑的新特征。传统研究方法在处理多层网络、多尺度、跨时空、开放环境等特性存在局限，需要从特性分析、调控和博弈三个角度出发，探索协同与决策方法。本报告以复杂系统协同与决策为主题，总结复杂系统机理分析、调控机制、决策与博弈等关键问题，希望为复杂系统协同与决策研究提供参考。

唐漾，博士，教授，博士生导师，德国洪堡基金、国家级高层次人才、科技部中青年科技创新领军人才、国家级海外高层次人才引进计划青年项目和上海市优秀学术带头人等计划入选者，ESI 全球高被引科学家。主要研究自主智能系统泛在感知和博弈决策，多智能体系统/复杂网络状态估计、控制和优化。围绕上述领域，在 Nature 子刊、Cell 子刊、Automatica 和 IEEE 汇刊上发表论文 100 余篇，申请/公开/授权专利 20 余件。主持国家科技部重点研发计划项目和课题、国家自然科学基金重点项目、人工智能基础研究应急管理项目、中德科学中心合作交流项目和面上项目等多个项目。目前担任 Nature 出版集团 Scientific Reports 资深编委，IEEE TNNLS，IEEE TCYB，IEEE TCASI，IEEE TETCI，IEEE SJ 和 EAAI (IFAC Journal)等多个国际期刊的副主编/编委。获得 2019 年度上海市自然科学奖一等奖(第一完成人)。

大会专题研讨会 2

11 月 13 日 10：45-11：45

系统科学发展展望

主持人：贾斌 教授 北京交通大学

主讲人：吴建军 教授 (北京交通大学)
李际超 教授 (国防科技大学)
赵 靖 教授 (上海理工大学)
李大庆 教授 (北京航空航天大学)

题目：系统科学与城市交通融合研究的一些思考

时间：10：45-10：57

摘要：一个相对完整的城市交通系统，其正常运行涉及到基础设施、出行者行为、交通工具、管理控制、运行环境等构成要素，是一个巨复杂的人机环交互系统。本报告从系统科学的视角，围绕城市交通系统及其未来发展中的一些基础性、共性的科学问题以及研究方向，给出系统科学与城市交通相融合进行研究的一些思考，以促进系统科学方法在城市交通管理与控制中的应用，提升交通系统运行效率，促进学科的交叉融合。

吴建军，教授，博士生导师，轨道交通控制与安全国家重点实验室副主任、综合交通运输大数据应用技术交通运输行业重点实验室副主任。教育部长江学者特聘教授、国家杰出青年科学基金和全国优秀博士学位论文获得者。兼任管理科学与工程学会常务副秘书长、交通运输管理分会主任、中国系统工程学会常务理事，《中国公路学报》副主编、《Frontiers of Engineering Management》、《管理科学学报》、《系统工程理论与实践》编委等。在 PNAS、TR-B 以及 TR 系列期刊上发表论文 170 余篇。主持国家杰青、国家自然科学基金委重大项目课题等国家级项目及行业应用课题。获教育部自然奖一等奖 2 项以及其他省部级科技奖励 4 项。出版著作 3 部，国家发明专利 20 余项。

题目：网络视角下战争复杂系统发展与展望

时间：11：09-11：21

摘要：战争复杂系统是一类典型的开放复杂巨系统，随着战争的信息化程度不断提升，特别是智能化建设快速转化为战斗力，战争要素泛在互联，有机融通了物理域、信息域和认知域，构建了多域一体的全维作战网络。未来智能化作为主导的战争形态下，战争运行机理和规律更加难以把握，战争迷雾更加浓厚。复杂网络理论与方法作为一种刻画分析复杂系统的得力工具，被越来越多运用到战争分析中来。本报告梳理了战争形态若干次演变过程，概述了战争复杂系统的复杂性来源，尝试从网络视角提出战争复杂系统研究需要重点关注的几个问题，并对战争复杂系统未来发展趋势进行展望，将有助于运用复杂系统思维认知战争，把握占据未来智能时代战争先机。

李际超，国防科技大学系统工程学院副教授，美国西北大学联合培养博士。中国科协（军事科技领域）青年人才托举工程资助对象，军委科技委“智创基金”获得者，湖南省优青，中国人工智能学会社会计算青年学者新星，学校高层次创新人才计划培养对象。主要从事复杂系统与复杂网络、数据分析与智能决策等方面研究，主持国家/军队/省部级项目 7 项，在包括 Nature 子刊等国际知名期刊发表论文 40 余篇，申请或授权国家发明专利 20 余项，研究成果被《泰晤士报》、《每日邮报》、《凯洛格观察》、《知识分子》等国内外知名媒体报道，博士论文获评中国管理科学与工程学会优秀博士学位论文、全军优秀博士学位论文。

题目：从系统思维建模到交通工程设计——以交叉口为例

时间：11：21-11：33

摘要：道路交通优化设计需要综合考虑人-车-路要素及其与道路设施和环境的交互运行规律。针对我国城市道路交通需求巨大、路网结构复杂和交通构成多样的特征，需要通过系统设计构建空间与时间协同优化的设计、管理和控制方法。引入动态的通行权分配，通过道路交通系统资源柔性分配与动态设计，将有限的时间和空间资源，与交通需求时空分布形成高度匹配，从而实现高效、安全、可靠、集约的道路交通系统。研究以交叉口为例，基于系统建模思维，探讨道路交通变结构优化设计理论，提出系列提升道路通行能力和效能的新设计方法，并实现工程落地应用，促进学科的交叉融合。

赵靖，教授，博士生导师，上海理工大学交通系统工程系主任。国家优秀青年科学基金获得者、上海市青年拔尖人才、上海市浦江人才。兼任上海市公路学会理事、世界交通运输大会公共交通设计技术委员会联合主席、JAT 等国际期刊编委。从事交通系统设计、交通控制与管理、交通流建模和公共交通方向研究。主持国家级项目 4 项，获教育部科学技术进步二等奖等省部级科技奖励 4 项。在 CACAIE、IEEE T-ITS、TR 系列等期刊发表论文 50 余篇，授权发明专利 10 项，软件著作权 6 项，主编专著 3 部，参编标准 2 部。

题目：复杂系统可靠性展望

时间：11：33-11：45

摘要：数字化、网络化、智能化时代，涉及我国国民经济发展各个领域的物理、信息、社会等复杂系统逐步具有了自我感知、互联互通、结构演化、功能耦合等复杂系统新特征，不确定性、时空演化和级联失效成为复杂系统故障的新特点。针对传统可靠性方法的局限性，面向复杂系统故障的新特点，需要从复杂网络视角出发，聚焦复杂系统共性原理，探索复杂网络的健康管理方法。本报告尝试提出了需要研究的关键问题，包括复杂网络的故障演化规律、复杂网络的可靠性建模、复杂网络的脆弱性分析、复杂网络的弹性优化策略等，希望为复杂系统可靠性研究提供参考。

李大庆，北京航空航天大学研究员、博导、首届校务委员会委员。2022 年获国家杰出青年科学基金，2018 年获国家优秀青年科学基金。围绕复杂系统管理，在 PNAS、Nature Physics、Nature Communications、RESS 等国际著名期刊上发表了研究成果，国家自然科学基金委、中国日报、科技日报等专文报道。主持了国自然、装发预研等科研项目。获得国防科技进步一等奖、航空学会技术发明一等奖。担任了管理科学与工程学会复杂系统管理专委会副主任，“双法”研究会高教管理分会副理事长，系统工程学会系统可靠性专委会常务理事，中国智能交通协会青专委专家。

第六届中国系统科学大会议程总览

11 月 11 日	11 月 12 日		11 月 13 日	
大会报到 时间： 11 日 14：00-20：00 12 日 07：00-10：00 13 日 07：00-10：00 地点： 上海市浦东新区华夏东路 6666 弄三甲港绿地国际会议中心		主持人：**顾春华** 教授		
	08：00-08：30	**开幕式**：大会主席**郭雷**院士致辞 系统科学学科评议组召集人**贾斌**教授致辞 上海理工大学校长**丁晓东**教授致辞 合影		
	08：30-09：30	**大会报告 1**：**刘国治** 院士 未来战争，将是以认知决策为中心的混合型控制战——复杂性将成为未来战争的重要武器 主持人：**狄增如** 教授	08：30-09：30	**大会报告 3**：**唐立新** 院士 Systems Optimization for Smart Industry 主持人：**高 岩** 教授
	09：30-10：30	**大会报告 2**：**薛禹胜** 院士 轨迹动力学——贯通整体论与还原论的探索 主持人：**李志斌** 教授	09：30-10：30	**大会报告 4**：**David Ríos Insua** 院士 Risk Models for Cybersecurity 主持人：**高 岩** 教授
	10：30-10：45	茶歇	10：30-10：45	茶歇(招聘)
	10：45-11：45	**专题研讨 1**：科学中的系统学 报告人：**张海涛、严钢、李辉、唐漾** 主持人：**狄增如** 地点：铂瑞厅	10：45-11：45	**专题研讨 2**：系统科学发展展望 报告人：**吴建军、李际超、赵靖、李大庆** 主持人：**贾斌** 地点：铂瑞厅
	11：45-13：00 自助餐与午休		11：45-13：00 自助餐与午休	
	13：00-15：00	**口头分组报告** 线下 SaA01-SaA06 线上 SaA01-SaA11	13：00-15：00	**口头分组报告** 线下 SuA01-SuA06 线上 SuA01-SuA12
	15：00-15：15	茶歇	15：00-15：15	茶歇
	15：15-17：15	**口头分组报告** 线下 SaB01-SaB06 线上 SaB01-SaB12 地点：十二宫 + 线上	15：15-17：15	**口头分组报告** 线下 SuB01-SuB06 线上 SuB01-SuB12 地点：十二宫 + 线上
18：00-20：00 晚餐	18：00-20：00	自助餐	18：00-20：00	闭幕式和晚宴

注：受到疫情影响，最终安排以大会官方网站发布的电子版“程序册”为准，请及时查阅。

会议程序线下组

2022 年 11 月 12 日 （周六）

SaA01 13 : 00 – 15 : 00 白羊厅

腾讯会议：103-775-119

电网及能源系统复杂性及模式识别

主持人：顾菊平 苏州科技大学

主持人：李军祥 上海理工大学

➢ SaA01 - 1 13 : 00 - 13 : 15

443 考虑电池储能系统接入的电热联合系统风电接纳能力评估

顾菊平 苏州科技大学

张新松 南通大学

➢ SaA01- 2 13 :15 - 13: 30

818Optimal Design of High-Power Medium-Frequency Transformer Using Hollow Conductors with Consideration of Multi-objective Parameters

郭云翔 南通大学

卢成 南通大学

张新松 南通大学

➢ SaA01 - 3 13: 30- 13 : 45

510 基于连续时间的智能电网实时定价模型

罗艺灵 上海理工大学

高岩 上海理工大学

➢ SaA01 - 4 13 : 45- 14 : 00

560Real time pricing of smart grid based on filled function method

屈德强 上海理工大学

李军祥 上海理工大学

➢ SaA01 - 5 14 : 00 - 14 : 15

801 移动边缘网络中的用户关联与缓存优化策略设计

杨小龙 北京信息科技大学

徐 湛 北京信息科技大学

➢ SaA01- 6 14 : 15 - 14 : 30

444 基于协同进化的光伏电站与电动汽车充电站联合规划

张新松 南通大学

➢ SaA01 - 7 14 : 30 - 14 :45

552Multivariable T-S Fuzzy Decision Variable Gain Coordinated Control of PV and Storage Hybrid DC Access

张晓彤 南通大学

茅靖峰 南通大学

印春云 南通大学

➢ SaA01 - 8 14 : 45 - 15 : 00

17A Traversal Multi-target Path Planning Method for Unmanned Cruise Ship in a Complex Environment

赵峙尧 北京工商大学

许继平 北京工商大学

杨蒙 北京工商大学

陈慧敏 北京工商大学

范依云 北京工商大学

SaA02 13 : 00 – 15 : 00 金牛厅

腾讯会议：150-455-565

网络高阶结构及动力学分析

主持人：史定华 上海大学

主持人：徐梦俏 大连理工大学

➢ SaA02 - 1 13 : 00 - 13 : 15

210The Kronecker-clique model for higher-order clustering Coefficients

李聪 复旦大学

➢ SaA02 - 2 13 : 15 - 13 : 30

153 共享单车系统中的普适标度律

李睿琪 北京化工大学

➢ SaA02 - 3 13 :30- 13 : 45

143 单纯形网络：从点线到单纯形，迈向高阶的桥梁

史定华 上海大学

➢ SaA02 - 4 13 : 45 - 14 : 00

142Higher-order similarity of human brain microstructural and functional networks

王浩 电子科技大学

吕琳媛 电子科技大学

➢ SaA02 - 5 14 : 00 - 14 :15

139A Path - based Approach to Analyzing the Global Liner Shipping Network

徐梦俏 大连理工大学

➢ SaA02 - 6 14 :15 - 14 : 30

252 广义单纯形模型及其应用

杨荣湄 电子科技大学
周方 电子科技大学
刘波 电子科技大学
吕琳媛 电子科技大学

➢ SaA02 - 7 14 : 30- 14 : 45

289 基于单纯复形的复杂网络高阶性研究

赵毅 哈尔滨工业大学（深圳）

➢ SaA02 - 8 14: 45 - 15 : 00

204 复杂网络视角下的全球集装箱海运系统抗毁性研究

朱逸凡 大连理工大学
徐梦俏 大连理工大学

SaA03 13 : 00 – 15 :00 双子厅

腾讯会议：959-362-817

系统工程理论与方法

主持人：曹林 北京信息科技大学
主持人：张家宁 北京邮电大学

➢ SaA03 - 1 13 : 00 - 13 : 15

794 视频类 UGC 价值评估体系研究

房津玉 北京信息科技大学
倪渊 北京信息科技大学
张健 北京信息科技大学

➢ SaA 03- 2 13 : 15 - 13 :30

785 融合 GNN 和 MLP 模型的中小微企业服务资源推荐算法

贾昊男 北京信息科技大学
张健 北京信息科技大学
陈进东 北京信息科技大学
何琼 北京信息科技大学

➢ SaA03 - 3 13: 30- 13 : 45

4Revealing spatio-temporal interaction patterns behind complex cities

刘晨馨 北京化工大学
李睿琪 北京化工大学

➢ SaA03 - 4 13 : 45 - 14 : 00

152Quantifying the structural and temporal characteristics of negative links in signed citation networks

宋多琪 北京师范大学
王文沛 北京师范大学
樊瑛 北京师范大学
邢延猛 北京师范大学
曾安 北京师范大学

➢ SaA03 - 5 14 : 00- 14 : 15

796 面向海量目标的航天侦察可见窗求解方法

宋沛然 北京信息科技大学
杜丙男 北京信息科技大学
曹林 北京信息科技大学
杜康宁 北京信息科技大学

➢ SaA03 - 6 14 : 15 - 14 : 30

789遮蔽空间单兵双足不等式约束融合定位仿真研究

王一静 北京信息科技大学
苏中 北京信息科技大学
李磊 北京信息科技大学
刘一康 北京信息科技大学

➢ SaA03 - 7 14 : 30 – 14:45

690 分支过程下超级传播者对信息消亡的影响研究

张家宁 北京邮电大学
Jinghua Xiao 北京邮电大学

➢ SaA03 - 8 14 : 45 - 15 : 00

807 基于 NKF-FRKF 的晃动基座初始对准方法

张晓苏 北京信息科技大学
李擎 北京信息科技大学
付国栋 北京德维创盈科技有限公司
苏中 北京信息科技大学

SaA04 13 : 00 – 15 : 00 巨蟹厅

腾讯会议：711-843-223

复杂网络

主持人：曾安 北京师范大学
主持人：李睿琪 北京化工大学

➢ SaA04 - 1 13 : 00 - 13 : 15

195 蚂蚁攻击蠼螋实验研究

陈语珂 北京师范大学
朱嘉琪 北京师范大学
韩战钢 北京师范大学

➢ SaA04 - 2 13 : 15 - 13:30

244 符号社会网络的信息传播免疫策略

李艾纹 北京师范大学
许小可 大连民族大学
樊瑛 北京师范大学

➢ SaA04 - 3 13: 30 - 13 : 45

2Hidden directionality unifies community detection and cluster analysis

李睿琪 北京化工大学
尚璠 北京化工大学

➢ SaA04 - 4 13 : 45 - 14 : 00

838 基于 Power-law 分布原则的传播源节点选取方法

研究

宋多琪 北京师范大学

➢ SaA04 - 5 14 : 00 - 14 : 15

280 识别复杂网络上隐匿的目标节点

殷浩斐 北京师范大学

曾安 北京师范大学

➢ SaA04 - 6 14 : 15 - 14 : 30

675 基于传播过程的网络拆解

张奥博 北京师范大学

曾安 北京师范大学

➢ SaA04 - 7 14 : 30 - 14 : 45

803 小型货车高速转弯防侧翻控制

张昊 北京信息科技大学

➢ SaA04 - 8 14 : 45 - 15 : 00

158 复杂网络中级联失效规模的双峰分布及其预测

仲崇欣 北京师范大学

曾安 北京师范大学

SaA05 13 : 00 – 15 : 00 双鱼厅

腾讯会议：564-126-324

群体智能理论及应用

主持人：王兴芬 北京信息科技大学

主持人：郭雨 北京师范大学

➢ SaA05 - 1 13 : 00- 13: 15

778 基于双重注意力对比网络的素描人脸合成方法

杜康宁 北京信息科技大学

曹林 北京信息科技大学

司淑狄 北京信息科技大学

郭亚男 北京信息科技大学

➢ SaA05 - 2 13 : 15 - 13 : 30

325 速度异质化个体对于群体行为影响

郭雨 北京师范大学

➢ SaA05 - 3 13 : 30 - 13 : 45

792 基于特征子空间和多目标遗传算法优化集成学习的僵尸企业识别研究

何轩 北京信息科技大学

倪渊 北京信息科技大学

张健 北京信息科技大学

➢ SaA05 - 4 13 : 45 - 14 : 00

788 粒子群优化噪声参数的行人导航零速修正算法

李磊 北京信息科技大学

苏中 北京信息科技大学

吴学佳 北京信息科技大学

王一静 北京信息科技大学

➢ SaA05 - 5 14 : 00 - 14 : 15

795 文化产业发展态势分析及预测

李思远 北京信息科技大学

倪渊 北京信息科技大学

张健 北京信息科技大学

➢ SaA05 - 6 14 : 15 - 14 : 30

790 基于超平面-Louvain-Bert 优化 LDA 模型的书法作品价值要素提取

潘小宇 北京信息科技大学

倪渊 北京信息科技大学

金春华 北京信息科技大学

张健 北京信息科技大学

➢ SaA05 - 7 14 : 30 - 14 :45

839 基于 TCN-Attention 的大宗商品价格预测

王兴芬 北京信息科技大学

王世杰 北京信息科技大学

岳婷 北京信息科技大学

➢ SuA05 - 8 14 : 45 - 15 : 00

793 基于深度学习的推荐算法综述

张立威 北京信息科技大学

倪渊 北京信息科技大学

张健 北京信息科技大学

SaA06 13 : 00 – 15 : 00 铂派厅

腾讯会议：565-755-172

人工智能、数据挖掘及其应用

主持人：赵峙尧 北京工商大学

主持人：张慧妍 北京工商大学

➢ SaA06 – 1 13 : 00 - 13 : 15

805Deep Learning Based Channel Estimation for Non-linear MIMO Systems in the Internet of Vehicles scenarios

巩译 北京信息科技大学

李欣儒 北京信息科技大学

孟繁轲 西安邮电大学

徐湛 北京信息科技大学

➢ SaA06 - 2 13 : 15 - 13 : 30

198 中国语境下，基于新能源汽车异质性的道路交通碳排放研究

郝旭 北京科技大学

➢ SaA06 - 3 13 : 30 - 13: 45

804 基于多标签文本分类的电影衍生品价值指标体系构建

廖世豪 北京信息科技大学

倪渊 北京信息科技大学

张健 北京信息科技大学

➢ SaA06 - 4 13 : 45 - 14: 00

[39]Attentive fine-grained recognition for cross-domain few-shot classification

萨良兵 北京工商大学
于重重 北京工商大学
马先钦 北京工商大学
赵霞 北京工商大学
谢涛 北京工商大学

➢ SaA06 - 5 14 : 00 - 14 : 15

[784] 考虑时序信息的中小微企业服务平台深度学习推荐算法

张海航 北京信息科技大学
陈进东 北京信息科技大学
张健 北京信息科技大学
何琼 北京信息科技大学

➢ SaA06 - 6 14 : 15 - 14 : 30

[53]Self-organizing deep belief modular echo state network for time series prediction

张慧妍 北京工商大学
王立 北京工商大学
孙茜 北京工商大学
王昭洋 北京工商大学

➢ SaA06 - 7 14 : 30 - 14: 45

[19]Water quality evolution mechanism modeling and health risk assessment based on stochastic hybrid dynamic systems

赵峙尧 北京工商大学
周宇琴 北京工商大学
王小艺 北京工商大学

➢ SaA06 - 8 14 :45 - 15 : 00

[781] 基于残差优化多层 Bi-LSTM 的情感分类算法

郑志超 北京信息科技大学
陈进东 北京信息科技大学
张健 北京信息科技大学

SaB01 15 : 15 – 17 : 30 白羊厅

腾讯会议：350-682-979

复杂系统的建模、分析和控制

主持人：陆国平 南通大学
主持人：谭远顺 重庆交通大学

➢ SaB01 - 1 15 : 15 - 15: 30

[829]Effects of official information and rumor on resource-epidemic coevolution dynamics

霍良安 上海理工大学
赵瑞芳 上海理工大学

➢ SaB01 - 2 15 : 30 - 15 : 45

[364] 混改企业融通发展高层梯队决策动力学仿真分析

焦忆雷 上海理工大学

➢ SaB01- 3 15 : 45- 16 :00

[740]Influence of heterogeneous nodes on oscillation in excitable networks

李涛 华侨大学

➢ SaB01 - 4 16 : 00 - 16 : 15

[432] 多层符号神经网络的领导跟随一致

陆国平 南通大学

➢ SaB01 - 5 16 : 15 - 16 :30

[404]Stability and bifurcation in a predator-prey system with prey-taxis

邱焕焕 重庆交通大学

➢ SaB01 - 6 16: 30- 16: 45

[833]Complexity and chaos control of a Cournot duopoly model with bounded rationality

谈文慧 中国地质大学
魏周超 中国地质大学（武汉）

➢ SaB01 - 7 16 : 45- 17 : 00

[599]Collective dynamics of phase oscillator populations with three-body interactions

王璇 华侨大学

➢ SaB01 - 8 17 : 00- 17 : 15

[492]Dynamic behavior of prostate cancer cells under antitumor immunity and pulse vaccination in a random environment

杨欢 重庆交通大学
谭远顺 重庆交通大学

➢ SaB01 - 9 17 : 15- 17 : 30

[293]Finite-time dissipative control for memristor-based bidirectional associative memory neural networks with time-varying delays

杨金荣 武汉科技大学
陈贵词 武汉科技大学

SaB02 15 : 15– 17 : 30 金牛厅

腾讯会议：698-962-436

复杂网络上的动力学模型研究

主持人：顾长贵 上海理工大学
主持人：阮中远 浙江工业大学

➢ SaB01 - 1 15 : 15 - 15 : 30

[70] 代谢网络冗余与进化年龄的关联

邓世果 上海工程技术大学

➢ SaB02 - 2 15 : 30 - 15 : 45

[9] 主时钟网络结构对生物节律的影响
顾长贵 上海理工大学
➢ SaB02 - 3 16 : 15- 16 :30
[841] 复杂网络背景下绿色产品扩散机理研究
李明 上海理工大学
刘臣 上海理工大学
霍良安 上海理工大学
➢ SaB02 - 4 16 : 30 - 16 : 45
[507] 网络动力系统中的时空动力学理论及应用研究
李怡然 复旦大学
➢ SaB02 - 5 15 : 45 - 16 : 00
[645]The reconstruction of the network structure in flocking systems based on time series
梁靖婕 国防科技大学
祁明泽 国防科技大学
段晓君 国防科技大学
➢ SaB02 - 6 16 : 00 - 16 : 15
[87]Using the manifolds of discrete dynamical systems to understand the entrainment of circadian oscillators.
廖光源 重庆邮电大学
➢ SaB02 - 7 16 : 45- 17 : 00
[54]Transfer entropy calculation for short time sequences with application to stock markets
邱路 上海师范大学
➢ SaB02 - 8 17 : 00 - 17 : 15
[10]Role of lurkers in threshold - driven information spreading dynamics
阮中远 浙江工业大学
➢ SaB02 - 9 17 : 15 - 17 : 30
[86]Scaling up real networks by geometric branching growth
郑木华 江苏大学

SaB03 15 : 15 – 17 : 30 双子厅

腾讯会议：387-760-271

多智能体与量子系统中的优化与博弈方法

主持人：程书明 同济大学
主持人：梁舒 同济大学
➢ SaB03 - 1 15 : 15 - 15: 30
[475]Detecting quantum entanglement with unsupervised learning
程书明 同济大学
➢ SaB03 - 2 15 : 30 - 15 : 45
[369]Influence of Misperception on Zero – Determinant Strategies in Iterated Prisoner’s Dilemma
程朝阳 中国科学院
陈冠溥 中国科学院
洪奕光 中国科学院
➢ SaB03 - 3 15 : 45 - 16 : 00
[362]Distributed sub-optimal optimization for generalized resource allocation problems
梁舒 同济大学
➢ SaB03 -4 16 : 00 - 16 : 15
[692] 基于第一性原理的因果分析、信息流及其应用
梁湘三 复旦大学
➢ SaB03 - 5 16 : 15- 16 :30
[242]Competitive Volleyball Algorithm for Global Optimization
孙硕 上海理工大学
➢ SaB03 - 6 16 : 30 - 16 : 45
[477]Quantum extreme learning machine
汪咏 同济大学
➢ SaB03 - 7 16 : 45 - 17 : 00
[367]Algorithm design and approximation analysis on distributed robust game
许戈辉 中国科学院
陈冠溥 中国科学院
➢ SaB03 - 8 17 : 00- 17 : 15
[557]Optimization of Action Recognition Model Based on Multi-Task Learning and Boundary Gradient
徐一鸣 南通大学
➢ SaB03 - 9 17 : 15- 17 : 30
[374]Distributed Algorithm for Seeking Bayesian Nash Equilibrium in Subnetwork Zero - sum Games
张汉铮 中国科学院
陈冠溥 中国科学院
洪奕光 中国科学院

SaB04 15 : 15– 17: 30 巨蟹厅

腾讯会议：759-716-436

复杂网络

主持人：张雷 重庆交通大学
主持人：王海英 上海理工大学
➢ SaB04 - 1 15 : 15 - 15 : 30
[551] 考虑中间设施点的无人清扫车路线优化模型及算法
崔允汀 上海理工大学
何胜学 上海理工大学
➢ SaB04 - 2 15 : 30 - 15 : 45
[840]The influence of individual emotions on the coupled

model of unconfirmed information propagation and epidemic spreading in multilayer networks

霍良安 上海理工大学

顾佳凤 上海理工大学

➢ SaB04 - 3 15 : 45 - 16 : 00

[165] 基于酶调控网络的模体比较

林海鹏 中国科学院

韩靖 中国科学院

➢ SaB04 - 4 16 : 00 - 16 : 15

[731]Epidemic dynamics on higher-dimensional small world networks

王海英 上海理工大学

➢ SaB04 - 5 16 : 15 - 16 : 30

[409]Frequency-Amplitude Correlation Inducing First-order Phase Transition in Coupled Oscillators

王降圣 上海理工大学

顾长贵 上海理工大学

➢ SaB04 - 6 16 :30- 16 : 45

[494] 复杂电磁环境的构建与度量研究

王兴财 电子科技大学

➢ SaB04- 7 16 : 45 - 17 : 00

[872]A Dynamic Event-Triggered Mean-Square Consensus Control for Discrete-time Stochastic Multi-Agent System With System Uncertainties

夏遵安 安徽工程大学

刘宏建 安徽工程大学

陈麒文 安徽工程大学

章冉 安徽工程大学

➢ SaB04- 8 17 : 00 - 17 : 15

[221]Motion modal recognition method based on Scharr operator

张雷 重庆交通大学

SaB05 15 : 15 – 17 : 15 双鱼厅

腾讯会议：980-294-620

稳定性与鲁棒性理论研究(1)

主持人：杨志春 重庆师范大学

主持人：费晨 上海理工大学

➢ SaB05 - 1 15 : 15 - 15 : 30

[12]Delay-dependent Asymptotic Stability of Highly Nonlinear Stochastic Differential Delay Equations Driven by G-Brownian Motion

费晨 上海理工大学

➢ SaB05 - 2 15: 30 - 15 : 45

[603]Robust cycles of Boolean control networks with finite disturbances

付世华 聊城大学

王建军 University of Camerino

➢ SaB05 - 3 15 : 45 - 16: 00

[105]Delay Tolerance of Hybrid Stochastic Differential Equations Driven by Lévy Noise

李文瑞 南京理工大学

费晨 上海理工大学

费为银 安徽工程大学

➢ SaB05 - 4 16 : 00 - 16 : 15

[735]Optimal time-decay rates of the 3D compressible nematic liquid crystal flows with discontinuous initial data and large oscillations

王涵 广西师范大学

张映辉 广西师范大学

➢ SaB05 - 5 16 : 15 - 16 : 30

[678]Global exponential stability of delay dynamical systems with impulsive effects due to logic choice

谢巧玲 重庆师范大学

杨志春 重庆师范大学

➢ SaB05 - 6 16 : 30 - 16 :45

[303]Small-Gain-Based Fuzzy Adaptive Control of Interconnected Systems with Unmodeled Dynamics

徐博 青岛大学

李元新 辽宁工业大学

➢ SaB05 - 7 16 : 45 - 17 : 00

[161] 非线性多智能体系统的模糊自适应固定时间一致性跟踪控制

张丽丽 青岛大学

➢ SaB05 - 8 17 : 00 - 17 : 15

[44] 基于策略迭代的多智能体系统自适应容错控制

Zhao Liang 东北大学

冀相晗 青岛大学

曹广田 青岛大学

马东升 青岛大学

SaB06 15 : 15– 17 : 15 铂派厅

腾讯会议：969-344-238

稳定性与鲁棒性理论研究(2)

主持人：刘子建 重庆交通大学

主持人：赵军圣 聊城大学

➢ SaB06 - 1 15: 15 - 15 : 30

[509]Adaptive output-feedback control for stochastic nonlinear systems with global practical output tracking

曹杨荷 聊城大学

- SaB06 - 2 15 : 30 - 15 : 45

[222]On the existence of the exact solution of quaternion-valued neural networks based on a sequence of approximate solutions

陈晓丰 重庆交通大学

- SaB06 - 3 15 : 45- 16 : 00

[435]Lipschitz-like property relative to a set and the generalized Mordukhovichcriterion

李明华 重庆交通大学/重庆文理学院

- SaB06 - 4 16 : 00 - 16 :15

[406]A novel one-layer recurrent neural network for solving interval-valued constrained optimization problem

李月秋 重庆交通大学

- SaB06 - 5 16 : 15 - 16 : 30

[180]Modeling and Analysis of a Nonlinear Age-Structured Model for Tumor Cell Populations with Quiescence

刘子建 重庆交通大学

- SaB06 - 6 16 : 30- 16 : 45

[216]Mean-square stability of stochastic quaternion-valued neural networks with variable coefficients and neutral delays

宋乾坤 重庆交通大学
曾润湉 重庆交通大学
赵振江 湖州师范学院
刘玉荣 扬州大学

- SaB06 - 7 16 : 45 - 17 : 00

[748]Adaptive Recursive Terminal Sliding Mode Control Based on Improved Fully Adjusted RBF Neural Network

张罗玉 南通大学
郭云翔 南通大学
张新松 南通大学
卢成 南通大学

- SaB06 - 8 17 : 00 - 17 : 15

[503]Prescribed-time Stabilization and Inverse Optimal of High-order Stochastic Nonlinear Systems

赵军圣 聊城大学
赵海娜 聊城大学

2022 年 11 月 13 日 （周日）

SuA01 13 : 00 – 15 : 00 白羊厅

腾讯会议：577-423-834

博弈论及其应用

主持人：孙昌浩 中国空间技术研究院

主持人：韩小雅 上海理工大学

➢ SuA01 - 1 13: 00 - 13 : 15

[470] 基于随机模型的医疗资源最优预留服务能力策略的研究

陈燕婷 上海理工大学

陈古艳 上海理工大学

➢ SuA01 - 2 13 : 15 - 13 : 30

[562]Optimal decisions for the innovative enterprise considering brand goodwill and consumers' quality expectation

韩小雅 上海理工大学

张会臣 上海理工大学

➢ SuA01 - 3 13 : 30 - 13 : 45

[440] 考虑个体风险偏好的创新产品信息扩散问题研究

霍良安 上海理工大学

谢笑笑 上海理工大学

➢ SuA01 - 4 13 : 45 - 14 : 00

[657]Sharing the cost of cleaning a polluted river based on optimal pollutant control

雷雨晴 上海理工大学

张 广 上海理工大学

➢ SuA01 - 5 14 : 00 - 14 : 15

[88]Distributed Weighted Vertex Cover via Game-Theoretic Learning

孙昌浩 中国空间技术研究院

➢ SuA01 - 6 14 : 15 - 14 : 30

[315] All - Against - One Stochastic adaptive Games

袁硕 中国科学院

➢ SuA01 - 7 14 : 30 - 14 : 45

[6]Adaptive allocation rules for hypergraph games

张广 上海理工大学

➢ SuA01 - 8 14 : 45 - 15 : 00

[456]Cooperative NS equilibria of games under uncertainty

张弦 上海理工大学

SuA02 13 : 00 – 15 : 00 金牛厅

腾讯会议：709-369-373

系统运筹、优化及调度

主持人：彭再云 重庆交通大学

主持人：张新功 重庆师范大学

➢ SuA02 - 1 13: 00 - 13 : 15

[480] 基于随机模型的具有长期诊疗需求病患诊疗安排的最优设计

陈燕婷 上海理工大学

李胡蓉 上海理工大学

➢ SuA02 - 2 13 : 15 - 13 : 30

[681] 基于最大边际的递归主动学习

古仕林 国防科技大学

➢ SuA02 - 3 13 : 30 - 13 : 45

[217]A One-Layer Recurrent Neural Network for Interval-Valued Optimization Problem with Linear Constraints

胡进 重庆交通大学

➢ SuA02 - 4 13 : 45 - 14 : 00

[149]Painlevé-Kuratowski convergence of minimal solutions for set-valued optimization problems via improvement sets

彭再云 重庆交通大学

➢ SuA02 - 5 14 : 00 - 14 : 15

[229]The Sorted-waste Capacitated Location Routing Problem with Queuing Time: A Cross-entropy and Simulated-annealing-based Hyper-heuristic Algorithm.

尚春剑 上海理工大学

➢ SuA02 - 6 14 : 15 - 14 : 30

[622]Online scheduling of two flowshop with lookahead and incompatible job families

张新功 重庆师范大学

➢ SuA02 - 7 14 : 30 - 14 : 45

[240]A sample average approximation method based on a gap function for stochastic multiobjective optimization problems

赵勇 重庆交通大学

➢ SuA02 - 8 14 : 45 - 15 : 00

[453]A New Relaxed Method For Solving Split Feasibility Problem with Multiple Output Sets

朱亚 上海理工大学

SuA03　　13 : 00 – 15 : 00　　双子厅

腾讯会议：909-239-094

交通系统复杂性(1)

主持人：邝　华　　广西师范大学

主持人：张　锐　　西南交通大学

➢ SuA03 - 1　　13 : 00 - 13 : 15

[547] Optimal Control to Improve Reliability of Demand Responsive Transport Priority at Signalized Intersections Considering the Stochastic Process

梁士栋　　上海理工大学

➢ SuA03 - 2　　13 : 15 - 13 : 30

[623] 城市交叉口动态直右车道设计及信号控制研究

梁士栋　　上海理工大学

宁　搏　　上海理工大学

➢ SuA03 - 3　　13 : 30 - 13 : 45

[847] 基于扩展 TPB 模型的城市居民绿色出行行为研究

陆　欢　　上海理工大学

干宏程　　上海理工大学

➢ SuA03 - 4　　13 : 45 - 14 : 00

[769]Simulation of High-speed Railway Train Operation Based on Cellular Automata

秦梦瑶　　西南交通大学

帅斌　　西南交通大学

许旻昊　　西南交通大学

➢ SuA03 - 5　　14 : 00 - 14 : 15

[808] 轴辐式高铁快运网络多级节点布局研究

孙宗胜　　西南交通大学

帅斌　　西南交通大学

➢ SuA03 - 6　　14 : 15 - 14 : 30

[441] 不良气象对智能网联异质交通流的影响研究

叶杨　　广西师范大学

高伟　　广西师范大学

邝华　　广西师范大学

白克钊　　广西师范大学

➢ SuA03 - 7　　14 : 30 - 14 : 45

[464] 基于驾驶人交通违法行为记录与事故严重程度关联的重点交通违法行为筛选及识别研究

张锐　　西南交通大学

帅斌　　西南交通大学

➢ SuA03 - 8　　14 : 45 - 15 : 00

[428] 空间分区效应对结伴行人应急疏散的影响研究

周昂　　广西师范大学

刘晨　　广西师范大学

邝华　　广西师范大学

白克钊　　广西师范大学

SuA04　　13 : 00 – 15 : 00　　巨蟹厅

腾讯会议：574-157-906

交通系统复杂性(2)

主持人：彭光含　　广西师范大学

主持人：周亦威　　上海理工大学

➢ SuA04 - 1　　13 : 00 - 13 : 15

[835]T 型信号交叉口动态直右车道优化设计及仿真评价

储慧怡　　上海理工大学

梁士栋　　上海理工大学

➢ SuA04 - 2　　13 : 15 - 13 : 30

[708]Predictive feedback control in coupled map car-following model integrating the headway deviation effect

彭光含　　广西师范大学

黎新海　　广西师范大学

➢ SuA04 - 3　　13 : 30 - 13 : 45

[416]Cooperative vehicular trajectory optimization for urban freeway on ramps

戚钧杰　　上海理工大学

赵靖　　上海理工大学

马晓旦　　上海理工大学

➢ SuA04 - 4　　13 : 45 - 14 : 00

[463] 出发旅客视角下的高铁车站衔接交通可达性分析

许旻昊　　西南交通大学

帅斌　　西南交通大学

➢ SuA04 - 5　　14 : 00 - 14 : 15

[433]Adaptive Signal Control for Overflow Prevention Based on Fuzzy Control

姚天宇　　上海理工大学

赵靖　　上海理工大学

➢ SuA04 - 6　　14 : 15 - 14 : 30

[403]Dynamic dilemma zone protection through vehicular trajectory optimization and speed guidance

张范磊　　上海理工大学

赵靖　　上海理工大学

➢ SuA04 - 7　　14 : 30 - 14 : 45

[405]Optimal control of automated left-turn platoon at contraflow left-turn lane intersections

赵　靖　　上海理工大学

杨寒煜　　上海理工大学

➢ SuA04 - 8　　14 : 45 - 15 : 00

[209]A spatial model with endogenous weight matrix for investigating travel flow differences between peak hours with massive mobile phone data

周亦威 上海理工大学
倪玲霖 浙江财经大学

SuA05 13 : 00 – 14 : 45 双鱼厅

腾讯会议：756-310-383

系统理论及其应用

主持人：张宏军 中国船舶工业系统工程研究院
主持人：房志明 上海理工大学

➢ SuA05 - 1 13 : 00 - 13 : 15

[117] 基于子域法的表贴式永磁电机系统转矩分析

陈春涛 青岛大学
吴新振 青岛大学

➢ SuA05 - 2 13 : 15 - 13 : 30

[853]Stabilization by Variable-Delay Feedback Control for Highly Nonlinear Neutral Stochastic Delay Hybrid Systems with Lévy Noise

李文瑞 南京理工大学
费晨 上海理工大学
沈明轩 安徽工程大学
费为银 安徽工程大学

➢ SuA05 - 3 13 : 30 - 13 : 45

[565]T - S 模糊系统自适应积分滑模控制

孙兴建 南通大学
顾菊平 苏州科技大学

➢ SuA05 - 4 13 : 45 - 14 : 00

[870] 基于数字孪生的汽车装配过程在线质量改进

吴锋 安徽工程大学

➢ SuA05 - 5 14 : 00 - 14 : 15

[747]System Architecture Modeling Based on Business Process Management and Service-Oriented Architecture

谢衡 上海理工大学
倪枫 上海理工大学

➢ SuA05 - 6 14 : 15 - 14 : 30

[328] 基于规则的复杂工程系统设计方法

张宏军 中国船舶工业系统工程研究院
黄百乔 中国船舶工业系统工程研究院

➢ SuA05 - 7 14 : 30 - 14 : 45

[720] 基于复杂适应系统理论的韧性城市治理系统构建探究

张瑾 上海理工大学
叶春明 上海理工大学

SuA06 13 : 00 – 15 : 00 铂派厅

腾讯会议：773-395-627

多主体系统与可靠性分析

主持人：宗小峰 中国地质大学
主持人：杨奕飞 江苏科技大学

➢ SuA06 - 1 13 : 00 - 13 : 15

[202] 基于河长制治理系统的河长制任务体系优化与重构 -----社会-生态系统理论视角

杜海娇 南昌大学
邓群钊 南昌大学

➢ SuA06 - 2 13 : 15 - 13 : 30

[558]A Global Relative Similarity for Inferring Interactions of Multi-agent Systems

顾孔静 国防科技大学
段晓君 国防科技大学
祁明泽 国防科技大学
晏良 国防科技大学

➢ SuA06 - 3 13 : 30 - 13 : 45

[100] 随机线性异质多自主体系统的协同输出反馈跟踪控制

李殿强 华东师范大学
李韬 华东师范大学

➢ SuA06 - 4 13 : 45 - 14 : 00

[66] 鱼群涌现机制下集群机器人运动强化的迁移控制

陶 宇 上海理工大学
刘 磊 上海理工大学

➢ SuA06- 5 14 : 00 - 14 : 15

[766] 复杂海洋装备系统健康演化机理与评估方法研究

杨奕飞 江苏科技大学
刘世界 江苏科技大学

➢ SuA06 - 6 14 : 15 - 14 : 30

[128] 多主体回声状态网络及其在混沌动力系统预测中的应用

张一帆 昆明理工大学
刘文奇 昆明理工大学

➢ SuA06 - 7 14 : 30 - 14 : 45

[40]Finite-time stabilization of non-local Lipschitzian stochastic time-varying nonlinear systems with Markovian switching

赵桂华 上海理工大学
刘淑君 四川大学

➢ SuA06 - 8 14 : 45 - 15 : 00

[730]Delay-Induced stochastic stability and Stochastic Consensus

宗小峰 中国地质大学

SuB01 15 : 15 – 17 : 30 白羊厅
腾讯会议: 168-314-381
复杂系统建模的应用(1)

主持人：王 彪 江苏科技大学
主持人：孙梦迪 聊城大学

➢ SuB01 - 1 15 : 15 - 15 : 30
[688] 基于超生成对抗网络的无监督集成学习
曹文明 重庆交通大学

➢ SuB01 - 2 15 : 30 - 15 : 45
[871]Outlier-Resistant State Estimation for Discrete-Time Delayed Complex Networks: A Partial-Nodes-Based Approach
陈麒文 安徽工程大学
刘宏建 安徽工程大学
夏遵安 安徽工程大学
章冉 安徽工程大学

➢ SuB01 - 3 15 : 45 - 16 : 00
[85] 复杂环境下时间序列的混沌判别研究
淡儒斌 电子科技大学

➢ SuB01 - 4 16 : 00 - 16 : 15
[220]Event-Triggered μ-State Estimation for Markovian Jumping Neural Networks With Mixed Time-Delays
李兵 重庆交通大学

➢ SuB01 - 5 16 : 15 - 16 : 30
[461]Output feedback H∞ control for singular hybrid systems with time-varying delays via variable elimination technique
孙 梦 聊城大学
尹月霞 聊城大学
王馨 聊城大学
庄光明 聊城大学

➢ SuB01 - 6 16 : 30 - 16 : 45
[484] 形态学算子的多模态场景拓展
孙梦迪 聊城大学
孙忠贵 聊城大学

➢ SuB01 - 7 16 : 45 - 17 : 00
[468]An Underwater Acoustic Target Recognition Method Based on ARNet
王 彪 江苏科技大学
张 伟 江苏科技大学

➢ SuB01 - 8 17 : 00 - 17 : 15
[749] 一种灵活的鲁棒增强型彩色图像水印方案
王芳晓 广西师范大学
罗玉玲 广西师范大学
刘俊秀 广西师范大学
张顺生 广西师范大学

➢ SuB01 - 9 17 : 15 - 17 : 30
[360]Optimal configuration of a wind-photovoltaic-hydrogen-gas-electric vehicles integrated energy system considering multiple uncertainties and carbon reduction
祝刚 上海理工大学
高岩 上海理工大学

SuB02 15 : 15 – 17 : 30 金牛厅
腾讯会议: 213-688-218
复杂系统建模的应用(2)

主持人：王其林 重庆交通大学
主持人：王艳 重庆师范大学

➢ SuB02 - 1 15 : 15 - 15 : 30
[821]On Tucker-Type Alternative Theorems and Necessary Optimality Conditions for Nonsmooth Multiobjective Optimization
冯 敏 重庆交通大学

➢ SuB02 - 2 15 : 30 - 15 : 45
[268]Data-driven valued dominance relation in incomplete ordered decision system
官礼和 重庆交通大学

➢ SuB02 - 3 15 : 45 - 16 : 00
[201]A novel Collaborative Filtering recommendation approach based on Soft Co-Clustering
李 曼 重庆交通大学

➢ SuB02 - 4 16 : 00 - 16 : 15
[188]Locality regularized latent low-rank representa tion for semi-supervised subspace clustering
梁仁莉 重庆交通大学

➢ SuB02 - 5 16 : 15 - 16 : 30
[86]基于模型对象消除方法的多点协同温度控制系统设计与研究
聂鹏强 江苏科技大学
徐松 江苏科技大学
陈迅 江苏科技大学
蒋伟 扬州大学
Seiji Hashimoto 群马大学

➢ SuB02 - 6 16 : 30 - 16 : 45
[299]An Integrated Surrogate Model Constructing Method: Annealing Combinable Gaussian Process

王柄霖 国防科技大学
晏 良 国防科技大学
段晓君 国防科技大学

➢ SuB02 -7 16 : 45 - 17 : 00

[167]Second-order weakly composed adjacent-generalized contingent epiderivatives and applications to composite set-valued optimization problems

王其林 重庆交通大学

➢ SuB02 - 8 17 : 00 - 17 : 15

[722] 医学图像分割的数学方法与临床应用

王 艳 重庆师范大学

➢ SuB02 - 9 17 : 15 - 17 : 30

[473]以慢响应为基准的多通道温度协同追踪控制系统

王峥 江苏科技大学
徐松 江苏科技大学
陈迅 江苏科技大学
蒋伟 扬州大学
Seiji Hashimoto Gunma University

SuB03 15 : 15 – 17 : 15 双子厅

腾讯会议：535-204-470

复杂系统建模的应用(3)

主持人：邱爱兵 南通大学
主持人：倪 枫 上海理工大学

➢ SuB03 - 1 15 : 15 - 15 : 30

[339] 基于 SSD 网络的电动车进电梯检测研究

黄 鹏 上海理工大学
房志明 上海理工大学
黄中意 上海理工大学

➢ SuB03 - 2 15 : 30 - 15 : 45

[398]COVID-19 环境下封闭校园内人员流动的传染病模型

李海冰 上海理工大学
房志明 上海理工大学
黄中意 上海理工大学

➢ SuB03 - 3 15 : 45 – 16 : 00

[447] 耦合行人运动的疾病传播模型研究

刘 晨 广西师范大学
蒋婵静 广西师范大学
刘 哲 广西师范大学
邝 华 广西师范大学
白克钊 广西师范大学

➢ SuB03 - 4 16 : 00 - 16 : 15

[806] 基于旅客异质性的高铁车站旅客到达规律分析

刘洪义 西南交通大学
帅 斌 西南交通大学

➢ SuB03 - 5 16 : 15 - 16 : 30

[682] 面向特征继承性增减的在线学习算法

刘兆清 国防科技大学

➢ SuB03 - 6 16 : 30 - 16 : 45

[559]A novel feedback controller design with robust fault isolation ability

邱爱兵 南通大学
李 雪 南通大学
顾菊平 苏州科技大学

➢ SuB03 - 7 16 : 45 - 17 : 00

[600]Multiple Instance Learning for Unilateral Data

汤西嘉 国防科技大学
徐超 国防科技大学

➢ SuB03 - 8 17 : 00 - 17 : 15

[422]Business process modeling based on i-BPMN

周宇秀 上海理工大学
倪枫 上海理工大学

SuB04 15 : 15 – 17 : 30 巨蟹厅

腾讯会议：542-552-880

复杂系统建模的应用(4)

主持人：房志明 上海理工大学
主持人：牟 鱼 重庆交通大学

➢ SuB04 - 1 15 : 15 - 15 : 30

[342]Effects of expected distance and companionship on individual descent speed in the stairwell

樊蕊 上海理工大学
房志明 上海理工大学
黄中意 上海理工大学

➢ SuB04 - 2 15 : 30 - 15 : 45

[864] 众新冠疫情线上和线下预防行为的动机研究

黄叶琳 安徽工程大学
张雪峰 安徽工程大学
杜林 安徽工程大学

➢ SuB04 - 3 15 : 45 - 16 : 00

[716]Two-Stage Transit Signal Priority Control Method to Improve Reliability of Bus Operation Considering Stochastic Process

梁士栋 上海理工大学
冷荣梦 上海理工大学

➢ SuB04 – 4 16 : 00 - 16 : 15

[189]Dynamics of microorganism cultivation with delay and stochastic perturbation

牟鱼 重庆交通大学

➢ SuB04 - 5 16 : 15 - 16 : 30

314 以人口年龄结构数据来衡量国家发展的普遍模式和发展状况

沈 忱 北京师范大学

李红刚 北京师范大学

➢ SuB04 - 6 16 : 30 - 16 : 45

472 基于循环神经网络的多通道协同温度控制系统研究与设计

王震林 江苏科技大学

徐松 江苏科技大学

黄巧亮 江苏科技大学

陈迅 江苏科技大学

蒋伟 扬州大学

Seiji Hashimoto Gunma University

➢ SuB04 - 7 16 : 45 - 17 : 00

714 虚拟学术社区用户交互行为特征研究：基于两类学科的比较

张伟 江苏科技大学

➢ SuB04 - 8 17 : 00 - 17 : 15

474 基于参考模型驱动的神经网络动态温度控制方法研究

赵黎明 江苏科技大学

徐松 江苏科技大学

陈迅 江苏科技大学

蒋伟 扬州大学

Seiji Hashimoto Gunma University

➢ SuB04 - 9 17 : 15 - 17 : 30

388 Examining the overconfidence and overreaction in China's carbon markets

周欣星 上海理工大学

高岩 上海理工大学

SuB05 15 : 15 – 17 : 30 双鱼厅

腾讯会议：553-917-486

经济复杂系统建模(1)

主持人： 梁湘三 复旦大学

主持人： 何胜学 上海理工大学

➢ SuB05 - 1 15 : 15 - 15 : 30

99 学习的语言思维物象学结构巨型系统理论

陈才天 物象信息科技（湖北）有限公司

➢ SuB05 - 2 15 : 30 - 15 : 45

570 考虑智能客服系统中顾客行为的多服务台优先级人工客服排队系统

陈燕婷 上海理工大学

陈嘉颖 湖南大学

➢ SuB05 - 3 15 : 45 - 16 : 00

526 求解乡村邮递员问题的信息量模型及合圈算法

崔允汀 上海理工大学

何胜学 上海理工大学

➢ SuB05 - 4 16 : 00 - 16 : 15

867ESG 下的代币平台运行机制研究

费为银 安徽工程大学

李任重 安徽工程大学

费晨 上海理工大学

➢ SuB05 - 5 16 : 15 - 16 : 30

693The role of individual stocks in contributing to the vulnerability of a stock market in terms of cumulative information flow and causality on a rigorous basis

梁湘三 复旦大学

➢ SuB05 - 6 16 : 30 - 16 : 45

583 基于小波分析碳排放权价格和石油价格的交互效应研究

龙会典 广东外语外贸大学

➢ SuB05 - 7 16 : 45 - 17 : 00

856 混合随机波动模型下带随机工资的 DC 型养老金最优投资策略

邵艳宇 安徽工程大学

夏登峰 安徽工程大学

费为银 安徽工程大学

➢ SuB05 - 8 17 : 00 - 17 : 15

836The emergence of cooperation from shared goals in the governance of common pool resources

屠澄轶 浙江理工大学

➢ SuB05 - 9 17 : 15 - 17 : 30

518Multi-agent reinforcement learning based real-time pricing for regional energy microgrid management

王菁祺 上海理工大学

SuB06 15 : 15 – 17 : 15 铂派厅

腾讯会议：956-940-490

经济复杂系统建模(2)

主持人：潘海峰 安徽工程大学

主持人：容逸能 复旦大学

➢ SuB06 - 1 15 : 15 - 15 : 30

862 通胀与跳扩散下的企业最优杠杆策略

鲍琳琳 安徽工程大学

费为银 安徽工程大学

潘海峰 安徽工程大学

➢ SuB06 - 2 15 : 30 - 15 : 45

865 气候变暖下企业碳减排对经济增长的影响

费为银 安徽工程大学
李婧雅 安徽工程大学
潘海峰 安徽工程大学

➢ SuB06 - 3 15 : 45 - 16 : 00

857 ESG 数字平台的代币定价机制研究
费为银 安徽工程大学
谢成成 安徽工程大学
费 晨 上海理工大学

➢ SuB06 - 4 16 : 00 - 16 : 15

290Panel Data Causal Inference Using a Rigorous Information Flow Analysis for Homogeneous, Independent and Identically Distributed Datasets
容逸能 复旦大学

➢ SuB06 - 5 16 : 15 - 16 : 30

514Fixed-time formation tracking for multiple nonholonomic wheeled mobile robots based on distributed observer
孙凤兰 重庆邮电大学
李 浩 重庆邮电大学

➢ SuB06 - 6 16 : 30 - 16 : 45

373 识别国际贸易系统中的碳排放关键行业
易虹汝 上海理工大学

➢ SuB06 - 7 16 : 45 - 17 : 00

160A global branch approach to normalized solutions for Schrodinger equations
张建军 重庆交通大学

➢ SuB06 - 8 17 : 15 - 17 : 30

157The evolution of the cross-broader venture capital network:1970 –2018
张欣 上海海事大学
许鹏达 上海海事大学

会议程序线上组

2022 年 11 月 12 日（ 周六 ）

SaA01　　13 : 00 – 15 : 00
腾讯会议：602-343-832
复杂系统的奇异态与部分同步

主持人：郑志刚　　华侨大学
主持人：刘宗华　　华东师范大学

➢ SaA01 - 1　　13 : 00 - 13 : 15
[648]Impact of network motifs on response dynamics
纪鹏　　复旦大学

➢ SaA01 - 2　　13 : 15 - 13 : 30
[575]Understanding the mechanisms of brain functions from the angle of synchronization and complex network
刘宗华　　华东师范大学

➢ SaA01 - 3　　13 : 30 - 13 : 45
[641] 头皮脑电图对癫痫发作的检测与识别
卢小杰　　安徽师范大学
黄守芳　　安徽师范大学
张季谦　　安徽师范大学

➢ SaA01 - 4　　13 : 45 - 14 : 00
[676]Topological - heterogeneity induced chimera states in excitable scale - free networks
钱郁　　宝鸡文理学院

➢ SaA01 - 5　　14 : 00 - 14 : 15
[668]Transient cluster synchronization in ecological networks
王新刚　　陕西师范大学

➢ SaA01 - 6　　14 : 15 - 14 : 30
[332]Fault Detection Problem for Discrete-Time Impulsive System Using Mixed Dissipativity Approach
要猛　　上海理工大学
魏国亮　　上海理工大学

➢ SaA01 - 7　　14 : 30 - 14 : 45
[651]Topological homogeneity-heterogeneity competition and wave dynamics in excitable networks
郑志刚　　华侨大学

➢ SaA01 - 8　　14 : 45 - 15 : 00
[652]Explosive synchronization by Cartesian product operation
邹勇　　华东师范大学

SaA02　　13 : 00 – 15 : 00
腾讯会议：197-804-905
网络传播动力学与新冠肺炎疫情研究

主持人：唐　明　　华东师范大学
主持人：许小可　　大连民族大学

➢ SaA02 - 1　　13 : 00 - 13 : 15
[187]Model - based evaluation of alternative reactive class closure strategies against COVID - 19
刘权辉　　四川大学

➢ SaA02 - 2　　13 : 15 - 13 : 30
[72] 基动态接触网络的新型冠状病毒肺炎疫情模拟与防控研究
唐明　　华东师范大学

➢ SaA02 - 3　　13 : 30 - 13 : 45
[84] 面向新冠肺炎疫情的非药物干预措施理论研究
王冰　　上海大学

➢ SaA02 - 4　　13 : 45 - 14 : 00
[37] 数据与计算传播学
吴晔　　北京师范大学

➢ SaA02 - 5　　14 : 00 - 14 : 15
[266] 复杂网络中的诱导渗流
谢家荣　　中山大学
王向荣　　南方科技大学
胡延庆　　中山大学

➢ SaA02 - 6　　14 : 15 - 14 : 30
[109] 密集人群环境下新冠肺炎防控措施的仿真与分析
许小可　　大连民族大学

➢ SaA02 - 7　　14 : 30 - 14 : 45
[287]Dynamics of the Thrshold Model on Hypergraphs
许新建　　上海大学

➢ SaA02 - 8　　14 : 45 - 15 : 00
[89] 时序网络上的结构和功能差异性研究
张子柯　　浙江大学

SaA03　　13 : 00 – 15 : 00
腾讯会议：666-623-362
复杂系统涌现及自组织行为研究

主持人：张希昀　　暨南大学
主持人：高　见　　安庆师范大学

➢ SaA03 - 1　　13 : 00 - 13 : 15
[177]Network-energy-based predictability and Link-corrected prediction in complex networks
柴　浪　　武汉科技大学
涂俐兰　　武汉科技大学

➢ SaA03 -2　　13 : 15 - 13 : 30
[13]Turing patterns induced by the random aggregation of spatial compositions
高见　　安庆师范大学

➢ SaA03 - 3　　13 : 30 - 13 : 45
[799] 无人机边缘网络离散人工蜂群缓存策略研究
洪　钖　　北京信息科技大学
张月霞　　北京信息科技大学

➢ SaA03 - 4　　13 : 45 - 14 : 00
[843]Network-Based Approach for Forecasting East Asian Summer Monsoon Rainfall
邵海明　　昆明理工大学

➢ SaA03 - 5　　14 : 00 - 14 : 15
[69] 个体有限移动的原理及应用
李文静　　浙江水利水电学院

➢ SaA03 - 6　　14 : 15 - 14 : 30
[607] 弛豫时间作为向富营养化湖泊状态临界转变的预警指标
马智钦　　昆明理工大学
曾春华　　昆明理工大学

➢ SaA03 - 7　　14 : 30 - 14 : 45
[48]Structure of Autocorrelation in Time Series
任恒刚　　泰山学院
张国锋　　泰山学院

➢ SaA03 - 8　　14 : 45 - 15 : 00
[126] 基于复杂网络的人体生理病理状态新定义
张希昀　　暨南大学

SaA04　　13 : 00 – 15 : 00
腾讯会议：611-131-939
复杂网络分析方法及在社会经济等系统中的应用

主持人：王有贵　　北京师范大学
主持人：贾　韬　　西南大学

➢ SaA04 - 1　　13 : 00 - 13 : 15
[205] 全球海运网络的重叠社团结构及其国际贸易格局关联特征
邓文慧　　大连理工大学
徐梦俏　　大连理工大学

➢ SaA04 - 2　　13 : 15 - 13 : 30
[144]Cycle structure in networks and its application
范天龙　　University of Fribourg
吕琳媛　　电子科技大学

➢ SaA04 - 3　　13 : 30 - 13 : 45
[286] 信息流动异质性对投资成败的影响性研究
管青　　中国地质大学（北京）

➢ SaA04 - 4　　13 : 45 - 14 : 00
[146] 基于相对性指标的经济系统分析
韩筱璞　　杭州师范大学

➢ SaA04 - 5　　14 : 00 - 14 : 15
[134]Quantifying the maximum capability of a topological feature in link prediction
贾韬　　西南大学

➢ SaA04 - 6　　14 : 15 - 14 : 30
[197] 宏观金融的集成网络方法
王有贵　　北京师范大学

➢ SaA04 - 7　　14 : 30 - 14 : 45
[278] 高阶网络上的竞争流行病传播研究
王伟　　重庆医科大学

➢ SaA04 - 8　　14 : 45 - 15 : 00
[275] 风险投资机构的共股东网络研究
姚卿　　北京师范大学
李睿琪　　北京化工大学

SaA05　　13 : 00 – 15 : 00
腾讯会议：947-476-910
博弈驱动的动态系统的进化和控制

主持人：穆义芬　　中国科学院
主持人：张建磊　　南开大学

➢ SaA05 - 1　　13 : 00 - 13 : 15
[346]Stability and bifurcation analysis for a nitrogen-fixing evolutionary game with environmental feedback and discrete delays
程海辉　　山东科技大学

➢ SaA05 - 2　　13 : 15 - 13 : 30
[855]Pricing and Return Mode Decision of Dual-Channel Supply Chain Considering Second-hand Market
程晋石　　安徽工程大学

➢ SaA05 - 3　　13 : 30 - 13 : 45
[33]The optimal strategy against Fictitious Play in infinitely repeated games

董洪成 中国科学院
穆义芬 中国科学院

➢ SaA05 - 4 13 : 45 - 14 : 00

[544]具有流结构的合作博弈及其应用

葛静沂 上海理工大学
张 广 上海理工大学

➢ SaA05 - 5 14 : 00 - 14 : 15

[49]The Optimal Play against Hedge Algorithm in Finitely Repeated Two - Player Zero - Sum Games

郭鑫祥 中国科学院
穆义芬 中国科学院

➢ SaA05 - 6 14 : 15 - 14 : 30

[616]Inferences about input - output - to - state stability across related systems

李 睿 北京大学

➢ SaA05 - 7 14 : 30 - 14 : 45

[336]Exploring the inducement for social dilemma and cooperation promotion mechanisms in structured populations

刘思媛 南开大学
张建磊 南开大学

➢ SaA05 - 8 14 : 45 - 15 : 00

[756]Migration based on environment comparison promotes cooperation in evolutionary games

张黎明 北京邮电大学
李海红 北京邮电大学
代琼琳 北京邮电大学
杨俊忠 北京邮电大学

SaA06 13 : 00 – 15 : 00
腾讯会议：211-318-977
网络群体智能分布式优化进展与展望

主持人：孙 宁 南开大学
主持人：芦安洋 东北大学

➢ SaA06 - 1 13 : 00 - 13 : 15

[758]基于遗传算法与蒙特卡洛模拟的边坡稳定性分析方法及应用

何 理 武汉科技大学
赵永明 武汉科技大学

➢ SaA06 - 2 13 : 15 - 13 : 30

[721]Ultra-long time identification and prediction of global temperature system

刘潇奕 东南大学
陈都鑫 东南大学

➢ SaA06 - 3 13 : 30 - 13 : 45

[723]DoS 及稀疏攻击下分布式系统的安全问题

芦安洋 东北大学

➢ SaA06 - 4 13 : 45 - 14 : 00

[732]On Exponential Consensus of Linear Systems over Switching Networks

马麒超 中国科学技术大学

➢ SaA06 - 5 14 : 00 - 14 : 15

[707]Distributed Online Optimization against Adversarial Attacks

韦梦立 东南大学
侯华舟 东南大学

➢ SaA06 - 6 14 : 15 - 14 : 30

[653]Neural Network-Based Adaptive Control for Underactuated Systems Subject to Transient Performance Constraints

杨桐 南开大学
孙宁 南开大学

➢ SaA06 - 7 14 : 30 - 14 : 45

[686]Learning decentralized linear quadratic regulator with partially nested information structure

叶林涛 华中科技大学
池明 华中科技大学
刘智伟 华中科技大学

➢ SaA06 - 8 14 : 45 - 15 : 00

[736]煤矿救援多机器人自主探索方法

张延庆 中国矿业大学
杨春雨 中国矿业大学

SaA07 13 : 00 – 15 : 00
腾讯会议：562-245-152
网络群体智能分布式协同控制与优化新进展

主持人：付俊杰 东南大学
主持人：张东培 重庆交通大学

➢ SaA07 - 1 13 : 00 - 13 : 15

[590]Distributed MPC based robust collision avoidance formation tracking of constrained multi-robot systems

付俊杰 东南大学
温广辉 东南大学

➢ SaA07 - 2 13 : 15 - 13 : 30

[764]Spatio-Temporal Causality Graph Convolutional Transformer: A Deep Learning Approach for Renewable Power Forecasting

贺岩岩 东南大学
陈都鑫 东南大学
朱 然 东南大学

虞文武 东南大学

➢ SaA07 - 3 13 : 30 - 13 : 45

611Distributed event-triggered generalized Nash Equilibrium seeking in multi-coalition noncooperative games with coupling constraints

李亚梅 南京信息工程大学
朱亚楠 南京信息工程大学
李涛 南京信息工程大学
郑柏超 南京信息工程大学

➢ SaA07 - 4 13 : 45 - 14 : 00

724Funnel AsymptoticTracking of High-Order Nonlinear Multi-Agent Systems with Unmatched Uncertainties

闵 笑 东南大学
Simone Baldi 东南大学
虞文武 东南大学
王 和 东南大学

➢ SaA07 - 5 14 : 00 - 14 : 15

725 Longitudinal and Lateral Control of Heterogeneous Vehicular Platoon with Consideration of Collision Avoidance

邱 蒙 东南大学
Simone Baldi 东南大学
虞文武 东南大学
王 和 东南大学

➢ SaA07 - 6 14 : 15 - 14 : 30

759Output Containment of Heterogeneous Multi-Agent Systems under External Disturbances

王 庆 北京航空航天大学

➢ SaA07 - 7 14 : 30 - 14 : 45

498Dynamic transitions for the S-K-T competition system

张东培 重庆交通大学

➢ SaA07 - 8 14 : 45 - 15 : 00

571 基于区块链隐私保护的智能电网实时定价

张同辉 上海理工大学
李军祥 上海理工大学

SaA08 13 : 00 – 15 : 00
腾讯会议：129-704-258
系统思维及其应用

主持人：张兴永 昆明理工大学
主持人：孟 飞 上海理工大学

➢ SaA08 - 1 13 : 00 - 13 : 15

646Method of solving linear system $AXB = E$ based on semi-tensor product of matrices

樊学玲 聊城大学
李 莹 聊城大学
刘志红 聊城大学
赵建立 聊城大学

➢ SaA08 - 2 13 : 15 - 13 : 30

640目标检测模型鲁棒性评估：基于空间敏感度的梯度攻击方法

付 凯 江苏科技大学
王明正 江苏科技大学
邵长斌 江苏科技大学
高 尚 江苏科技大学

➢ SaA08 - 3 13 : 30 - 13 : 45

131Finite-time Event-triggered Adaptive network Tracking Control of output-constrained for Stochastic Nonlinear Systems

刘 佳 青岛大学
于金鹏 青岛大学
刘加朋 青岛大学

➢ SaA08 - 4 13 : 45 - 14 : 00

734Existence of solutions for a calss of poly-Laplacian coupled system on finite graphs

齐婉婷 昆明理工大学
张兴永 昆明理工大学
刘翠玲 昆明理工大学
谢俊平 昆明理工大学

➢ SaA08 - 5 14 : 00 - 14 : 15

337 舰船非接触水下爆炸系统的混合不确定度量化

杨伊伊 山东科技大学

➢ SaA08 - 6 14 : 15 - 14 : 30

733Existence of nontrivial solutions for a class of poly-Laplacian system with mixed nonlinearity on graphs

余小丽 昆明理工大学
张兴永 昆明理工大学
谢俊平 昆明理工大学
张雪琛 昆明理工大学

➢ SaA08 - 7 14 : 30 - 14 : 45

93 何谓系统思维

袁宏建 黄冈供电公司

➢ SaA08 - 8 14 : 45 - 15 : 00

513 武汉疫情的“蝴蝶效应”是如何形成的① ——兼谈普及系统学知识的必要性、紧迫性

袁宏建 黄冈供电公司

SaA09　　13 : 00 – 15 : 00
腾讯会议：220-675-723
系统工程理论与方法

主持人：莫立坡　　北京工商大学
主持人：王瑜　　北京工商大学
➢ SaA09 -1　　13 : 00 - 13 : 15
[522]Robust Pose Graph Optimization against Outliers using Consistency Credibility Factor
蔡　洁　　上海理工大学
魏国亮　　上海理工大学
➢ SaA09 - 2　　13 : 15 - 13 : 30
[605] 基于光纤 FBG 光栅的超声传感器性能研究
陈代勇　　广西师范大学
张　萍　　广西师范大学
王力虎　　广西师范大学
梁维刚　　广西师范大学
➢ SaA09 – 3　　13 : 30 - 13 : 45
[81]Distributed Heterogeneous Mult-Agent Optimization with or without Nonconvex Constraints
莫立坡　　北京工商大学
胡豪昆　　北京工商大学
➢ SaA09 - 4　　13 : 45 - 14 : 00
[285]Design and Analysis of Elevator Guide Rail Detection System
牛超群　　青岛大学
赵东杰　　青岛大学
阿里纳玛提　　青岛大学
徐　茂　　青岛大学
朱　林　　青岛大学
Shuzhi Ge　　新加坡国立大学
➢ SaA09 - 5　　14 : 00 - 14 : 15
[74]Temporal Stability of the Impact of Roadside Barriers on Injury-Severity of Mountainous Crashes: A Random Parameters Logit Approach with Heterogeneity in Means and Variances
宋栋栋　　北京交通大学
➢ SaA09 - 6　　14 : 15 – 14 : 30
[502] 基于超声回波重组相位分析的颗粒粒径测量方法
谭　红　　广西师范大学
王力虎　　广西师范大学
梁维刚　　广西师范大学
➢ SaA09 - 7　　14 : 30 - 14 : 45
[94]A Data Augmentation Method for Fully Automatic Brain Tumor Segmentation
王　瑜　　北京工商大学
计亚荣　　北京工商大学
肖洪兵　　北京工商大学
➢ SaA09 - 8　　14 : 45 - 15 : 00
[225] 考虑折返线的地铁系统提高运行可靠性研究
张朝阳　　北京交通大学
高　亮　　北京交通大学

SaA10　　13 : 00 – 15 : 00
腾讯会议：371-538-685
复杂网络

主持人：韩忠明　　北京工商大学
主持人：霍良安　　上海理工大学
➢ SaA10 - 1　　13 : 00 - 13 : 15
[92] 基于网络嵌入方法的耦合网络节点表示学习
韩忠明　　北京工商大学
➢ SaA10 - 2　　13 : 15 - 13 : 30
[313] 基于时态网络社会标记物的社会突发事件预警
李辉春　　国防科技大学
➢ SaA10 - 3　　13 : 30 - 13 : 45
[438]A note on quantitative characterizations of symmetry in complex networks
马纪成　　重庆文理学院
➢ SaA10 - 4　　13 : 45 - 14 : 00
[31]Asymmetrical Synchronization of Extreme Rainfall Events in Southwest China
乔盼节　　昆明理工大学
龚志强　　中国气象局
刘文奇　　昆明理工大学
张永文　　昆明理工大学
➢ SaA10 - 5　　14 : 00 - 14 : 15
[95]Optimal Deployment of Heterogeneous Nodes to Enhance Network Invulnerability
孙　茜　　北京工商大学
羊峰波　　北京工商大学
王小艺　　北京工商大学
王　立　　北京工商大学
➢ SaA10 - 6　　14 : 15 - 14 : 30
[96]Network Invulnerability Enhancement Algorithm Based on WSN Closeness Centrality
孙　茜　　北京工商大学
羊峰波　　北京工商大学
王小艺　　北京工商大学
王　立　　北京工商大学
➢ SaA10 - 7　　14 : 30 - 14 : 45

[185]Quantification of network structural dissimilarities based on graph embedding

王志鹏 杭州师范大学
詹秀秀 杭州师范大学
刘闯 杭州师范大学
张子柯 浙江大学

➢ SaA10 - 8 14 : 45 - 15 : 00

[193] Degree-based algorithms for influence maximization problem in hypergraphs

谢 明 杭州师范大学
詹秀秀 杭州师范大学
刘 闯 杭州师范大学
张子柯 浙江大学

SaA11 13 : 00 – 15 : 00
腾讯会议：395-150-231
复杂网络与群体智能

主持人：樊 瑛 北京师范大学
主持人：暴 琳 江苏科技大学

➢ SaA11 - 1 13 : 00 - 13 : 15

[694] 用户行为驱动的偏好代理模型辅助的交互式个性化进化搜索算法

暴 琳 江苏科技大学
吴 杨 江苏科技大学
齐 亮 江苏科技大学
宋英磊 江苏科技大学
叶树霞 江苏科技大学
张永韡 江苏科技大学
孙雪莹 江苏科技大学
李长江 江苏科技大学
桂 红 江苏科技大学
吴战胜 江苏科技大学

➢ SaA11 - 2 13 : 15 - 13 : 30

[457] 基于动态演化的复杂作战体系抗毁性研究

陈文秀 中山大学

➢ SaA11 - 3 13: 30 - 13 : 45

[516] 基于模体的多层网络社团划分

刘亚芳 北京师范大学
樊 瑛 北京师范大学

➢ SaA11 - 4 13 : 45 - 14 : 00

[771] 树种算法改进及其实际约束优化问题求解

钱立泽 吉林财经大学
姜建华 吉林财经大学

➢ SaA11 - 5 14 : 00 - 14 : 15

[760]Social relationship adjustments within the same sex promote marital bliss

单 旭 北京邮电大学

➢ SaA11 - 6 14 : 15 - 14 : 30

[824]Social relationship adjustments within the same sex promote marital bliss (同性社会关系的调整促进了婚姻的幸福)

单 旭 北京邮电大学
武 斌 北京邮电大学

➢ SaA11 - 7 14 : 30 - 14 : 45

[665]Synchronization of Complex Dynamical Networks Subject to DoS Attacks: An Improved Coding-Decoding Protocol

邢梦平 安徽工业大学
卢剑权 东南大学
邱建龙 临沂大学
沈 浩 安徽工业大学

➢ SaA11 - 8 14 : 45 - 15 : 00

[389] 复杂网络中的系综不等价

张 齐 江苏科技大学

SaB01 15 : 15 – 17 : 30
腾讯会议：638-488-140
复杂系统动力学

主持人：曾春华 昆明理工大学
主持人：杨 金 重庆交通大学

➢ SaB01 - 1 15 : 15 - 15 : 30

[390]Threshold dynamics of a stochastic model of intermittent androgen deprivation therapy for prostate cancer

陈 林 重庆交通大学
杨 金 重庆交通大学

➢ SaB01 - 2 15 : 30 - 15 : 45

[207]Seasonal prediction of ozone pollution in China using the SST memory effect

陈 源 昆明理工大学

➢ SaB01 - 3 15 : 45 - 16 : 00

[845] 网络结构对传播动力学爆发式相变的影响

王胜烽 北京邮电大学

➢ SaB01 - 4 16 : 00 - 16 : 15

[15]Irregular spots on body surfaces of vertebrates induced by supercritical pitchfork bifurcations

王 欣 安庆师范大学
高 见 安庆师范大学

➢ SaB01 - 5 16 : 15 - 16 : 30

[341]Darboux transformation, soliton solutions of the

variable coefficient nonlocal modified Korteweg-de Vries equation

辛祥鹏 聊城大学

➢ SaB01 - 6 16 : 30 - 16 : 45

[168]Modelling effects of a chemotherapeutic dose response on a stochastic model for prostate cancer with androgen deprivation therapy

杨 金 重庆交通大学

➢ SaB01 - 7 16 : 45- 17 : 00

[7]Long-term memory of air pollution and its spatial patterns in China

于 平 昆明理工大学

➢ SaB01 - 8 17 : 00 - 17 : 15

[437]Effect of individual and enterprise behaviors on the interplay between product-attributes information propagation and word-of-mouth communication in multiplex networks

袁 伟 上海理工大学

霍良安 上海理工大学

➢ SaB01 - 9 17 : 15 - 17 : 30

[29]Spatial early warning signals of critical transitions in complex systems

曾春华 昆明理工大学

SaB02 15 : 15 – 17 : 15

腾讯会议：431-379-675

复杂系统动力学

主持人：卢剑权 东南大学

主持人：张琴 重庆交通大学

➢ SaB02 - 1 15 : 15 - 15 : 30

[619] 基于储备池算法的耦合映象格子时空混沌系统的学习与预测

高 健 北京邮电大学

兰岳恒 北京邮电大学

Jinghua Xiao 北京邮电大学

➢ SaB02 - 2 15 : 30 - 15 : 45

[755] 基于因果关系发现的突发事件网络舆情传播建模方法研究

Jun Zhang 山东理工大学

➢ SaB02 - 3 15 : 45 - 16 : 00

[519]Multistability analysis of state-dependent switched Hopfield neural networks with the Gaussian-wavelet-type activation function

刘 洋 山东科技大学

王 震 山东科技大学

➢ SaB02 - 4 16 : 00 - 16 : 15

[392]Zero inertial limit of incompressible Qian–Sheng model

马扬军 重庆交通大学

➢ SaB02 - 5 16 : 15 - 16 : 30

[637]Finite-time synchronization of quaternion-valued neural networks with delays: A switching control method without decomposition

彭 涛 东南大学

卢剑权 东南大学

➢ SaB02 - 6 16 : 30 - 16 : 45

[620] 混沌扭摆实验的自动建模

谢桂今 北京邮电大学

高 健 北京邮电大学

兰岳恒 北京邮电大学

Jinghua Xiao 北京邮电大学

➢ SaB02 - 7 16 : 45 - 17 : 00

[411]Existence and uniqueness of axially symmetric compressible subsonic jet impinging on an infinite wall

张 琴 重庆交通大学

➢ SaB02 - 8 17 : 00 - 17 : 15

[430] 两类自由半群作用的系统的原像分枝熵

张文达 重庆交通大学

SaB03 15 : 15 – 17 : 15

腾讯会议：111-707-071

稳定性与鲁棒性理论

主持人：林 崇 青岛大学

主持人：杨绪君 重庆交通大学

➢ SaB03 - 1 15 : 15 - 15 : 30

[239] 矩形时滞广义系统的稳定性与状态导数反馈镇定

耿文韬 青岛大学

林 崇 青岛大学

陈 兵 青岛大学

➢ SaB03 - 2 15 : 30 - 15 : 45

[361]Output-Feedback Control for Multiple Uncertain Euler-Lagrange Systems Based on Extended State Observer

郭鑫晨 上海理工大学

魏国亮 上海理工大学

➢ SaB03 - 3 15 : 45 - 16 : 00

[787] 针对高机动目标的攻击角度约束有限时间收敛制导律

李俊贤 北京信息科技大学

范军芳 北京信息科技大学

陈仕伟 北京信息科技大学
豆登辉 北京信息科技大学

➢ SaB03 - 4 16 : 00 - 16 : 15

[115]Optimized Control Strategy Based on EPCH and DBMP Algorithms for a Class MIMO Nonlinear System

孟祥祥 青岛大学
于海生 青岛大学
张 洁 青岛大学
颜克甲 青岛大学
杨 庆 青岛大学

➢ SaB03 - 5 16 : 15 - 16 : 30

[71]Exponential stabilization of chaotic systems based on fuzzy time-triggered intermittent control

彭 硕 青岛大学
王庆芝 青岛大学
傅保增 青岛大学

➢ SaB03 - 6 16 : 30 - 16 : 45

[407]On radius of robust feasibility for convex conic programs with data uncertainty

王 梅 重庆交通大学

➢ SaB03 - 7 16 : 45 - 17 : 00

[408]Stability of nabla discrete distributed-order dynamical systems

杨绪君 重庆交通大学

➢ SaB03 - 8 17 : 00 - 17 : 15

[75] 具有输出延迟和欺诈攻击的 CPS 基于观测器的镇定

张 满 青岛大学
耿文韬 青岛大学
林 崇 青岛大学
陈 兵 青岛大学

SaB04 15 : 15 – 17 : 15
腾讯会议：513-690-513
稳定性与鲁棒性理论

主持人：宋乾坤 重庆交通大学
主持人：薛小维 重庆文理学院

➢ SaB04 - 1 15 : 15 - 15 : 30

[418]Global asymptotic stability of fractional-order complex-valued neural networks with probabilistic time-varying delays

陈思邯 重庆交通大学
宋乾坤 重庆交通大学
赵振江 湖州师范学院
刘玉荣 扬州大学

➢ SaB04 - 2 15 : 30 - 15 : 45

[420]Global Mittag-Leffler stability for fractional-order quaternion-valued neural networks with piecewise constant arguments and impulses

陈彦希 重庆交通大学
宋乾坤 重庆交通大学
赵振江 湖州师范学院
刘玉荣 扬州大学

➢ SaB04 - 3 15 : 45 - 16 : 00

[419]Robust stability for a class of fractional-order complex-valued projective neural networks with neutral-type delays and uncertain parameters

黄为琴 重庆交通大学
宋乾坤 重庆交通大学
赵振江 湖州师范学院
刘玉荣 扬州大学

➢ SaB04 - 4 16 : 00 - 16 : 15

[854]Stabilisation of highly nonlinear neutral stochastic systems by delay feedback control

沈明轩 安徽工程大学
费 晨 上海理工大学

➢ SaB04 - 5 16 : 15 - 16 : 30

[417]Stabilization of T-S fuzzy fractional rectangular descriptor time-delay system

吴 倩 重庆交通大学
宋乾坤 重庆交通大学
赵振江 湖州师范学院
刘玉荣 扬州大学

➢ SaB04 - 6 16 : 30 - 16 : 45

[485]Coderivatives and Aubin properties of solution mappings for parametric vector variational inequality problems

薛小维 重庆文理学院

➢ SaB04 - 7 16 : 45 - 17 : 00

[531] 基于站点线路数的城市公交网络鲁棒性研究

谢怡燃 昆明理工大学
李国华 昆明理工大学
杨 波 昆明理工大学

➢ SaB04 - 8 17 : 00 - 17 : 15

[442]Optimality conditions for robust weakly efficient solutions in uncertain optimization

翟玉雯 重庆交通大学

SaB05　　15 : 15 – 17 : 15
腾讯会议：718-578-046
系统演化及其稳定性分析

主持人：董高高　　江苏大学
主持人：房庆祥　　中国计量大学
➢ SaB05 - 1　　15 : 15 - 15 : 30
598Wielding Intermittency with Cycle Expansions
曹环宇　　北京邮电大学
兰岳恒　　北京邮电大学
➢ SaB05 - 2　　15 : 30 - 15 : 45
643 宏观与中微观尺度下的复杂网络鲁棒性分析
董高高　　江苏大学
➢ SaB05 - 3　　15 : 45 - 16 : 00
777Attractivity and stability of solutions of hereditary integral equations
房庆祥　　中国计量大学
➢ SaB05 - 4　　16 : 00 - 16 : 15
439 考虑媒体覆盖的随机谣言传播模型研究
霍良安　　上海理工大学
董雅芳　　上海理工大学
➢ SaB05 - 5　　16 : 15 - 16 : 30
869G-布朗运动驱动的随机神经网络指数稳定性
梁　勇　　安徽工程大学
费为银　　安徽工程大学
➢ SaB05 - 6　　16 : 30 - 16 : 45
860Exponential stability of infinite delay stochastic systems with Markovian switching
梅春晖　　安徽工程大学
沈明轩　　安徽工程大学
费为银　　安徽工程大学
➢ SaB05 - 7　　16 : 45 - 17 : 00
647 网络形式背景的概念稳定性分析
闫梦宇　　昆明理工大学
李金海　　昆明理工大学
➢ SaB05 - 8　　17 : 00 - 17 : 15
633 数据丢包下非线性系统的事件触发脉冲控制
朱海涛　　东南大学
卢剑权　　东南大学

SaB06　　15 : 15 – 17 : 15
腾讯会议：149-554-469
系统建模

主持人：刘翠玲　　北京工商大学
主持人：潘　峰　　贵州民族大学
➢ SaB06 - 1　　15 : 15 - 15 : 30
750Handoff calls' joining behavior and incentive mechanism in wireless cellular networks with retrial orbit
曹　建　　北京邮电大学
➢ SaB06 - 2　　15 : 30 - 15 : 45
259 基于离散化建模的对交通便利性的评估方法
郭子乐　　北京交通大学
王行健　　北京交通大学
➢ SaB06 - 3　　15 : 45 - 16 : 00
83Multi-view Multi-objective Optimization for Location of Electric Vehicle Charging Stations
郝媛媛　　北京交通大学
四兵锋　　北京交通大学
赵春亮　　中山大学
➢ SaB06 - 4　　16 : 00 - 16 : 15
212 基于 TrAdaBoost 算法的近红外光谱模型传递研究
刘翠玲　　北京工商大学
徐金阳　　北京工商大学
孙晓荣　　北京工商大学
张善哲　　北京工商大学
訾佳睿　　北京工商大学
➢ SaB06 - 5　　16 : 15 - 16 : 30
757 系统科学视域认知演化计算及其 OOP 建模方法
潘　峰　　贵州民族大学
谢雨寒　　贵州民族大学
苏浩翀　　贵州民族大学
➢ SaB06 - 6　　16 : 30 - 16 : 45
338 基于遥感图像 3D-CNN 的蓝藻水华预测方法
王　立　　北京工商大学
李文浩　　北京工商大学
吴羽溪　　北京工商大学
王小艺　　北京工商大学
刘载文　　北京工商大学
➢ SaB06 - 7　　16 : 45 - 17 : 00
226 高效城市路网实时可达性算法研究——以北京为例
王行健　　北京交通大学
高　亮　　北京交通大学
➢ SaB06 - 8　　17 : 00 - 17 : 15
817Lasso 回归对人均 GDP 影响因素分析——以重庆市为例
张恩丹　　重庆交通大学

SaB07　　15 : 15 – 17 : 30
腾讯会议：639-713-958
信息系统与信号处理

主持人：缪　旻　　北京信息科技大学
主持人：龙　飞　　贵州民族大学

➢ SaB07 - 1　　15 : 15 - 15 : 30
232 深度学习相位解缠
韩焱森　　国防科技大学

➢ SaB07 - 2　　15 : 30 - 15 : 45
673 基于二维超材料结构实现电磁波高效非对称传输的研究
龙　飞　　贵州民族大学

➢ SaB07 - 3　　15 : 45 - 16 : 00
800 三维集成微纳系统集成用 TSV 关键技术研究新进展
缪　旻　　北京信息科技大学
李振松　　北京信息科技大学
孙　亮　　北京信息科技大学

➢ SaB07 - 4　　16 : 00 - 16 : 15
719 基于表面肌电信号的假肢手控制技术的研究
潘福东　　广西师范大学
郁凡　　广西师范大学
赵书华　　广西师范大学

➢ SaB07 - 5　　16 : 15 - 16 : 30
779Chip-scale optical communication and signal processing
秦军　　北京信息科技大学

➢ SaB07 - 6　　16 : 30 - 16 : 45
642 基于变阶分数阶各向异性扩散的图像去噪方法
舒小虎　　国防科技大学
韩佳玲　　国防科技大学
王泽龙　　国防科技大学

➢ SaB07 - 7　　16 : 45 - 17 : 00
798 短距离 53GBaud_s PAM4 光信号信号并行均衡算法研究
孙剑　　北京信息科技大学

➢ SaB07 - 8　　17 : 00 - 17 : 15
488Total variation with modified group sparsity for CT reconstruction under low SNR
张伶俐　　重庆文理学院

➢ SaB07 - 9　　17 : 15 - 17 : 30
658 Advances in Particle Filtering
张庆铭　　贵州民族大学

SaB08　　15 : 15 – 17 : 15
腾讯会议：945-693-627
滤波、估计与预测

主持人：高尚　　江苏科技大学
主持人：李兵　　重庆交通大学

➢ SaB08 - 1　　15 : 15 - 15 : 30
528 基于支持向量机分类的个人信用评价
高尚　　江苏科技大学

➢ SaB08 - 2　　15 : 30 - 15 : 45
56PFVAE: A Planar Flow-Based Variational Auto-Encoder
金学波　　北京工商大学
宫文涛　　北京工商大学
孔建磊　　北京工商大学
白玉廷　　北京工商大学
苏婷立　　北京工商大学

➢ SaB08 - 3　　15 : 45 - 16 : 00
254 基于高光谱技术的乌龙茶儿茶素及其酯类衍生物含量的快速判别
刘翠玲　　北京工商大学
秦冬　　人工智能学院
凌彩金　　广东省农业科学院茶叶研究所
孙晓荣　　北京工商大学
邵礼阳　　广东省农业科学院茶叶研究所
周巧仪　　广东省农业科学院茶叶研究所
吴静珠　　北京工商大学
昝佳睿　　北京工商大学

➢ SaB08 - 4　　16 : 00 - 16 : 15
434The Optimal Distributed Kalman Filtering Fusion with Linear Equality Constraint
李华　　重庆交通大学

➢ SaB08 - 5　　16 : 15 - 16 : 30
148 基于自适应随机共振的信号估计方法
潘燕　　山东科技大学

➢ SaB08 - 6　　16 : 30 - 16 : 45
400Event-Triggered State Estimation for Fractional-Order Neural Networks
许冰睿　　重庆交通大学
李兵　　重庆交通大学

➢ SaB08 - 7　　16 : 45 - 17 : 00
320 Short-term Social Conflict Prediction for pedestrian
于继宇　　青岛大学
赵东杰　　青岛大学
冉鹏飞　　青岛大学

徐茂 青岛大学
牛超群 青岛大学
Shuzhi Ge 新加坡国立大学

➢ SaB08 - 8 17 : 00 - 17 : 15

[399] H_∞ state estimation for Round-Robin protocol-based Markovian jumping neural networks with mixed time delays

邹聪 重庆交通大学

SaB09 15 : 15 – 17 : 15
腾讯会议：882-155-755
模式识别

主持人：段法兵 青岛大学
主持人：孙晓荣 北京工商大学

➢ SaB09 - 1 15 : 15 - 15 : 30

[67] 基于阈值网络的自适应随机共振极限学习机

陈泽嘉 青岛大学
段法兵 青岛大学
白赛娅 青岛大学
李伟进 青岛大学

➢ SaB09 - 2 15 : 30 - 15 : 45

[101] 基于便携式近红外光谱仪的花生冻伤品质无损检测研究

高翔 北京工商大学
吴静珠 北京工商大学

➢ SaB09 - 3 15 : 45 - 16 : 00

[68] 基于随机共振的阈值网络超参数在线学习

李伟进 青岛大学
段法兵 青岛大学
白赛娅 青岛大学
陈泽嘉 青岛大学

➢ SaB09 - 4 16 : 00 - 16 : 15

[111] Study on cottonseed plumpness based on terahertz time-domain transmission imaging technology

李 阳 北京工商大学
吴静珠 北京工商大学

➢ SaB09 - 5 16 : 15 - 16 : 30

[35] 一种多视角的通过异质图嵌入的科研论文分类方法

吕怡琴 国防科技大学
谢 正 国防科技大学

➢ SaB09 - 6 16 : 30 - 16 : 45

[57] Transformer and CNN Fusion Classification Method for Building Structural Health Monitoring

苏婷立 北京工商大学
李 健 北京工商大学
金学波 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学

➢ SaB09 - 7 16 : 45 - 17 : 00

[98] 拉曼光谱技术快速检测专用煎炸油极性组分

孙晓荣 北京工商大学
田 密 北京工商大学
刘翠玲 北京工商大学
吴静珠 北京工商大学

➢ SaB09 - 8 17 : 00 - 17 : 15

[52] SAR image despeckling based on variance constrained convolutional neural network

郑 彤 北京工商大学
陈嘉仑 北京工商大学
李 聪 北京工商大学

SaB10 15 : 15 – 17 : 15
腾讯会议：159-721-751
模式识别

主持人：李 阳 北京工商大学
主持人：邢素霞 北京工商大学

➢ SaB10 - 1 15 : 15 - 15 : 30

[125] 基于 Tikhonov 正则化和随机共振的阈值网络泛化性能研究

白赛娅 青岛大学
段法兵 青岛大学
李伟进 青岛大学
陈泽嘉 青岛大学

➢ SaB10 - 2 15 : 30 - 15 : 45

[118] 基于卷积神经网络和高光谱成像的花生冻伤无损鉴别

崔程 北京工商大学
吴静珠 北京工商大学

➢ SaB10 - 3 15 : 45 - 16 : 00

[251] Fine-grained pests & diseases recognition via Spatial Fea-ture-enhanced attention architecture with high-order pooling representation for Precision Agriculture Practice

孔建磊 北京工商大学
王宏兴 北京工商大学
杨成才 北京工商大学
Xuebo Jin 北京工商大学
苏婷立 北京工商大学
白玉廷 北京工商大学

➢ SaB10 - 4 16 : 00 - 16 : 15

[250]Deep-stacking network approach by multisource data mining for hazardous risk identification in IoT-based intelligent food management systems

孔建磊 北京工商大学
杨成才 北京工商大学
Xuebo Jin 北京工商大学
苏婷立 北京工商大学
白玉廷 北京工商大学

➢ SaB10 - 5 16 : 15 - 16 : 30

[112] Study on rapid nondestructive identification of rice varieties based on THz-ATR Technology

李 阳 北京工商大学
吴静珠 北京工商大学

➢ SaB10 - 6 16 : 30 - 16 : 45

[138] 基于太赫兹时域光谱的花生冻伤无损鉴别

吕钟鸣 北京工商大学
吴静珠 北京工商大学
吴静珠 北京工商大学

➢ SaB10 - 7 16 : 45 - 17 : 00

[175]ViT 预训练模型的胸腔 X 线影像多标签分类

邢素霞 北京工商大学
鞠子涵 北京工商大学
刘子骄 北京工商大学
王 瑜 北京工商大学
范福强 北京工商大学

➢ SaB10 - 8 17 : 00 - 17 : 15

[182] 基于高光谱技术的花生种子内部霉变检测方法研究

张 倩 北京工商大学

SaB11 15 : 15 – 17 : 15
腾讯会议：680-545-508
模式识别与经济系统分析

主持人：徐一鸣 南通大学
主持人：张云丰 安徽工程大学

➢ SaB11 - 1 15 : 15 - 15 : 30

[825]Temperature Prediction of Battery Energy Storage Plant Based on EGA - BiLSTM

蒋 凌 南通大学
顾菊平 苏州科技大学
张新松 南通大学

➢ SaB11 - 2 15 : 30 - 15 : 45

[780] 基于先验张量近似的高光谱异常目标检测

李 禄 北京信息科技大学

➢ SaB11 - 3 15 : 45 - 16 : 00

[318] 基于随机动态优化自编码器的数据降维

任昱昊 青岛大学
许丽艳 青岛大学
段法兵 青岛大学

➢ SaB11 - 4 16 : 00 - 16 : 15

[524] 数字时代下平台经济的反垄断规制研究

魏继媛 四川省社会科学院

➢ SaB11 - 5 16 : 15 - 16 : 30

[664] 能见度对地下建筑个体及小群体疏散速度影响的研究

王 一 上海理工大学
房志明 上海理工大学

➢ SaB11 - 6 16 : 30 - 16 : 45

[832]Research on Driver Status Recognition System of Intelligent Vehicle Terminal Based on Deep Learning

徐一鸣 南通大学
彭 玮 南通大学
王 栗 南通大学

➢ SaB11 - 7 16 : 45 - 17 : 00

[529] Research on Eddy Current Image Denoising of Titanium Plate based on Sparse Representation K-SVD

张艺丹 昆明理工大学

➢ SaB11 - 8 17 : 00 - 17 : 15

[858] 考虑政府双重补贴与消费者双重偏好的双渠道供应链决策研究

张云丰 安徽工程大学

SaB12 15 : 15 – 17 : 15
腾讯会议：233-866-778
数据挖掘与大数据

主持人：陈谊 北京工商大学
主持人：金学波 北京工商大学

➢ SaB12 - 1 15 : 15 - 15 : 30

[102]A survey on visualization approaches for exploring association relationships in graph data

陈 谊 北京工商大学
张清慧 北京工商大学

➢ SaB12 - 2 15 : 30 - 15 : 45

[324]Fuzzy information decomposition incorporated and weighted Relief-F feature selection: When imbalanced data meets incompletion

窦 军 上海理工大学
宋 燕 上海理工大学
魏国亮 上海理工大学

张亚萌 上海理工大学

- SaB12 - 3 15 : 45 - 16 : 00

[55]A Variational Bayesian Deep Network with Data Self-Screening Layer for Massive Time-Series Data Forecasting

金学波 北京工商大学
宫文涛 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学
苏婷立 北京工商大学

- SaB12 - 4 16 : 00 - 16 : 15

[104] 聚类算法在电动出租车充电站选址中的应用

李 雪 山东科技大学
李 勍 山东科技大学
孙秋霞 山东科技大学

- SaB12 - 5 16 : 15 - 16 : 30

[64]Broad Echo State Network with Reservoir Pruning for Nonstationary Time Series Prediction

刘文杰 北京工商大学
白玉廷 北京工商大学
金学波 北京工商大学
王小艺 北京工商大学
苏婷立 北京工商大学
孔建磊 北京工商大学

- SaB12 - 6 16 : 30 - 16 : 45

[255] 基于全球视角的“一带一路”沿线国家人口迁移特征及演化趋势

马佳骏 北京师范大学
李小萌 北京师范大学
陈清华 北京师范大学

- SaB12 - 7 16 : 45 - 17 : 00

[58]Self-supervised Learning for Human Activity Recognition using Sensor Data

苏婷立 北京工商大学
李 健 北京工商大学
金学波 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学

- SaB12 - 8 17 : 00 - 17 : 15

[848] 基于手机定位大数据和遥感数据的居民区人口在室率计算

张小咏 北京信息科技大学

2022 年 11 月 13 日（周日）

SuA01　　13 : 00 – 15 : 00
腾讯会议：660-135-676
数据挖掘与大数据

主持人：邬吉波　　重庆交通大学
主持人：孙秋霞　　山东科技大学

➢ SuA01 - 1　　13 : 00 - 13 : 15

235 基于高阶网络模型的时态社交网络事件检测方法
李翔　　国防科技大学
张雪　　国防科技大学
黄彭奇子　　国防科技大学
赵城利　　国防科技大学
段晓君　　国防科技大学

➢ SuA01- 2　　13 :15 - 13: 30

329 基于机器学习方法的翼型气动性能分
林锦星　　中山大学

➢ SuA01 - 3　　13: 30- 13 : 45

261 基于 K-Means 聚类和路网时空关联性分析的交通速度短时预测
孙秋霞　　山东科技大学
贾秀燕　　山东科技大学
李勍　　山东科技大学

➢ SuA01 - 4　　13 : 45- 14 : 00

260 基于对比度和共识日的交通速度预测
孙秋霞　　山东科技大学
孙砚琦　　山东科技大学
李勍　　山东科技大学

➢ SuA01 - 5　　14 : 00 - 14 : 15

455The way to Invest: Trading Strategies Based on ARIMA and Investor Personality
汤骁宇　　江苏科技大学
朱　琎　　江苏科技大学
刘子涵　　江苏科技大学
徐思佳　　江苏科技大学

➢ SuA01- 6　　14 : 15 - 14 : 30

493A generalized difference-based mixed two-parameter estimator in partially linear model
邬吉波　　重庆交通大学

➢ SuA01 - 7　　14 : 30 - 14 : 45

256 基于投资者情绪和多重注意力机制的神经网络股票价格预测
张建鑫　　山东科技大学
王向荣　　山东科技大学

➢ SuA01 - 8　　14 : 45 - 15 : 00

334A weighted fuzzy candlestick model for stock market price prediction
张亚萌　　上海理工大学
宋　燕　　上海理工大学
魏国亮　　上海理工大学

SuA02　　13 : 00 – 15 : 00
腾讯会议：243-166-912
大数据与机器学习

主持人：于化龙　　江苏科技大学
主持人：王　琦　　江苏科技大学

➢ SuA02 - 1　　13 : 00 - 13 : 15

506 基于收入与消费维度的精准扶贫政策的效应评估
范　聪　　重庆交通大学

➢ SuA02 - 2　　13 : 15 - 13 : 30

535PLVI-CE：一种复合不确定性和多样性度量准则的多标记主动学习算法
顾　妍　　江苏科技大学
于化龙　　江苏科技大学
高　尚　　江苏科技大学

➢ SuA02 - 3　　13 :30- 13 : 45

601 基于单类三角全局对齐核极限学习机的无人机状态数据异常检测
胡飞沙　　江苏科技大学
王　琦　　江苏科技大学
于化龙　　江苏科技大学
高　尚　　江苏科技大学

➢ SuA02 - 4　　13 : 45 - 14 : 00

534PDE-SMOTE：一种基于概率密度估计的 SMOTE 过采样算法
还章军　　江苏科技大学
于化龙　　江苏科技大学
高　尚　　江苏科技大学

➢ SuA02 - 5　　14 : 00 - 14 :15

539 基于聚类技术的类别不平衡分段决策阈值策略研究

卢梦珂 江苏科技大学
于化龙 江苏科技大学
高 尚 江苏科技大学

➢ SuA02 - 6 14 :15 - 14 : 30

536 基于异构集成的类别不平衡学习算法研究

孟祥宇 江苏科技大学
高 尚 江苏科技大学
于化龙 江苏科技大学
葛云飞 江苏科技大学

➢ SuA02 - 7 14 : 30- 14 : 45

597 基于双因变量序列 Probit 模型的事故责任双方驾驶员受伤严重程度研究

宋栋栋 北京交通大学

➢ SuA02 - 8 14: 45 - 15 : 00

538CycleAE：一种基于特征空间插值的过采样生成方法

吴仕祺 江苏科技大学
邵长斌 江苏科技大学
于化龙 江苏科技大学

SuA03 13 : 00 – 15 : 00
腾讯会议：791-412-733
滤波、估计与预测的数据挖掘方法

主持人：何 理 武汉科技大学
主持人：刘 洋 山东科技大学

➢ SuA03 - 1 13 : 00 - 13 : 15

628 基于分层聚类的不平衡多标记学习方法研究

段继聪 江苏科技大学
于化龙 江苏科技大学
高 尚 江苏科技大学

➢ SuA03- 2 13 : 15 - 13 :30

630DME：一种基于分布相似度的自适应在线加权集成学习方法

冯宝全 江苏科技大学
于化龙 江苏科技大学
高尚 江苏科技大学

➢ SuA03 - 3 13: 30- 13 : 45

330 微差爆破振动能量分析及延期时间识别研究

何 理 武汉科技大学
刘易和 武汉科技大学
李琳娜 武汉科技大学

➢ SuA03 - 4 13 : 45 - 14 : 00

156 基于 Kruskal-Wallis 检验的多分类基因特征选择算法

刘 洋 山东科技大学
周长银 山东科技大学

➢ SuA03 - 5 14 : 00- 14 : 15

617 基于余弦-高斯核函数模型的随机渐进式概念认知

刘之茗 昆明理工大学
李金海 昆明理工大学

➢ SuA03 - 6 14 : 15 - 14 : 30

844Construction of implicit social network based on ISM-RMR algorithm and recommendation between users and items

余鑫怡 武汉科技大学
涂俐兰 武汉科技大学
柴 浪 武汉科技大学
陈 娟 武汉科技大学

➢ SuA03 - 7 14 : 30 – 14:45

831Double-Vector-Based Model-Free Predictive Current Control for Three-Level Inverter-Fed PMSM

周陈辉 南通大学
於 锋 南通大学
程勋慧 南通大学

➢ SuA03 - 8 14 : 45 - 15 : 00

629 基于间接样本先验分布信息提取的代价敏感学习方法研究

周杉林 江苏科技大学
于化龙 江苏科技大学
高 尚 江苏科技大学

SuA04 13 : 00 – 15 : 00
腾讯会议：854-566-428
系统模拟及仿真

主持人：曹俊英 贵州民族大学
主持人：杜绍洪 重庆交通大学

➢ SuA04 - 1 13 : 00 - 13 : 15

677 分数阶微分方程最优控制问题高阶数值格式的收敛性分析

曹俊英 贵州民族大学

➢ SuA04 - 2 13 : 15 - 13:30

172High order CDG-FE methods for the Green-Naghdi model with the enhanced dispersive property

程用平 重庆交通大学

➢ SuA04 - 3 13: 30 - 13 : 45

791考虑弹体动力学的时间协同和角度控制三维制导律研究

豆登辉 北京信息科技大学
范军芳 北京信息科技大学
陈仕伟 北京信息科技大学
李俊贤 北京信息科技大学

➢ SuA04 - 4 13 : 45 - 14 : 00

[213]Adaptive finite element method for partial differential equations

杜绍洪 重庆交通大学

➢ SuA04 - 5 14 : 00 - 14 : 15

[861]Theta-Milstein method for stochastic differential equations driven by G-Brownian motion

邓寿年 安徽工程大学
费为银 安徽工程大学
梅春晖 安徽工程大学

➢ SuA04 - 6 14 : 15 - 14 : 30

[582] 人际信任对集体智慧影响的计算实验研究

胡德强 大连理工大学
党延忠 大连理工大学
岳 鑫 大连理工大学

➢ SuA 04 - 7 14 : 30 - 14 : 45

[423] 四旋翼无人机的分数阶终端滑膜姿态控制器

严云龙 江苏科技大学

➢ SuA04 - 8 14 : 45 - 15 : 00

[593] 基于深度学习的新混沌信号及其在图像加密中的应用

周 双 重庆师范大学

SuA05 13 : 00 – 15 : 00
腾讯会议：550-241-710
博弈论及应用

主持人：宋乾坤 重庆交通大学
主持人：张 广 上海理工大学

➢ SuA05 - 1 13 : 00- 13: 15

[16]Feedback Stackelberg-Nash Equilibrium in Linear-Quadratic Mixed-Leadership Stochastic Differential Games

黄 琪 山东大学
史敬涛 山东大学

➢ SuA05 - 2 13 : 15 - 13 : 30

[424]Nash equilibrium and bang-bang property for the non-zero-sum differential game of multi-player uncertain systems with Hurwitz criterion

李 茜 重庆交通大学
宋乾坤 重庆交通大学
刘玉荣 扬州大学

➢ SuA05 - 3 13 : 30 - 13 : 45

[414]Robust error bound for convex inequality system under data uncertainty

Li Xiaobing 重庆交通大学

➢ SuA05 - 4 13 : 45 - 14 : 00

[820]Co-evolution of Vaccination Behavior and Perceived Vaccination Risk can lead to a Stag-Hunt like Game

刘 媛 北京邮电大学
武 斌 北京邮电大学

➢ SuA05 - 5 14 : 00 - 14 : 15

[782] 一种满意博弈论的机器人自主避险方法研究

王炜烨 北京信息科技大学

➢ SuA05 - 6 14 : 15 - 14 : 30

[525] 具有批量服务的 M/G/1 排队系统的进队策略分析

卫安妮 昆明理工大学
赵 宁 昆明理工大学

➢ SuA05 - 7 14 : 30 - 14 :45

[350]Natural selection between two games with environmental feedback

袁海蕊 山东科技大学

➢ SuA05 - 8 14 : 45 - 15 : 00

[783] 大宗商品电子交易市场的治理策略选择：惩罚 vs. 激励

郑泽志 北京信息科技大学
马艳红 北京信息科技大学

SuA06 13 : 00 – 15 : 00
腾讯会议：358-325-905
系统运筹、优化及调度

主持人：吕 莹 北京交通大学
主持人：彭建文 重庆师范大学

➢ SuA06 – 1 13 : 00 - 13 : 15

[159] 差分进化算法求解带时间窗的非线性充电的电动车辆路径优化问题

邓佳文 青岛大学
张纪会 青岛大学

➢ SuA06 - 2 13 : 15 - 13 : 30

[436]Risk-aversion multi-mode project scheduling with hybrid uncertainty

刘辉冉 上海理工大学
房志明 上海理工大学

➢ SuA06 - 3 13 : 30 - 13: 45

[776] 求解多目标优化问题的邻近牛顿法

彭建文 重庆师范大学

➢ SuA06 - 4 13 : 45 - 14: 00

[815]E-α-预不变凸区间值函数及最优性条件
彭健益 重庆交通大学
➢ SuA 06 - 5 14 : 00 - 14 : 15
[211] 基于灵敏度方法下连续时间 Markov 决策过程中的均值-方差组合优化问题
涂海婷 暨南大学
➢ SuA06 - 6 14 : 15 - 14 : 30
[155] 改进萤火虫算法求解多维复杂函数优化问题
王李萍 山东科技大学
赵茂先 山东科技大学
张贺杰 山东科技大学
➢ SuA06 - 7 14 : 30 - 14: 45
[310]Integrated optimization of metro multi-station passenger inflow control and bus bridging service
王兴蓉 北京交通大学
吕莹 北京交通大学
➢ SuA06 - 8 14 :45 - 15 : 00
[234] 基于低秩正则和组稀疏编码的泊松图像去噪
魏颖 山东科技大学

SuA07 13 : 00-15 : 00
腾讯会议：545-850-194
系统运筹、优化及调度

主持人：高 见 安庆师范大学
主持人：张惠珍 上海理工大学
➢ SuA07 – 1 13 : 00 - 13 : 15
[246] 基于风险的重大工程建设项目突发事件多方式协同救援路径优化研究
陈旭浩 北京交通大学
吕 莹 北京交通大学
➢ SuA07 - 2 13 : 15 - 13 : 30
[382]Scheduling Strategies for Autonomous Mobile Robots in Smart Hospitals with Dynamic Requests
程璐璐 昆明理工大学
赵 宁 昆明理工大学
➢ SuA07 - 3 13 : 30 - 13: 45
[355] 基于系统工程的汽车零部件项目风险管理研究
范文扬 中山大学
➢ SuA07 - 4 13 : 45 - 14: 00
[859] 考虑运输的低碳柔性作业车间调度
李 明 安徽工程大学
➢ SuA07 - 5 14 : 00 - 14 : 15
[391]A note on “Higher-order generalized Studniarski epiderivative and its applications in set-valued optimization” [Positivity22:1371–1385(2018)]
唐 田 重庆交通大学
➢ SuA07 - 6 14 : 15 - 14 : 30
[819]E-半预不变凸区间值函数的性质与区间规划的最优性条件
文 铭 重庆交通大学
➢ SuA07 - 7 14 : 30 - 14: 45
[386] 人机融合环境下自动发药机的药品拣选的路径规划
袁梦鸽 昆明理工大学
赵 宁 昆明理工大学
➢ SuA07 - 8 14 :45 - 15 : 00
[412]Well-posedness and scalarization for set optimization problems via free-disposal sets
曾 悦 重庆交通大学

SuA08 13 : 00-15 : 00
腾讯会议：304-388-090
系统运筹、优化及调度

主持人：周 博 重庆交通大学
主持人：刘媛华 上海理工大学
➢ SuA08 – 1 13 : 00 - 13 : 15
[393]The Equivalence of Three Types of Error Bounds for Weakly and Approximately Convex Functions
白思轩 重庆交通大学
➢ SuA08 - 2 13 : 15 - 13 : 30
[394]Stability for semi-infinite vector optimization problems via generalized order sets
陈雪静 重庆交通大学
➢ SuA08 - 3 13 : 30 - 13: 45
[415]Optimality conditions and duality for E-differentiable fractional interval-valued optimization problems with generalied convex
邓春艳 重庆交通大学
➢ SuA08 - 4 13 : 45 - 14: 00
[481] 基于三级分配网络的应急资源分配决策模型
董银环 昆明理工大学
➢ SuA08 - 5 14 : 00 - 14 : 15
[413]Inertia subgradient extragradient method for solving pseudomonotone variational inequality problems in Banach spaces
彭志莹 重庆交通大学
➢ SuA08 - 6 14 : 15 - 14 : 30
[814]Generalized Robust Duality in Constrained Nonconvex Optimization
王 杰 重庆交通大学

➢ SuA08 - 7 14 : 30 - 14: 45

[421]A Wasserstein distributionally robust chance constrained programming approach for emergency medical system planning problem

袁月飞 重庆交通大学
宋乾坤 重庆交通大学
周 博 重庆交通大学

➢ SuA08 - 8 14 :45 - 15 : 00

[284]Planning PEV Fast-Charging Stations Using Data-Driven Distributionally Robust Optimization Approach Based on Phi-divergence

周 博 重庆交通大学

SuA09 13 : 00-15 : 00
腾讯会议：721-975-304
系统安全、运筹、优化及调度

主持人：刘翠玲 北京工商大学
主持人：陶 杰 上海理工大学

➢ SuA09 – 1 13 : 00 - 13 : 15

[215] 南方 6 省水生蔬菜重金属含量特征及其膳食暴露评估

刘翠玲 北京工商大学
张述敏 北京工商大学
杨桂玲 浙江省农业科学院
张 冉 北京工商大学

➢ SuA09 - 2 13 : 15 - 13 : 30

[521]An accelerated subgradient extragradient algorithm for solving bilevel pseudomonotone and non-Lipschitz Continuous variational inequality problems

李 丹 重庆交通大学

➢ SuA09- 3 13 : 30 - 13: 45

[505]A note on “New higher-order weak lower inner epiderivatives and application to Karush-Kuhn-Tucker necessary optimality conditions in set-valued optimization”[Japan Journal of Industrial and Applied Mathematics. 37,851-866(2020)]

吕茂媛 重庆交通大学

➢ SuA09 - 4 13 : 45 - 14: 00

[520] 基于回溯线搜索的新型共轭梯度法

尹玉玲 重庆交通大学

➢ SuA09 - 5 14 : 00 - 14 : 15

[613]A new adaptive nonmonotone Newton algorithm

袁柳洋 武汉科技大学
晋慧慧 武汉科技大学

➢ SuA09 - 6 14 : 15 - 14 : 30

[508] 集值优化问题 Benson 真有效解的最优性条件

张雨荷 重庆交通大学

➢ SuA09 - 7 14 : 30 - 14: 45

[595]Distributed optimization with hybrid linear constraints for multi-agent networks

郑燕玲 东南大学
刘庆山 东南大学
汪 秒 东南大学

➢ SuA09 - 8 14 :45 - 15 : 00

[504] 集值优化问题弱有效解的二阶合成径向导数型最优性条件

张云淞 重庆交通大学

SuA10 13 : 00-15 : 00
腾讯会议：668-170-040
人类行为、社会系统、金融系统

主持人：王先甲 武汉大学
主持人：黄中意 上海理工大学

➢ SuA10 -1 13 : 00 - 13 : 15

[697] 基于 QQ 群的群体交流行为动力学建模

陈嘉妮 广西师范大学

➢ SuA10 - 2 13 : 15 - 13 : 30

[834]Exploring routine dynamics from the ‘bottom-up’: A mixed-method approach by combining agent-based modeling and laboratory experimental research

高德华 山东工商学院

➢ SuA10 - 3 13 : 30 - 13: 45

[842]Effect of decay behavior of information on disease dissemination in multiplex network

霍良安 上海理工大学
孟世光 上海理工大学

➢ SuA10- 4 13 : 45 - 14: 00

[863] 通胀不确定下银行存款价值与资本结构优化

黄玉喜 安徽工程大学
潘海峰 安徽工程大学
费为银 安徽工程大学

➢ SuA10 - 5 14 : 00 - 14 : 15

[176] 学术名著产出的时空特征分析

李晓凯 北京邮电大学
张 鹏 北京邮电大学
曾 安 北京师范大学

➢ SuA10- 6 14 : 15 - 14 : 30

[323]Construction and robustness of directed-weighted financial stock networks via meso-scales

苏青青 武汉科技大学

涂俐兰 武汉科技大学
王先甲 武汉大学
荣 航 武汉科技大学

➢ SuA10 - 7 14 : 30 - 14: 45

340 基于可编辑 VR 实验平台的突发事件下跟随效应研究

田 赛 上海理工大学
黄中意 上海理工大学
房志明 上海理工大学

➢ SuA10 - 8 14 :45 - 15 : 00

122 几种儿童易感病传染率比较分析

翟夏菲 青岛大学
赵继军 青岛大学

SuA11 13 : 00 - 15 : 15
腾讯会议：621-637-380
交通系统复杂性

主持人：韩 晓 北京交通大学
主持人：王嘉文 上海理工大学

➢ SuA11 – 1 13 : 00 - 13 : 15

78 群体出行选择行为建模和实验

韩 晓 北京交通大学

➢ SuA11- 2 13 : 15 - 13 : 30

200 城市交通网络冗余性的幂律分布研究

胡一冰 同济大学
许项东 同济大学

➢ SuA11- 3 13 : 30 - 13: 45

696Traffic management framework with dedicated connected automated vehicle lane considered in a mixed traffic environment

尚 影 北京交通大学

➢ SuA11- 4 13 : 45 - 14: 00

38Pre-trip Reservation Enabled Route Guidance and Signal Control Cooperative Method for Improving Network Throughput

王嘉文 上海理工大学
杭佳宇 常州大学

➢ SuA11 - 5 14 : 00 - 14 : 15

223Managing merging from a CAV lane to a human-driven vehicle lane considering the uncertainty of human driving

熊邦凯 北京交通大学
姜 锐 北京交通大学

➢ SuA11- 6 14 : 15 - 14 : 30

490 三支决策理论在多属性/多准则决策中的应用研究

尹龙军 重庆邮电大学

➢ SuA11- 7 14 : 30 - 14: 45

228Inference of ride-splitting patterns and evaluation of CO2 reduction capacity

支丹月 北京交通大学
吕 莹 北京交通大学

➢ SuA11 - 8 14 :45 - 15 : 00

76Identifying intracity freight trip ends from heavy truck GPS trajectories

杨一涛 北京交通大学
贾 斌 北京交通大学
闫小勇 北京交通大学
姜 锐 北京交通大学

➢ SuA11 - 9 15 :00 - 15 : 15

837 考虑土地利用性质的公交—地铁复合节点重要度识别方法

张梦瑶 北京工业大学
周雨阳 北京工业大学

SuA12 13 : 00 - 15 : 15
腾讯会议：483-667-636
交通系统建模与复杂性

主持人：孙凤兰 重庆邮电大学
主持人：赵 靖 上海理工大学

➢ SuA12 – 1 13 : 00 - 13 : 15

174 基于乘客异质性的早高峰单起点多讫点公交均衡研究

卢昱臻 北京交通大学

➢ SuA12- 2 13 : 15 - 13 : 30

191 纯电动公交多模式充电调度优化

石意如 北京交通大学
谢东繁 北京交通大学

➢ SuA12- 3 13 : 30 - 13: 45

501Group Consensus of Heterogeneous Multi-Agent Systems Based on Cooperative-Competitive Networks with Packet Loss and Second-Order Agent Speed is Unknown

孙凤兰 重庆邮电大学
武肖帅 重庆邮电大学
朱 伟 重庆邮电大学

➢ SuA12- 4 13 : 45 - 14: 00

224Modeling multi-line bus bunching considering capacity constraint and transfer passengers' routing

behavior

王智超 北京交通大学

姜 锐 北京交通大学

➢ SuA12 - 5 14 : 00 - 14 : 15

231 基于 Seq2Seq 架构的理论与数据协同驱动的跟驰模型研究

王立峥 北京交通大学

谢东繁 北京交通大学

➢ SuA12- 6 14 : 15 - 14 : 30

208 基于深度学习的数据驱动入匝道换道模型

韦 凯 北京交通大学

谢东繁 北京交通大学

➢ SuA12 - 7 14 : 30 - 14: 45

136A multi-task ride-sourcing gap prediction method based on deep learning convolution

许广曈 北京交通大学

吕 莹 北京交通大学

孙会君 北京交通大学系统科学研究所

➢ SuA12 - 8 14 :45 - 15 : 00

227 混合公交系统排班优化

余亚鹏 北京交通大学

谢东繁 北京交通大学

➢ SuA12 - 9 15 :00 - 15 : 15

410Joint optimisation of regular and demand-responsive transit services

赵 靖 上海理工大学

孙思诚 上海理工大学

SuB01 15 : 15 – 17 : 15

腾讯会议：663-542-505

交通系统、物流系统建模与复杂性

主持人：邝华 广西师范大学

主持人：龚燕萍 河南农业大学

➢ SuB01 - 1 15 : 15 - 15: 30

483 求解旅行商问题的波动降温模拟退火算法

陈晟宗 青岛大学

张纪会 青岛大学

➢ SuB01 - 2 15 : 30 - 15 : 45

450A novel mixed car-following model with consideration of self-stabilizing control under V2X environment.

蓝礼礼 广西师范大学

何金芳 广西师范大学

邝华 广西师范大学

白克钊 广西师范大学

➢ SuB01- 3 15 : 45- 16 :00

427A New Three-lane Lattice Hydrodynamic Model Considering the Mean Expected Velocity Field Effect in ITS Environment

杨凤兰 广西师范大学

蓝礼礼 广西师范大学

邝华 广西师范大学

白克钊 广西师范大学

➢ SuB01 - 4 16 : 00 - 16 : 15

276 时空演化视角下地下轨道交通的脆弱性

周方 河南农业大学

龚燕萍 河南农业大学

宁一博 河南农业大学

➢ SuB01- 5 16 : 15 - 16 :30

306 城市多方式交通网络承载能力计算方法

赵芳 北京交通大学

四兵锋 北京交通大学

➢ SuB01 - 6 16: 30- 16: 45

316 基于列生成算法的自动定制公交系统调度优化

周广京 北京交通大学

➢ SuB01 - 7 16 : 45- 17 : 00

241 基于无码头共享单车的出行扩张聚集特征研究

张沛然 北京交通大学

高 亮 北京交通大学

➢ SuB01 - 8 17 : 00- 17 : 15

352Learning-based restoration sequence ordering for multi-site traffic signal failure

赵婷婷 北京交通大学

SuB02 15 : 15 – 17 : 30

腾讯会议：356-209-161

人工智能及类脑计算

主持人：于重重 北京工商大学

主持人：王大辉 北京师范大学

➢ SuB02 - 1 15 : 15 - 15 : 30

500Ritt-Wu Characteristic Set Method for Laurent Partial Differential Polynomial Systems

胡又壬 重庆交通大学

➢ SuB02 - 2 15 : 30 - 15 : 45

383 基于级联森林的不平衡样本癌症亚型分类研究

姜春晓 山东科技大学

➢ SuB02 - 3 15 : 45 - 16 : 00

283 Mask Wearing Detection Based on Deep Learning under complex illumination conditions

冉鹏飞 青岛大学

赵东杰 青岛大学
于继宇 青岛大学
徐茂 青岛大学
朱林 青岛大学
Shuzhi Ge 新加坡国立大学

➢ SuB02 - 4 16 : 00 - 16 : 15

32 基于多主体分布式宽度学习的多特征脑电情绪识别

施水玲 昆明理工大学
刘文奇 昆明理工大学

➢ SuB02 - 5 16 : 15- 16 :30

624 物理神经网络研究现状与展望

田松岩 中山大学
陈洪波 中山大学

➢ SuB02 - 6 16 : 30 - 16 : 45

103 Controllability Analysis of InSCC Topology

肖朋朋 国防科技大学
纪志坚 国防科技大学

➢ SuB02 - 7 16 : 45- 17 : 00

196 Intelligent Online Tuning Control Method Based on an improved Wavelet Neural Network and NARX Prediction

朱爱云 青岛大学
于海生 青岛大学
孟祥祥 青岛大学

➢ SuB02 - 8 17 : 00 - 17 : 15

277Indoor Navigation based on Deep Reinforcement Learning with Potential Energy and Curiosity Mechanism

朱 林 青岛大学
赵东杰 青岛大学
徐 茂 青岛大学
牛超群 青岛大学
Shuzhi Ge 新加坡国立大学

➢ SuB02 - 9 17 : 15 - 17 : 30

802Brain-inspired Highly Energy-Efficient Stochastic Computing System Based on Memristors

赵钰迪 北京信息科技大学
缪 旻 北京信息科技大学

SuB03 15 : 15 – 17 : 15
腾讯会议：935-712-196
人工智能、系统安全及系统建模

主持人：倪 渊 北京信息科技大学
主持人：何建辉 江苏科技大学

➢ SuB03 - 1 15 : 15 - 15: 30

816 基于 ARIMA 和 LSTM 的黄淮海平原土壤含水量预测

丁玉盼 重庆交通大学

➢ SuB03 - 2 15 : 30 - 15 : 45

631A Two-Stage Network for Age Estimation by Fine-Grained Learning and Label Attention

胡春龙 江苏科技大学

➢ SuB03 - 3 15 : 45 - 16 : 00

634Compact facial age estimation by multi-modal distribution learning

何建辉 江苏科技大学
胡春龙 江苏科技大学

➢ SuB03 -4 16 : 00 - 16 : 15

828Fractional modeling and parameter identi cation of lithium-ion battery

蒋泽宇 南通大学
李俊红 南通大学
顾菊平 苏州科技大学

➢ SuB03 - 5 16 : 15- 16 :30

638 基于深度 Q 网络与行为克隆算法的无人机路径规划

孔富晨 江苏科技大学
王琦 江苏科技大学
于化龙 江苏科技大学
高尚 江苏科技大学

➢ SuB03 - 6 16 : 30 - 16 : 45

627 基于高阶关联矩阵的抗噪声储备池算法

刘胜钰 北京邮电大学
高健 北京邮电大学
Jinghua Xiao 北京邮电大学

➢ SuB03 - 7 16 : 45 - 17 : 00

663 基于 DDQN 和 Q 学习联合策略的双阶段无人机动态路径规划算法

潘德民 江苏科技大学
王琦 江苏科技大学
于化龙 江苏科技大学
高尚 江苏科技大学

➢ SuB03 - 8 17 : 00- 17 : 15

654Preventing False Data Injection Attacks in LFC System via the AEG Model and KF Algorithm

张志勋 东南大学
胡建强 东南大学
卢剑权 东南大学

曹进德 东南大学

SuB04 15 : 15 – 17 : 15
腾讯会议：918-721-390
人机交互协同与网络安全

主持人：李辉 北京师范大学
主持人：孟飞 上海理工大学

➢ SuB04 - 1 15 : 15 - 15 : 30

656G-quadruplex and Au-NPsdual signal amplificationopticalmicrofiber interferometerbiosensor
陆杭林 广西师范大学

➢ SuB04 - 2 15 : 30 - 15 : 45

786 基于卵巢囊肿超声图像的轻量级深度学习分类模型
刘娟琴 北京信息科技大学
范军芳 北京信息科技大学
李俊贤 北京信息科技大学
豆登辉 北京信息科技大学

➢ SuB04 - 3 15 : 45 - 16 : 00

581 Conformable 分数阶随机 SIR 模型的参数估计
聂娜 武汉科技大学
蒋君 武汉科技大学
冯育强 武汉科技大学

➢ SuB04 - 4 16 : 00 - 16 : 15

267 基于改进 3D U-net 神经网络的脑部 CT 肿瘤图像分割方法
王浩聪 山东科技大学
孙裕洋 山东科技大学
陈明 山东科技大学

➢ SuB04- 5 16 : 15- 16 : 30

672Leader-following Consensus Control of Unknown Nonlinear MASs under False Data Injection Attacks
王梅溶 东南大学
胡建强 东南大学
曹进德 东南大学

➢ SuB04 - 6 16 :30- 16 : 45

596Resilient Penalty Function Method for Distributed Constrained Optimization under Byzantine Attack
许晨涛 东南大学
刘庆山 东南大学

➢ SuB04- 7 16 : 45 - 17 : 00

23 论中医学的基础方法论是归属论
薛公佑 北京中医药大学

➢ SuB04- 8 17 : 00 - 17 : 15

50 中医经络本质与气血关系的系统学讨论

赵良举 重庆大学

SuB05 15 : 15 – 17 : 30
腾讯会议：627-623-776
群体智能理论及应用

主持人：刘文奇 昆明理工大学
主持人：刘磊 上海理工大学

➢ SuB05 - 1 15 : 15 - 15 : 30

660 一种半角距离变化的差分进化处理约束优化问题
苟辉朋 贵州民族大学
潘峰 贵州民族大学
李伟 贵州民族大学

➢ SuB05 - 2 15: 30 - 15 : 45

30Distributed Multi-Agent Learning is More Effectively than Single-Agent
柯淑雅 昆明理工大学
刘文奇 昆明理工大学

➢ SuB05 - 3 15 : 45 - 16: 00

689 一类具有输入时滞的线性多智能体系统在切换拓扑条件下的一致性控制方法
李长江 江苏科技大学
暴琳 江苏科技大学
叶树霞 江苏科技大学
王梓池 江苏科技大学
王建树 江苏科技大学

➢ SuB05 - 4 16 : 00 - 16 : 15

114The construction of controllable graphs based on equipotential node
刘萌萌 青岛大学
纪志坚 青岛大学

➢ SuB05 - 5 16 : 15 - 16 : 30

659 一种基于自适应进化的混沌布谷鸟搜索算法
李伟 贵州民族大学
潘峰 贵州民族大学
苟辉朋 贵州民族大学

➢ SuB05 - 6 16 : 30 - 16 :45

543 融合反向学习与精英演化的哈里斯鹰优化算法
李雨恒 江苏科技大学
高尚 江苏科技大学
于化龙 江苏科技大学
孟祥宇 江苏科技大学

➢ SuB05 - 7 16 : 45 - 17 : 00

458 矩阵结构遗传算法
潘峰 贵州民族大学

➢ SuB05 - 8 17 : 00 - 17 : 15

123 基于模拟退火机制的自适应粘性粒子群算法
孙一凡 青岛大学
张纪会 青岛大学
➢ SuB05 - 9 17 : 15 - 17 : 30
326 群体速度异质性对集群运动的影响
唐威振 北京师范大学
韩战钢 北京师范大学

SuB06 15 : 15 – 17 : 15
腾讯会议：121-492-788
博弈论及系统建模

主持人：何亚荟 北京工商大学
主持人：张广 上海理工大学
➢ SuB06 - 1 15: 15 - 15 : 30
745 图博弈的比例分离解
顾雯玮 上海理工大学
张广 上海理工大学
➢ SuB06 - 2 15 : 30 - 15 : 45
868 政府干预下智能动力电池逆向供应链主体行为演化研究
高一凌 安徽工程大学
➢ SuB06 - 3 15 : 45- 16 : 00
51The rapid detection of Cu+2 in food based on QDs membrane
何亚荟 北京工商大学
➢ SuB06 - 4 16 : 00 - 16 :15
546Fractional order game model of green and low-carbon innovation evolution in manufacturing enterprises and its discretization
姜楠 武汉科技大学
冯育强 武汉科技大学
王先甲 武汉大学
➢ SuB06 - 5 16 : 15 - 16 : 30
650Existence and stability of fuzzy Pareto-Nash equilibrium for generalized multi-objective fuzzy games
李文 武汉科技大学
李德宜 武汉科技大学
冯育强 武汉科技大学
➢ SuB06 - 6 16 : 30- 16 : 45
738 响应变量随机缺失下偏正态众数混合专家模型的参数估计
鲁钰 昆明理工大学
吴刘仓 昆明理工大学
王格格 昆明理工大学
➢ SuB06 - 7 16 : 45 - 17 : 00
396Some Dynamical Behaviors of Fractional-Order Commutative Quaternion-Valued Neural Networks via Direct Method of Lyapunov
夏砚楠 重庆交通大学
➢ SuB06 - 8 17 : 00 - 17 : 15
866Provincial CO2 emission efficiency analysis in China based on a game cross-efficiency approach with a fixed-sum undesirable output
张孝琪 安徽工程大学

SuB07 15 : 15 – 17 : 30
腾讯会议：147-458-474
复杂系统管理、辨识与控制

主持人：张珣 北京工商大学
主持人：刘亚威 重庆交通大学
➢ SuB07 - 1 15: 15 - 15 : 30
127Robustness of rank aggregation methods for malicious disturbance
陈冬梅 北京师范大学（珠海）
吴俊 北京师范大学
➢ SuB07 - 2 15 : 30 - 15 : 45
523 城市特大降雨中道路交通动态疏散组织研究
杜进华 北京交通大学
刘家林 北京交通大学
李新刚 北京交通大学
➢ SuB07 - 3 15 : 45- 16 : 00
311Effects of supply reliability, risk aversion and wealth on retailer's optimal order strategy
刘亚威 重庆交通大学
➢ SuB07- 4 16 : 00 - 16 :15
194 个体动机对团队绩效的影响：一种自下而上与自上而下任务分配方式的对比
王少妮 大连理工大学
党延忠 大连理工大学
➢ SuB07 - 5 16 : 15 - 16 : 30
272 基于 SHAPLEY 值的多层网络重要节点价值评估
夏庭汉 北京师范大学
赵东波 机电研究院
樊明 机电研究院
陈清华 北京师范大学
➢ SuB07 - 6 16 : 30- 16 : 45
469 A Robust Rating Aggregation Method based on User Homolaterality for Collusive Disturbance
祝欢 北京师范大学（珠海）

吴俊 北京师范大学

➢ SuB07 - 7 16 : 45 - 17 : 00

[169] 多目标数字标牌优化选址——以北京市六环内为例

张珣 北京工商大学
王雨雪 中国农业大学
梁春芳 北京工商大学
张滨 北京工商大学
毛珩懿 北京工商大学

➢ SuB07 - 8 17 : 00 - 17 : 15

[186]Spatiotemporal Characteristics and Driving Factors of Black Carbon in Augsburg, Germany: Combination of Mobile Monitoring and Street View Images

张珣 北京工商大学
张佳亮 北京工商大学
吴立杰 北京工商大学

➢ SuB07 - 9 17 : 15 - 17 : 30

[119] 基于深度强化学习的预测避撞跟驰算法

郑钰琪 北京交通大学
严瑞东 北京航空航天大学
贾斌 北京交通大学
姜锐 北京交通大学

SuB08 15 : 15 – 17 : 30
腾讯会议：559-918-463
复杂系统工程

主持人：赵文虓 中国科学院
主持人：金学波 北京工商大学

➢ SuB08 - 1 15: 15 - 15 : 30

[62]A Deep Network Prediction Model for Heavy Metal Cadmium in the Rice Supply Chain

金学波 北京工商大学
张佳帅 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学
苏婷立 北京工商大学

➢ SuB08 - 2 15 : 30 - 15 : 45

[63]A Reversible Automatic Selection Normalization (RASN) Deep Network for Predicting in the Smart Agriculture System

金学波 北京工商大学
张佳帅 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学
苏婷立 北京工商大学

➢ SuB08 - 3 15 : 45- 16 : 00

[322]Solving Fredholm integral equation of the first kind using Gaussian process regression

邱仁军 国防科技大学

➢ SuB08- 4 16 : 00 - 16 :15

[45] Research on traceability of grain and oil quality and safety based on trusted blockchain and trusted identification

许继平 北京工商大学
韩佳琪 北京工商大学
张新 北京工商大学
王小艺 北京工商大学

➢ SuB08 - 5 16 : 15 - 16 : 30

[41]Research on Optimization of Grain and Oil Quality and Safety Blockchain Based on DEMATEL-ISM

许继平 北京工商大学
张博洋 北京工商大学
张新 北京工商大学
赵峙尧 北京工商大学

➢ SuB08- 6 16 : 30- 16 : 45

[113]Parameter identification for the fractional-order chaotic, chaotic with noise and hyper-chaotic financial systems via Fractional-order Chaotic cuckoo search algorithm

杨忠保 黔南民族师范学院

➢ SuB08 - 7 16 : 45 - 17 : 00

[26]Adaptive Regulation of Block-Oriented Nonlinear Systems Using Binary Sensors with Applications to Automotive Engine Control

赵文虓 中国科学院

➢ SuB08- 8 17 : 00 - 17 : 15

[42] Information Traceability Model for the Grain and Oil Food Supply Chain Based on Trusted Identification and Trusted Blockchain

张新 北京工商大学
李悦 北京工商大学
许继平 北京工商大学
赵峙尧 北京工商大学

➢ SuB08- 9 17 : 15 - 17 : 30

[43]Dynamic supervision model of rice supply chain based on blockchain and smart contract

张新 北京工商大学
彭祥贞 北京工商大学
许继平 北京工商大学

王小艺 北京工商大学

SuB09 15 : 15 – 17 : 15
腾讯会议：133-246-077
系统建模与分析

主持人： 崔雪锋 北京师范大学
主持人：李俊红 南通大学

➢ SuB09 - 1 15: 15 - 15 : 30

245 基于机器学习全球肉类消费预测模拟
崔雪锋 北京师范大学

➢ SuB09 - 2 15 : 30 - 15 : 45

108 麻疹在中国的空间传播
韩世峰 青岛大学

➢ SuB09 - 3 15 : 45- 16 : 00

549Parameter identification of Hammerstein–Wiener nonlinear systems with unknown time delay based on the linear variable weight particle swarm optimizatio
李俊红 南通大学
宗天成 南通大学
陆国平 南通大学

➢ SuB09- 4 16 : 00 - 16 :15

695 基于深度强化学习的移动机器人密集人群导航方法
孙雪莹 江苏科技大学
徐雯煜 江苏科技大学
暴琳 江苏科技大学
季雅君 江苏科技大学

➢ SuB09 - 5 16 : 15 - 16 : 30

297neural network-based emotional speech expression in human-computer interaction systems
王智 青岛大学
Shuzhi Ge 新加坡国立大学
yinhua liu 青岛大学

➢ SuB09 - 6 16 : 30- 16 : 45

812Adaptive sliding mode control for MEMS gyroscopes based on immersion and invariance theory
张罗玉 南通大学
郭云翔 南通大学
张新松 南通大学
卢成 南通大学

➢ SuB09 - 7 16 : 45 - 17 : 00

20Microbiological predictive modeling and risk analysis based on the one-step kinetic integrated Wiener process
赵峙尧 北京工商大学
陈谦 北京工商大学

王小艺 北京工商大学

➢ SuB09 - 8 17 : 00 - 17 : 15

402Poincaré model shows how heterogeneity in light sensitivity can alter circadian clock function
周建 上海理工大学
顾长贵 上海理工大学
杨会杰 上海理工大学

SuB10 15 : 15 – 17 : 15
腾讯会议：586-885-744
系统建模分析与应用

主持人：邓小媛 昆明理工大学
主持人：任磊 南通大学

➢ SuB10 - 1 15: 15 - 15 : 30

685 基于多标签分类的增量模糊概念认知学习
邓小媛 昆明理工大学

➢ SuB10 - 2 15 : 30 - 15 : 45

813 考虑多类型市场主体的日前能量—调峰联合优化
高希 南通大学

➢ SuB10 - 3 15 : 45- 16 : 00

550联想机制下的概念认知模型
郭可依 昆明理工大学

➢ SuB10- 4 16 : 00 - 16 :15

614 单节点储备池学习能力的非线性动力学分析 ——以 logistics 映射为例
蓝秀文 北京邮电大学
陈伟 北京邮电大学
高健 北京邮电大学
Jinghua Xiao 北京邮电大学

➢ SuB10 - 5 16 : 15 - 16 : 30

271A spiking network model accounting for multi-peaked distribution in visual working memory task
雷力行 北京师范大学
王大辉 北京师范大学

➢ SuB10 - 6 16 : 30- 16 : 45

727 基于虚拟阻抗的两级式单相逆变器二次纹波电流传播特性研究
任磊 南通大学
张新松 南通大学

➢ SuB10 - 7 16 : 45 - 17 : 00

827Application of bidirectional DC/DC converter based on sliding mode control in DC microgrid
尹玉强 南通大学
茅靖峰 南通大学

➢ SuB10 - 8 17 : 00 - 17 : 15

[170]Pre-shooting Electroencephalographic Activity of Professional Shooters in a Competitive State

张洁 青岛大学
Shuzhi Ge 新加坡国立大学
蒋婉玥 青岛大学

SuB11 15 : 15 – 17 : 30
腾讯会议：765-187-033
人工智能、进化算法与应用

主持人：陈贵词 武汉科技大学
主持人：黄中意 上海理工大学

➢ SuB11 - 1 15: 15 - 15 : 30

[292] Finite-time dissipative filter design for discrete-time

陈贵词 武汉科技大学
周鑫 武汉科技大学
张青 武汉科技大学

➢ SuB11 - 2 15 : 30 - 15 : 45

[356] Robust minimum cost consensus model for multi-criteria decision making under uncertain circumstances

戴泽兴 上海理工大学

➢ SuB11 - 3 15 : 45- 16 : 00

[377] 基于元胞自动机的森林火灾模型

郭宇宁 上海理工大学
房志明 上海理工大学

➢ SuB11- 4 16 : 00 - 16 :15

[625] 基于信息传播模型的社交网络营销策略研究

黄宇灵 上海理工大学
刘磊 上海理工大学

➢ SuB11 - 5 16 : 15 - 16 : 30

[357] 基于感知层优化的深度强化学习人群疏散研究

梁荣 上海理工大学
黄中意 上海理工大学
房志明 上海理工大学

➢ SuB11 - 6 16 : 30- 16 : 45

[465] 基于改进免疫粒子群算法的电力-天然气系统分布鲁棒经济调度问题

刘玉兵 上海理工大学

➢ SuB11 - 7 16 : 45 - 17 : 00

[715]The effects of node arrangement in ring-coupled power grid

黎雪风 华侨大学

➢ SuB11 - 8 17 : 00 - 17 : 15

[762]Segregation dynamics driven by network leaders

王文璇 北京邮电大学

➢ SuB11 - 9 17 : 15 - 17 : 30

[728] 考虑怀疑及辟谣机制的 SEMIR 谣言传播模型

左飞宇 贵州民族大学

SuB12 15 : 15 – 17 : 30
腾讯会议：538-697-193
多主体系统与复杂系统动力学

主持人：孙凤兰 重庆邮电大学
主持人：黄良玉 广西师范大学

➢ SuB12 - 1 15: 15 - 15 : 30

[553] 带恒功率负载的 DC-DC 变换器的非线性特性分析

黄良玉 广西师范大学

➢ SuB12 - 2 15 : 30 - 15 : 45

[680]Combining superpixel information with Markov random field for segmentation of liver tumors

姜燕 重庆邮电大学

➢ SuB12 - 3 15 : 45- 16 : 00

[479]Event-triggered stochastic consensus for networked Lagrangian systems with semi-Markov switching topologies and communication delays

潘素英 重庆邮电大学

➢ SuB12- 4 16 : 00 - 16 :15

[467]Image Space Analysis for Set Optimization Problems with Applications

徐阳栋 重庆邮电大学

➢ SuB12- 5 16 : 15 - 16 : 30

[514]Fixed-time formation tracking for multiple nonholonomic wheeled mobile robots based on distributed observer

孙凤兰 重庆邮电大学
李浩 重庆邮电大学

➢ SuB12- 6 16 : 30- 16 : 45

[511]Spherical fuzzy prospect theory based on optimal reference matrix for emergency decision-making

王宇泰 重庆邮电大学
陈六 重庆邮电大学

➢ SuB12 - 7 16 : 45 - 17 : 00

[395]Deep Neuro-dynamic Programming for Real-time Control Strategy Optimization of An Integrated Power System

叶贝 上海理工大学
高岩 上海理工大学

➢ SuB12- 8 17 : 00 - 17 : 15

[527]Perturbation analysis and condition numbers of mixed least squares-scaled total least squares problem

张平平 重庆邮电大学

- SuB12- 9 17 : 15 - 17 : 30

555Global attracting set and asymptotic behavior for a class of impulsive functional Hopfield neural networks by a novel vector inequality

朱伟 重庆邮电大学
周伟松 重庆邮电大学
李桂铧 重庆邮电大学

摘要集（线下）

2022 年 11 月 12 日（ 周六 ）

SaA01　　13 : 00 – 15 : 00　　白羊厅

腾讯会议：103-775-119

电网及能源系统复杂性及模式识别

主持人：顾菊平　　苏州科技大学

主持人：李军祥　　上海理工大学

➢ SaA01 - 1　　13 : 00 - 13 : 15

443 考虑电池储能系统接入的电热联合系统风电接纳能力评估

顾菊平　　苏州科技大学

张新松　　南通大学

为促进风电消纳，减少“弃风”，将电池储能系统（Battery energy storage system, BESS）接入电热联合系统。为考虑风功率的不确定性，基于风功率预测误差的概率特性建立风功率场景概率模型。然后，建立了包含 BESS 的电热联合系统风电接纳能力评估模型。模型具有系统运行成本最低和“弃风”电量最小两个不同维度优化目标，且目标优化之间可能存在冲突。为求解该模型，基于改进主要目标法将其转化为多个单目标优化问题，并采用 GAMS 中 DICOPT 求解器给出了风电接纳能力评估模型的帕累托解集。基于帕累托解集，从接纳电量和接纳成本两方面对 BESS 接入后的电热联合系统风电接纳能力进行了深入分析。最后，进行了仿真分析，验证了本文所提模型及求解算法的有效性。

➢ SaA01- 2　　13 :15 - 13: 30

818Optimal Design of High-Power Medium-Frequency Transformer Using Hollow Conductors with Consideration of Multi-objective Parameters

郭云翔　　南通大学

卢成　　南通大学

张新松　　南通大学

Power electronic transformer (PET) is applied to the high-speed train for lightweight demand. A 300kW/5kHz high-power medium-frequency transformer (HPMFT) using hollow conductors in a power unit of the PET is optimally designed in this paper. The target of the design is to balances the loss, leakage inductance, and weight of the HPMFT. For this purpose, the design parameters of the HPMFT are firstly confirmed according to the system structure and parameters of the PET. Secondly, the design process of the HPMFT is developed. Finally, the results of 48 design schemes of core-type and shell-type structures are compared by the comprehensive evaluation standard, which equilibrates the three above objective parameters of the HPMFT. According to the optimal scheme, a prototype is manufactured, whose test results verify the correctness of the optimal design method.

➢ SaA01 - 3　　13: 30- 13 : 45

510 基于连续时间的智能电网实时定价模型

罗艺灵　　上海理工大学

高岩　　上海理工大学

智能电网需求侧管理的目标在于缓解高峰期用电，实时定价通过调整用户的用电模式来对不同的电价信号做出响应，达到削峰填谷的目标，是需求侧管理最有效的方法。目前基于离散时间的智能电网实时定价模型没有侧重考虑发电和用电的时间连续性这一重要特征对实时定价的影响，本文基于发电和用电的时间连续性，以及社会福利最大化模型，提出一个基于连续时间的智能电网实时定价模型，把数值优化问题转变为泛函极值优化问题。最后通过数学推导和算例分析来证明基于连续时间的实时定价模型的合理性与有效性。

➢ SaA01 - 4　　13 : 45- 14 : 00

560Real time pricing of smart grid based on filled function method

屈德强　　上海理工大学

李军祥　　上海理工大学

The cost of electricity mainly comes from the peak periods of electricity consumption, so cutting the peaks and filling the valleys of electricity consumption is the key to solve this problem. The real-time pricing of smart grid based on smart meters can guide customers' electricity consumption through price to cut the peaks

and fill the valleys of electricity consumption. The assumption that users' marginal utility of electricity consumption is decreasing makes the real-time pricing model based on social welfare maximization is convex. In reality, there are customers with non-decreasing marginal utility, and their utility needs to be depicted by a non-concave function, which makes the real-time pricing model based on social welfare maximization is non-convex. Previous methods for solving the convex real-time pricing model are often trapped in the local optimum of the non-convex model and cannot obtain the global optimum price of electricity. In this paper, we apply the filled function method to solve the non-convex real-time pricing model for customers with non-decreasing marginal utility, and guide them to use electricity reasonably through the global optimal price.

➢ SaA01 - 5 14 : 00 - 14 : 15

[801] 移动边缘网络中的用户关联与缓存优化策略设计

杨小龙 北京信息科技大学
徐湛 北京信息科技大学

针对容量受限的回程链路难以满足业务数据传输要求的问题，考虑基站发射功率、无线信道质量及内容推送机制等因素，对通信资源分配、用户关联、内容缓存与推送的问题进行建模，从而实现用户平均传输时延最小化。首先，建立了基于推送的移动边缘网络模型，基站可以给用户推送定制化业务，改变用户的请求概率，进而影响内容缓存与传输。在基站缓存容量、发射功率以及回程链路容量等约束下，以用户平均传输时延最小化为目标，构建混合时间尺度下的波束赋形、缓存策略以及内容推送的联合优化问题。仿真结果表明所设计的优化算法具有低用户平均传输时延优势。

➢ SaA01- 6 14 : 15 - 14 : 30

[444] 基于协同进化的光伏电站与电动汽车充电站联合规划

张新松 南通大学

分布式光伏电站（Distributed PV generator，DPVG）与电动汽车充电站（Electric Vehicle electric charge station，EVCS）大规模接入将对配电系统运行产生显著影响，因此，有必要进行 DPVG 与 EVCS 在联合规划，提高配电系统运行效率。针对该问题，本文在利用场景概率法对配电系统规划典型日内潮流进行概率分析的基础上，建立了同时考虑 DPVG 出力与 EVCS 充电负荷随机特性的 EVCS-DPVG 联合规划模型。在确保配电系统运行工况满足机会约束的前提下，同时优化 DPVG 与 EVCS 的建设位置与容量，尽可能降低配电系统的网损。将 EVCS-DPVG 联合规划模型分解为 EVCS 规划子问题和 DPVG 规划子问题，采用协同进化算法求解，通过模拟生态系统进化的并行求解机制提高求解效率。该算法可显著节约规划人员的时间，提高工作效率。最后，基于 IEEE 33 节点配电系统的仿真实验对本文所提模型和求解方法的合理性进行验证。

➢ SaA01 - 7 14 : 30 - 14 :45

[552]Multivariable T-S Fuzzy Decision Variable Gain Coordinated Control of PV and Storage Hybrid DC Access

张晓彤 南通大学
茅靖峰 南通大学
印春云 南通大学

Hybrid DC access for PV and storage is an important structural form for distributed renewable energy microgrid applications. This paper focuses on improving the access utilization rate of PV and storage energy and enhancing the access stability of the DC bus voltage. Firstly, based on the voltage droop control method for multi-source access systems, the relationship between the power margin of PV and storage energy and the regulation of bus voltage deviation is analyzed. Then, multivariate T-S fuzzy decision mechanism is used to design a nonlinear virtual resistance-based voltage droop gain coefficient, which to achieve highly adaptive coordinated distribution of PV and storage power as well as support bus voltage regulation. The T-S fuzzy input variables are the bus voltage deviation of the access point, the state of charge of the energy storage unit, and the photovoltaic light intensity. Finally, the simulation system is built by means of MATLAB/Simulink, and the feasibility and effectiveness of the proposed method is verified through a multi-case simulation comparison with traditional control methods.

➢ SaA01 - 8 14 : 45 - 15 : 00

[17]A Traversal Multi-target Path Planning Method for Unmanned Cruise Ship in a Complex Environment

赵峙尧 北京工商大学
许继平 北京工商大学
杨蒙 北京工商大学

陈慧敏 北京工商大学
范依云 北京工商大学

To solve the problem of multi-target optimal path planning for unmanned cruise ships in complex environments, a hybrid multi-target path planning method is proposed in this study. The method is divided into two parts: first, an improved grey wolf optimizer (GWO) algorithm is used to calculate the optimal multi-target cruise sequence. Second, the A* algorithm combined with the improved artificial potential field (APF) method is used to complete the single-target path planning between each target. The multi-target path planning problem is transformed into a TSP-like problem by this method. In view of the unconsidered environmental factors in the traditional GWO algorithm, the environmental impact factors are introduced into the fitness function to reflect the impact of obstacles and unknown areas during multi-target sequence planning. Based on the planned target sequence, the single-target path planning between each target point is then completed. The problem of an unreachable target caused by traditional APF method is improved by the optimized repulsive potential function. The simulation results in a complex environment showed that the proposed method in this study could plan a better execution sequence to reach the target point. For the same target point, the proposed method exhibited a better performance than other methods in terms of distance and time costs.

SaA02 13 : 00 – 15 : 00 金牛厅

腾讯会议：150-455-565

网络高阶结构及动力学分析

主持人：史定华 上海大学

主持人：徐梦俏 大连理工大学

➢ SaA02 - 1 13 : 00 - 13 : 15

[210]The Kronecker-clique model for higher-order clustering Coefficients

李聪 复旦大学

We propose a Kronecker-clique model, which possesses the higher-order properties, i.e., high-order clustering coefficients, of real-world networks. The higher-order clustering coefficient is defined as the closure probability of cliques. The higher-order structure of Kronecker-clique model is formed by introducing some cliques into the stochastic Kronecker model according to the degree-dependent function. We compare the higher-order clustering coefficients of the Kronecker-clique model with those of the stochastic Kronecker model and the HyperKron model when fitting the real-world networks. The results indicate that the Kronecker-clique model performs better than the stochastic Kronecker model, the HyperKron model as well as the traditional clustered model. Moreover, we perform k-core decomposition and show that the maximum k-core of the Kronecker-clique model is closer to that of real-world networks compared with the stochastic Kronecker model.

➢ SaA02 - 2 13 : 15 - 13 : 30

[153] 共享单车系统中的普适标度律

李睿琪 北京化工大学

Fundamental laws of human mobility have been extensively studied, yet we are still lacking a comprehensive understanding of the mobility patterns of sharing conveyances. Since travellers would highly probably no longer possess their own conveyances in the near future, the interplay between travellers and sharing bikes is a central question for developing more sustainable transportation. Dockless bike-sharing systems that record detailed information of every trip provide us a unique opportunity for revealing the hidden patterns behind riding activities. By treating each bike as an individual entity, we reveal that distributions of mobility indicators of bikes are quite different from humans; and mobility patterns are even inconsistent across cities. All above discrepancies can be well explained by a choice model that is characterized by a universal scaling. Our model unveils that instead of choosing among the newest bikes, the distribution of rank values of selected bikes on usage condition manifests a truncated power-law and is quite stable across several cities despite various diversities. Our framework would have broad implications in sharing economy and contribute towards developing a greener, healthier, and more sustainable future city.

➢ SaA02 - 3 13 :30 - 13 : 45

[143] 单纯形网络：从点线到单纯形，迈向高阶的桥梁

史定华 上海大学

普通网络起源于哥尼斯堡七桥问题，其中陆地被抽象为节点，桥梁被抽象为连线。从系统的角度，若节

点看做为主体，则连线反映两端节点有成对相互作用。复杂网络中的高阶相互作用如何建模？我们分析了现有的超网络和单复形两类模型、研究现状和发展机遇，指出单纯形网络是刻画网络高阶相互作用的有力工具。这与我们研究的全齐性网络一脉相承。两节点成对相互作用采用连线表示，多节点高阶相互作用则用超边来刻画。网络高阶相互作用(主体从二到多的)模型，除了超网络就是普通网络自身(不同邻接方式的)高阶结构。通常网络结构的邻接方式和相互作用的主体都只涉及节点和连线，考虑到节点是 0 阶、连线是 1 阶单纯形，推广到高阶单纯形，如三角形(2 阶)、四面体(3 阶)等，就自然产生了单纯形网络。单纯形网络除了可同时讨论多阶相互作用之外，还有优雅的数学理论和实用的计算工具。例如，通过计算我们知道：秀丽线虫的神经元网络最高可以是 7 阶的单纯形网络，在大脑功能上扮演重要作用的高阶洞有更强的同步能力，以及高阶网页排序指标性能更优等等。

➢ SaA02 - 4 13 : 45 - 14 : 00

[142]Higher-order similarity of human brain microstructural and functional networks

王浩 电子科技大学
吕琳媛 电子科技大学

尽管人脑拥有相对固定的物理解剖结构，但其可以支持丰富的认知功能，这种一对多的关系，引发了人们对研究大脑结构-功能关系的特别兴趣。髓鞘是一个重要的大脑微结构标志，然而对个体的微结构-功能关系却知之甚少。在此，我们用一个高阶框架探索大脑微结构与功能的关系。结果表明，全局（网络层面）的高阶微结构-功能关系与男性参与者的人格分数呈负相关，并随着年龄的增长而下降。节点的高阶微结构-功能关系在整个大脑中的排列并不均匀，在联合皮层中更强，在感觉皮层中更低，显示出性别差异。值得注意的是，高阶微结构-功能关系从整体（全脑）到局部（局部环路）都得到保持，表明了一个直接的且引人注目的大脑结构和功能交互的原则。此外，虚拟攻击核心节点可以破坏大脑的功能-结构高阶关系。我们的主要结果在不同分析和处理步骤中得到验证。总之，我们的发现推进了从高阶功能-结构交互视角理解认知、个体差异和衰老等问题，并提供了一个衡量复杂系统之间相似性的框架。

➢ SaA02 - 5 14 : 00 - 14 : 15

[139]A Path - based Approach to Analyzing the Global Liner Shipping Network

徐梦俏 大连理工大学

The maritime shipping network is the backbone of global trade. Data about the movement of cargo through this network comes in various forms, from ship-level Automatic Identification System (AIS) data, to aggregated bilateral trade volume statistics. Multiple network representations of the shipping system can be derived from any one data source, each of which has advantages and disadvantages. In this work, we examine data in the form of liner shipping service routes, a list of walks through the port-to-port network aggregated from individual shipping companies by a large shipping logistics database. This data is inherently sequential, in that each route represents a sequence of ports called upon by a cargo ship. Previous work has analyzed this data without taking full advantage of the sequential information. Our contribution is to develop a path-based methodology for analyzing liner shipping service route data, computing navigational trajectories through the network that both respect the directional information in the shipping routes and minimize the number of cargo transfers between routes, a desirable property in industry practice. We compare these paths with those computed using other network representations of the same data, finding that our approach results in paths that are longer in terms of both network and nautical distance. We further use these trajectories to re-analyze the role of a previously-identified structural core through the network, as well as to define and analyze a measure of betweenness centrality for nodes and edges.

➢ SaA02 - 6 14 : 15 - 14 : 30

[252]广义单纯形模型及其应用

杨荣湄 电子科技大学
周方 电子科技大学
刘波 电子科技大学
吕琳媛 电子科技大学

单纯形(Simplex)上的高阶交互作用为复杂网络的研究提供了新的视角，揭示了传统成对交互关系下所遗漏的非平凡动力学性质。目前已有一些基于高阶视角的复杂网络研究，但针对单纯形是如何影响网络功能的研究仍处于空白。本文提出了一种基于单纯形的生成模型，固定网络度序列并调控网络中二

阶单纯形的数量，挖掘单纯形对网络功能的作用。在四个实证网络和两个随机网络上的实验表明，二阶单纯形对传播动力学、渗流、牵制控制和社团检测等应用均有显著影响。模型在控制二阶单纯形的数量的同时，也可以间接控制二阶以上单纯形的数量。

➢ SaA02 - 7 14 : 30 - 14 : 45

289 基于单纯复形的复杂网络高阶性研究

赵毅 哈尔滨工业大学（深圳）

高阶结构普遍存在于实际复杂网络，现有图论等方法在描述高阶性方面存在技术局限，迫切需要发展代数拓扑理论方法以研究复杂网络的高阶性。为此，我们构造复杂网络的单纯复形，研究基于网络高阶交互作用的传播动力学。一方面，我们将高阶结构与非线性发生率相结合，构建了基于单纯复形的 SIRS 传播模型，通过对实际网络和合成网络的单纯复形进行大量的仿真，发现了基于单纯复形的传播动力学可以刻画标准的网络传播模型无法描述的现象，包括双稳态，不连续相变，以及疾病的周期性暴发。为了从理论上分析上述现象，在匀质性假设的条件下，采用平均场方法对模型进行简化，通过稳定性分析理论，得到了各个平衡点的稳定性以及疾病暴发的双稳态，并论证了系统的不连续相变以及疾病周期性暴发的现象是由高阶结构特征与非线性发生率导致的。另一方面，我们研究了复杂网络的高阶与低阶特征相耦合的传播机制，提出观点融合与消息传递的耦合传播模型。采用马尔科夫链方法构建其耦合传播过程，其中单形内进行观点的沟通与融合，单形间进行信息的交流。我们推导得到了此模型的传播临界值并发现并理论解释了传播过程中出现的跳变现象。总之，单纯复形为描述复杂网络的高阶结构提供理论依据，在复杂网络上基于高阶交互作用的传播动力学建模分析中起到重要的作用。

➢ SaA02 - 8 14: 45 - 15 : 00

204 复杂网络视角下的全球集装箱海运系统抗毁性研究

朱逸凡 大连理工大学
徐梦俏 大连理工大学

海上运输承担 90%以上中国国际贸易货运量、90%以上全球国际贸易货运量，其中，集装箱班轮运输承担全球约 70%的海运货物价值量，全球集装箱海运系统的稳健运行对各国对外贸易和经济发展尤为重要。新冠疫情以来，突发事件影响下的全球集装箱海运系统脆弱性凸显，拥堵在全球港口之间持续蔓延。本研究基于全球集装箱班轮海运航线历史数据，从复杂网络视角构建级联失效模型，探索全球集装箱海运系统的港口拥堵蔓延机制。模型良好地复现了港口的真实拥堵范围，发现网络结构和船公司航线行为共同影响全球集装箱海运系统的抗毁性能。本研究有助于深刻理解该系统的级联失效动力学机制，为维护全球海运物流供应链稳定和国际贸易发展提供科学参考。

SaA03 13 : 00 – 15 :00 双子厅

腾讯会议：959-362-817

系统工程理论与方法

主持人：曹林 北京信息科技大学

主持人：张家宁 北京邮电大学

➢ SaA03 - 1 13 : 00 - 13 : 15

794 视频类 UGC 价值评估体系研究

房津玉 北京信息科技大学
倪渊 北京信息科技大学
张健 北京信息科技大学

伴随着移动互联网的快速发展，视频类 UGC 已然成为当今人们分享信息，传递心情的新方式。合理评估其价值，对视频类 UGC 今后高质量创作、促进文化及信息的传播都具有重大意义。通过梳理已有文献，本文以信息生态链为主线，提出 UGC 价值生态链，从创作者、平台、用户三个维度构建评估体系。其中，本文在用户维度基于主题图谱理论与文本挖掘算法从海量用户评论中实现了提取价值评估要素。结果表明，视频类 UGC 由创作者、平台、用户三方面组成，通过因子分析验证了该评估体系的合理性，由视频类 UGC 分层分类结果来评估不同类型的 UGC 价值分布情况，并最终制定差异化的 UGC 发展策略。

➢ SaA03- 2 13 : 15 - 13 :30

785 融合 GNN 和 MLP 模型的中小微企业服务资源推荐算法

贾昊男 北京信息科技大学
张健 北京信息科技大学
陈进东 北京信息科技大学
何琼 北京信息科技大学

中小微企业服务需求多样且分散，传统的推荐算法难以从交易数据中提取出企业和服务之间的复杂关系，实现个性化推荐。基于企业服务资源交易数据，本文融合图神经网络（GNN）和多层感知机模型（MLP），提出基于 GNN-MLP 的中小微企业服务资

源推荐算法。首先，基于 GNN 构建企业-服务资源异构图，利用协同过滤思想学习不同节点与其邻居节点之间的深度嵌入表示；其次基于 MLP，将初始嵌入通过激活函数在多个隐藏层之间进行嵌入变换计算，获取企业-服务之间的非线性交互关系；最后融合两种深度嵌入表示，通过向量内积运算预测企业的服务需求。基于真实的企业-服务资源交易记录进行模型验证，并与 NeuMF、NGCF 等模型进行比较，实验结果表明，本算法的召回率和归一化折损累计增益分别达到了 0.805 和 0.463，相对于其他算法均有一定提升，证明算法有效。

➢ SaA03 - 3 13 : 30- 13 : 45

[84]Revealing spatio-temporal interaction patterns behind complex cities

刘晨馨 北京化工大学
李睿琪 北京化工大学

Cities are typical dynamic complex systems that connect people and facilitate interactions. Revealing universal collective patterns behind spatio-temporal interactions between residents is crucial for various urban studies, of which we are still lacking a comprehensive understanding. Massive cellphone data enable us to construct interaction networks based on spatio-temporal co-occurrence of individuals. The rank-size distributions of hourly dynamic population of locations are stable, although people are almost constantly moving in cities and hotspots that attract people are changing over time in a day. A larger city is of a stronger heterogeneity as indicated by a larger scaling exponent. After aggregating spatio-temporal interaction networks over consecutive time windows, we reveal a switching behavior of cities between two states. During the ``active" state, the whole city is concentrated in fewer larger communities; while in the ``sleeping" state, people are scattered in more smaller communities. Above discoveries are universal over diversified cities across continents. In addition, a city sleeps less, when its population grows larger. And spatio-temporal interaction segregation can be well approximated by residential segregation in smaller cities, but not in larger ones. We propose a temporal-population-weighted-opportunity model by integrating time-dependent departure probability to make dynamic predictions on human mobility, which can reasonably well explain observed patterns of spatio-temporal interactions in cities.

➢ SaA03 - 4 13 : 45 - 15 : 00

[152]Quantifying the structural and temporal characteristics of negative links in signed citation networks

宋多琪 北京师范大学
王文沛 北京师范大学
樊瑛 北京师范大学
邢延猛 北京师范大学
曾安 北京师范大学

Although the citation relationships among papers can help in tracking and understanding the development of knowledge, few studies have noted that the content and sentiments of citations of a paper differ. An author may agree with or criticize the cited paper, which represent different ways of inheriting knowledge. Here, using sentiment-labeled citation data to construct a directed signed citation network in the field of Computational Linguistics, we systematically quantify the structural patterns of negative citations, impact assortativity of involved papers, occurrence time distribution and consequences of receiving negational attention. Remarkably, we find that papers with different impacts have a similar probability of receiving negative citations, and highly cited papers tend to give negative citations to low-impact papers but avoid giving negative citations to high-impact papers. Our research also reveals the random occurrence rules and colocation patterns of negative citation distribution. In addition, we show that, in the short term, the high probability of multiple negative citations is positively related to the impact of the cited paper, but it is negatively related to the impact in the long run. Our findings explain the pattern by which negative citations occur and deepen the understanding of negative citations.

➢ SaA03 - 5 15 : 00- 15 : 15

[796] 面向海量目标的航天侦察可见窗求解方法

宋沛然 北京信息科技大学
杜丙男 北京信息科技大学
曹林 北京信息科技大学
杜康宁 北京信息科技大学

为有效提高航天侦察领域指挥控制系统获取侦察目标信息的准确性和时效性，提出了一种面向海量

目标的观测卫星可见窗口快速求解算法。该方法将多对多观测问题分解为若干单对单子问题，获取待侦察目标周边星下点轨迹信息，依据载荷约束结合二分法确定卫星对目标观测的可见时间窗口起止时刻与卫星姿态控制信息。对锥形、矩形两种视场类型的卫星观测仿真结果表明：同规模数据量下与STK软件相比使用本方法求解结果与STK结果精度持平，但求解速率比使用STK求解有大幅提升，能够同时满足实际工程应用中对目标观测窗口计算精度和时效性要求。

➢ SaA03 - 6 14 : 15 - 14 : 30

789遮蔽空间单兵双足不等式约束融合定位仿真研究

王一静 北京信息科技大学
苏中 北京信息科技大学
李磊 北京信息科技大学
刘一康 北京信息科技大学

在一些遮蔽空间环境，如地铁施工、隧道检修、灾害现场等内部，对于单兵的入内救援有了新的挑战，自主的单兵定位是保障人员安全的必要手段。在现有的利用足部定位的方法中，采用单足定位方法往往由于导航惯性器件使用期间会出现误差积累和航向漂移问题，导致定位效果较差，针对这一问题，提出了双足固联惯性器件的不等式约束轨迹融合方法，缩短零速修正的间隔，增加观测量，并且双脚分别进行自主定位，通过行走间的物理约束构造不等式约束，从而提高位置和航向精度。

➢ SaA03 - 7 14 : 30 – 14 : 45

690 分支过程下超级传播者对信息消亡的影响研究

张家宁 北京邮电大学
Jinghua Xiao 北京邮电大学

推特等社交平台的出现创造了信息完全独立、无中心、无群组、的传播方式，信息的传播不再局限于转发分享等行为，在推特上的只要被讨论评论过的信息都会附着在传播链上，单条信息的树状传播链条可以很好地用分支模型进行刻画。信息在社交平台上的传播受到人类行为的异质性影响，现有对于信息在社交平台上的传播研究多关注超级传播者导致的爆发作用而很少讨论其对信息消亡的作用。本文基于推特真实数据，用CMJ分支过程（Crump-Mode-Jagers Branching Processes）模拟单条信息随时间的传播路径，推导信息的消亡概率。具体上利用混合柏松过程区分超级传播者与普通用户（其比例由 a 控制），使用幂律分布调整信息传播的时间间隔，仿真结合理论研究超级传播者在信息传播过程中的作用以及对信息消亡的影响。

➢ SaA03 - 8 14 : 45 - 15 : 00

07 基于 NKF-FRKF 的晃动基座初始对准方法

张晓苏 北京信息科技大学
李擎 北京信息科技大学
付国栋 北京德维创盈科技有限公司
苏中 北京信息科技大学

针对惯性行人导航初始对准中系统模型不准确和噪声统计特性未知的情况下常规卡尔曼滤波精度下降的问题，本文扩充杆臂误差为状态量，建立微幅晃动基座模型，提出了新型自适应卡尔曼滤波 (NAKF) 的对准方法。结合先验误差协方差反馈自适应卡尔曼滤波(NKF)与快速鲁棒卡尔曼滤波(FRKF)，在状态估计中利用先验残差序列自适应调整协方差 Q，然后基于最大相关熵准则进行量测更新，并且为了提高计算速度，利用近似矩阵反演方法求矩阵的逆。通过实验比较了 NAKF 与 KF 的滤波效果，结果表明，使用 NAKF 的初始对准精度更好。

SaA04 13 : 00 – 15 : 00 巨蟹厅

腾讯会议：711-843-223

复杂网络

主持人：曾安 北京师范大学
主持人：李睿琪 北京化工大学

➢ SaA04 - 1 13 : 00 - 13 : 15

195 蚂蚁攻击蠼螋实验研究

陈语珂 北京师范大学
朱嘉琪 北京师范大学
韩战钢 北京师范大学

生物集群是自然界中的常见现象，集群行为广泛存在于生物群体当中。攻击行为是指群内个体间因对有限资源等的竞争而诱发一方攻击另一方的行为，不同生物群体的攻击行为多种多样。蚂蚁作为典型的社会性昆虫，在领地被入侵时会形成很强的对外攻击性。本文以蚂蚁群体作为研究对象，蠼螋作为外部动态刺激，设计蚂蚁攻击实验并建立攻击行为模型。本研究探究蚁群与其他物种相遇时的行为特点及其协同攻击的运动规则，分析集群系统异质个体间的攻击行为特征。

➢ SaA04 - 2 13 : 15 – 13 : 30

244 符号社会网络的信息传播免疫策略

李艾纹 北京师范大学
许小可 大连民族大学
樊瑛 北京师范大学

在社会网络高速交流分享信息的条件下，对一些虚

假信息进行有效的免疫，将大大减少虚假信息的传播给社会带来的不良影响和损失。目前，大多数研究致力于积极关系类型的个体之间的信息传播免疫。然而，在真实社交网络中，人与人之间的关系类型还可能有消极的。本研究针对同时带有积极和消极关系的符号社会网络，结合正度中心性和负度中心性提出三种新的免疫策略，并且基于遗传算法对其进行优化，从而对具有对立态度的用户传播虚假信息的过程进行有效的控制。基于符号网络的传播模型，本研究首先在随机符号网络实验中探究了不同免疫策略对传播范围的影响。结果显示在不同正边比例和正边传播速率条件下，正度和负度中心性之积在更多条件内具有较小的传播范围，免疫效果更好。该结果说明符号网络连边的正负性质在免疫过程中扮演着重要的角色。然后在随机符号网络和实证符号网络的实验中，将提出的免疫策略与原始免疫策略比较。两个免疫评价指标的结果显示三种新的免疫策略的结果不仅有更小的极大连通子图大小，而且均具有较小的到达稳态传染状态的速率，相比原始四种免疫策略具有更好的免疫效果。此外，对三种新的免疫策略进行遗传算法优化的结果中得到了更好的免疫效果。本研究有助于深入理解网络中正关系和负关系在信息传播免疫中的作用，推动了符号网络在信息传播和控制上的应用。

➢ SaA04 - 3 13 : 30 – 13 : 45

[2]Hidden directionality unifies community detection and cluster analysis

李睿琪 北京化工大学
尚璠 北京化工大学

Community detection and cluster analysis have long been regarded analogous yet studied separately for decades, both of which aim to group similar objects into categories. We are lacking a unified framework for both tasks mainly due to fundamental differences between vector and topology and difficulties on bi-mapping between them. We discover that phase transition in percolation theory signifies a proper distance threshold when converting vector to topology, which assists better clustering high-dimensional data. We propose a fast local searching algorithm applicable to both tasks based on hidden directionality that is identified from local information. Such directionality specifies a hierarchical following relation that an object will be in the same group as the closest object that is of a larger local value. Our algorithm also naturally gives rise to meaningful group centers. The strength of our framework is demonstrated on several test cases in both fields with ground-truth category labels.

➢ SaA04 - 4 13 : 45 - 14 : 00

[838] 基于 Power-law 分布原则的传播源节点选取方法研究

宋多琪 北京师范大学

影响力最大化问题是复杂网络中的热点问题，传统算法的目标是寻找 K 个影响力高的节点，然而实际中激活高影响力节点的成本也是高的。另一方面，激活低影响力节点的成本很低，而多个低影响力节点作用的叠加往往是非线性的。因此在成本限制的条件下，如何组合不同影响力的节点作为传播源是十分重要的。本文使用基于 Power-law 分布的组合原则对初始传染源进行挑选，发现幂指数与传播范围成倒 U 型函数关系，即存在最优幂指数，使得大小影响力节点组合效果最佳。我们在线性阈值和级联失效动力学下证明了我们的结果，并讨论了网络拓扑、动力学特性和成本约束对最优幂指数的影响。我们还将该结论推广至超图上的传播模型。

➢ SaA04 - 5 14 : 00 - 14 : 15

[280] 识别复杂网络上隐匿的目标节点

殷浩斐 北京师范大学
曾安 北京师范大学

识别复杂网络中的关键节点是网络科学研究中的一个重要课题。然而，在诸如计算机病毒源头的识别、疾病的治疗、谣言的遏制等许多现实问题中关键的目标节点并不总是清晰明确的。因此，本研究基于压缩感知提出了一种具有反馈机制的探测方法，依次选取不同的初始节点进行传播，根据每次的反馈结果对目标节点进行预测。本研究依次测试了不同网络结构和传播概率下传播次数和初始传播节点的选取对目标节点识别精度的影响。实验结果表明该方法在一定情况下可以在减少 80%的成本下，实现约 90% - 100%的探测精度。最后，将该研究应用在不同的实际网络中，实验结果进一步验证了该方法的可行性。

➢ SaA04 - 6 14 : 15 - 14 : 30

[675] 基于传播过程的网络拆解

张奥博 北京师范大学
曾安 北京师范大学

目前，对多层网络的研究是一个重要的研究方向，与单层网络相比，多层网络可以揭示更多复杂系统

的属性。研究表明，从多层角度分析系统时，会得到更丰富的结果，但我们很多时候不能获得真实系统中关系的完整信息，而忽视个体之间不同交互类型，这就可能会导致丢失很多信息造成不准确的估计和预测。本文创新性地提出将单层聚合网络拆分为多层网络的方法，我们旨在解决如何构建一个通用框架来将单层聚合网络拆分为多层网络的问题。我们基于传播的动力学过程提出将单层聚合网络拆分为多层网络的计算框架，根据传播的时间序列通过计算对聚合网络进行拆解，并且在规则、小世界、无标度网络中进行测试都能达到 95%以上的准确性。我们还分析该方法中两层网络传播概率的差异性、层间的相似性等因素对网络拆解准确率的影响，同时将该方法应用到实际网络。

➢ SaA04 - 7 14 : 30 - 14 : 45

803 小型货车高速转弯防侧翻控制

张昊 北京信息科技大学

车辆在高速转向的过程中，很容易发生侧滑或侧翻问题。为了针对小型货车在高速转向行驶过程中的防侧翻控制，本文使用一种前馈反馈控制器对车辆的横向荷载传递速率（LTR）进行控制，并使用差动制动控制车辆状态。建立三自由度车辆侧翻参考模型，利用 Carsim 建立小型货车模型，利用 Matlab/Simulink 软件实现控制器的设计，通过联合仿真对不同的路面状况进行模拟实验。实验结果表明，该控制方法可以有效提升小型货车在高速转向过程的稳定性，实现对车辆的防侧翻控制。

➢ SaA04 - 8 14 : 45 - 15 : 00

158 复杂网络中级联失效规模的双峰分布及其预测

仲崇欣 北京师范大学
曾安 北京师范大学

随着复杂网络规模的不断扩大和功能的复杂化，网络中的微小扰动可能会触发整个系统的崩溃，级联失效已成为常见的系统性风险。在以往的研究中，人们发现级联失效的规模呈现幂律分布，但近来也有学者发现级联规模呈现双峰分布，这意味着网络中级联失效规模的两极化。本文基于 Motter and Lai 模型，进一步研究了复杂网络中级联失效规模双峰分布的形成机制及预测。结果表明双峰分布的出现与网络的平均度相关，并且右峰的形成一方面由于节点首次级联能够触发的节点的中心性更大，另一方面则是级联持续步数更长。最后，我们提出了基于介数的指标来预测节点的级联失效规模，并在人工网络和实际网络上与常用指标进行对比验证，结果明显优于已有的预测指标。

SaA05 13 : 00 – 15 : 00 双鱼厅

腾讯会议：564-126-324

群体智能理论及应用

主持人：王兴芬 北京信息科技大学

主持人：郭雨 北京师范大学

➢ SaA05 - 1 13 : 00- 13: 15

778 基于双重注意力对比网络的素描人脸合成方法

杜康宁 北京信息科技大学
曹林 北京信息科技大学
司淑狄 北京信息科技大学
郭亚男 北京信息科技大学

针对传统素描人脸合成方法中存在的素描图像栅格化、纹理不清晰、图像真实感较差问题，通过研究素描人脸合成系统机理和属性的感知、表征、建模等智能行为的理论，提出了一种基于双重注意力对比网络的素描人脸合成系统，实现图像光学域和素描域的双重转换。该系统在传统生成对抗损失的基础上加入注意力判别特征，形成多任务判别器，在多层次图像块对比网络中增加注意力机制对特征信息赋予不同的权重，优化细节特征。此外，加入风格均值损失提高图像的风格相似性。实验表明，该方法生成的素描肖像轮廓更加丰富，图像真实感更强。

➢ SaA05 - 2 13 : 15 - 13 : 30

325 速度异质化个体对于群体行为影响

郭雨 北京师范大学

生物集群复杂性就是这样的复杂系统问题之中的重要一员。对于生物集群来说，单个生物个体以及生物集群群体，有着完全不相同的表现以及性质，“more is different”这句话在生物集群之中更是表现的淋漓尽致。在之前的研究中，大多数人都关注同质群体之中的集群行为，但由于自然界中普遍存在的随机性与多样性，群体当中的个体差异是广泛存在的，而这样的更贴近实际的异质化群体集群行为的研究更有意义。为此，本文着重于对异质化个体对群体集群行为的影响进行探讨，并选取了速度异质化这一在运动之中最普遍的特质进行了研究。本文构建了一个模型去描述速度异质化对群体影响的内在机理，并总结出了一个可以指导实践的规律，以试图对集群运动的控制进行参考。

➢ SaA05 - 3 13 : 30 - 13 : 45

792 基于特征子空间和多目标遗传算法优化集成学习的僵尸企业识别研究

何轩 北京信息科技大学
倪渊 北京信息科技大学
张健 北京信息科技大学

针对僵尸企业可靠性识别问题，本文提出了一种基于特征子空间和多目标遗传算法优化的集成学习方法。本文在脱敏企业数据集上，结合前人的研究和领域知识构造了僵尸企业识别多维度特征体系，基于沙普利值度量的特征贡献方法计算了各可解释模型的特征子空间。在这基础上利用多目标遗传算法来搜索最优的基模型组合和软投票机制下各模型的最优权重进行集成。本方法在数据集上最终获得了99.95%的 F1 分数、99.96%的准确率和 99.90%的召回率。并在小样本数据上依旧维持了 99.5%以上的 F1 分数，超越了其他方法。实验结果证明，与单一模型和普通集成学习方法相比本文的方法在不损害模型可解释性的基础上，取得了更好的分类效果，并在小样本数据上表现良好，具有更强的鲁棒性。

➢ SaA05 - 4 13 : 45 - 14 : 00

788 粒子群优化噪声参数的行人导航零速修正算法

李磊 北京信息科技大学
苏中 北京信息科技大学
吴学佳 北京信息科技大学
王一静 北京信息科技大学

针对使用零速修正算法进行行人惯性导航时，固定噪声参数不适用所造成的导航精度较低的问题，提出了一种基于粒子群算法优化噪声参数的零速修正算法。通过最小化零速阶段的滤波器新息序列可以在线调整滤波参数，以适应当前行人运动状态，最后通过对多组行人行走惯导数据进行解算来验证算法有效性。分别使用了标准零速修正算法和粒子群优化的零速修正算法对惯性数据进行解算，并计算两种算法解算结果的位置误差。经对比表明，提出的算法能够得到更小的定位误差和更平滑的解算轨迹。

➢ SaA05 - 5 14 : 00 - 14 : 15

795 文化产业发展态势分析及预测

李思远 北京信息科技大学
倪渊 北京信息科技大学
张健 北京信息科技大学

摘要：文化是综合国力的重要组成部分，也是增强综合国力的重要力量，“十四五”时期文化产业迎来发展黄金期。为精准预测文化产业的未来发展态势，本文以波特的钻石理论为基础，以文献计量分析为手段，构建了融合新冠疫情因素的文化产业发展态势的预测指标体系，结合随机森林和基于粒子群优化算法的支持向量机模型的预测优点，提出了一种融合百度搜索指数的组合预测模型，并以电影行业为研究对象进行对比实验。结果表明，与单一预测模型相比，组合预测模型明显提高了预测精度，百度搜索指数作为文化产业发展态势预测模型的影响因素具有较强的有效性

➢ SaA05 - 6 14 : 15 - 14 : 30

790 基于超平面-Louvain-Bert 优化 LDA 模型的书法作品价值要素提取

潘小宇 北京信息科技大学
倪渊 北京信息科技大学
金春华 北京信息科技大学
张健 北京信息科技大学

针对书法作品价值评估分歧大、标准缺失的难题,借助大数据与人工智能方法高效准确地识别书法作品价值要素,为各种书法作品交易活动提供技术支撑。借助优化 LDA 模型实现书法作品价值要素挖掘。基于传统 LDA 模型，通过 Louvain 算法对频繁词集共现网络划分的社区数作为最佳主题数，引入超平面选取领域停用词并剔除该类词语,应用 Bert 模型降低文本特征矩阵的稀疏性。通过书法价值评估文献的实验显示，与传统 LDA 模型相比，改进后模型的困惑度和平均主题优质率分别降低了 588.9861 和 0.8787，平均主题相似度提高了 0.0134，且识别的主题内容更加集中、主题间的差异增大、交叉变小。新模型可以自动确定最佳主题数、领域停用词和特征补充，提高要素的识别率和集中度。

➢ SaA05 - 7 14 : 30 - 14 : 45

839 基于 TCN-Attention 的大宗商品价格预测

王兴芬 北京信息科技大学
王世杰 北京信息科技大学
岳婷 北京信息科技大学

提高大宗商品价格预测精度，并进行准确预测，可以有效规避在复杂影响因素下大宗商品供需变动、价格剧烈波动所造成的市场风险，保证经济的平稳运行。本文提出一种基于极限梯度提升（XGBoost）算法和引入注意力机制（Attention）的时间卷积网络（TCN）模型的多特征价格预测方法。在建立模型前，通过文献整理和极限梯度提升（XGBoost）算法分析并筛选影响因素，然后将选择的多特征数据输入到 TCN-Attention 得到最终价格波动的预测结果。从多角度进行误差分析与比较实验，结果证明了基于 XGBoost 特征筛选的预测方法，评估指标比未进

行特征筛选整体下降 10%以上。同时引入了注意力机制的 TCN-Attention 模型要比其他基准预测精度更高，评估指标整体下降 50%以上。

➢ SuA05 - 8 14 : 45 - 15 : 00

[793] 基于深度学习的推荐算法综述

张立威 北京信息科技大学
倪渊 北京信息科技大学
张健 北京信息科技大学

随着网络用户的快速增长，大量的数据也随之呈现出指数级增长，为了帮助用户在海量数据中找到自己的想要的数据，推荐算法应运而生。推荐算法可以根据用户的数据，计算出用户可能的兴趣点，从而给用户推荐他们可能感兴趣的信息，从而使用户能够非常快速地知道可能自己都没有察觉的兴趣点。首先对国内外的推荐算法相关领域进行了文献计量分析，从统计结果分析出研究前沿、发展趋势、热门领域等重要信息，然后对目前推荐领域的常用算法进行了归纳总结，主要介绍了基于内容的推荐、基于协同过滤的推荐、基于深度学习的推荐以及混合推荐的优缺点以及改进路线，之后对推荐算法存在的问题进行介绍并总结目前的解决办法，最后对以后推荐算法的发展方向进行了分析。

SaA06 13 : 00 – 15 : 00 铂派厅

腾讯会议：565-755-172

人工智能、数据挖掘及其应用

主持人：赵峙尧 北京工商大学

主持人：张慧妍 北京工商大学

➢ SaA06 – 1 13 : 00 - 13 : 15

[805]Deep Learning Based Channel Estimation for Non-linear MIMO Systems in the Internet of Vehicles scenarios

巩译 北京信息科技大学
李欣儒 北京信息科技大学
孟繁轲 西安邮电大学
徐湛 北京信息科技大学

Nonlinear MIMO technology has been proven to solve the problem of excessive power consumption caused by the base station with more than 100 antenna pairs have been adopted for Internet of Vehicles (IoV). However, the nonlinear MIMO scheme applied in the IoV scenario does not consider the real-world channel with the characteristics of vehicle motion. In addition, traditional channel estimation in nonlinear MIMO technology are not robust under the variation of channel parameters in IoV. To get more accurate channel estimation results and achieve perfect robustness for changing channel parameters, we propose a channel estimation scheme of Half Phase Only (HPO)-MIMO based on Convolutional Neural Network (CNN). Moreover, we also use the COST 2100 channel model, which is more suitable for simulating the IoV scenario. Furthermore, the channel estimation scheme based on CNN algorithm can be used favorably in the nonlinear MIMO and IoV scenarios. Simulation results have shown that the proposed CNN-based channel estimation achieves outstanding mean squared error performance compared to the Generalized Approximate Messaging (GAMP) algorithm. Besides, the excellent performances prove the rationality of using the COST 2100 channel model.

➢ SaA06 - 2 13 : 15 – 13 : 30

[198] 中国语境下，基于新能源汽车异质性的道路交通碳排放研究

郝旭 北京科技大学

推广新能源汽车是道路交通碳减排的重要途径，新能源汽车特有的使用异质性导致新能源汽车实际碳排放和理论值差异很大；因此准确核算新能源汽车实际碳排放成为评估我国道路交通碳排放的关键瓶颈。本研究针对我国典型的插电式混合动力乘用车与微型纯电动车，进行了中国语境下面向异质性的新能源汽车碳排放建模研究：采用机器学习对新能源汽车纯电利用系数等特有的使用异质性量化分析，构建基于大数据的新能源汽车实际碳排放核算方法，并据此分析新能源汽车碳排放异质性对于道路交通系统碳减排复杂性的影响。本研究可为我国制定制定与评估新能源汽车碳减排措施奠定理论基础，对我国交通领域碳达峰与碳中和的实现提出有针对性的建议。

➢ SaA06 - 3 13 : 30 - 13: 45

[804] 基于多标签文本分类的电影衍生品价值指标体系构建

廖世豪 北京信息科技大学
倪渊 北京信息科技大学
张健 北京信息科技大学

本文提出在电影衍生品结构化价值指标体系基础上，通过多标签文本分类模型融合非结构化评论数据，可以提高原有价值指标体系的可信度与合理性。使用 BERT 模型获得评论文本的词向量表示，结合 Bi-LSTM 与 Attention 机制进一步增强文本信息，将评

论文本分类至多种价值指标标签，进而对结构化体系投票，大量评论文本所普遍关注的点即为关键指标，通过增删改来优化原有价值指标体系。实验表明，该模型在多标签文本分类数据集下准确率较高，能有效地将非结构化评论数据与电影衍生品价值指标体系融合。

➢ SaA06 - 4 13 : 45 – 14 : 00

[39]Attentive fine-grained recognition for cross-domain few-shot classification

萨良兵 北京工商大学
于重重 北京工商大学
马先钦 北京工商大学
赵霞 北京工商大学
谢涛 北京工商大学

Cross-domain few-shot classification aims to recognize images in the new categories and domains that only contain few but unacquainted images. Considering the problems of fine-grained recognition in cross-domain few-shot classification including marginal overall-discrepancy in feature distribution and obvious fine-grained difference in dataset, this paper proposes a simple and effective attentive fine-grained recognition (AFGR) model. Specifically, the residual attention module is stacked into the feature encoder based on the residual network, which can linearly enhance different semantic feature information to help the metric function better locate the fine-grained feature information of the image. In addition, a bilinear metric function structure is proposed to learn and fuse different fine-grained image features, respectively, since the weights of bilinear measurement functions are not shared. Eventually, the final classification result is obtained by merging the recognition of bilinear metric function through posterior probability multiplication. In this paper, ablation experiments and comparative experiments are carried out with the typical few-shot dataset mini-ImageNet as the training domain and the CUB, Cars, Places and Plantae datasets as the test domain. The experimental results demonstrate that the proposed AFGR method is effective, with the highest increase in recognition accuracy 13.82% and 7.95% compared with the latest results under the experimental settings of 5-way1-shot and 5-way5-shot, respectively, which also proves the problems of fine-grained recognition in cross-domain small sample classification.

➢ SaA06 - 5 14 : 00 - 14 : 15

[784]考虑时序信息的中小微企业服务平台深度学习推荐算法

张海航 北京信息科技大学
陈进东 北京信息科技大学
张健 北京信息科技大学
何琼 北京信息科技大学

利用用户时间交互信息能够发掘推荐服务的时间关联性，提升中小微企业服务推荐效果。本文选用用户时间交互序列数据作为主要建模数据，基于GRU(Gate Recurrent Unit)深度神经网络及协同过滤技术建立深度学习推荐算法。选用用户时间交互数据训练 GRU 网络，利用数据中用户随时间推移的隐含兴趣属性，对用户时序项目倾向特征建模；选取用户全部历史交互数据及近期交互数据，利用协同过滤算法发掘不同时期数据中的用户兴趣属性，对其长短期兴趣特征建模；综合用户长短期兴趣特征以及时序项目倾向特征，采用赋权法为用户推荐兴趣项目列表。研究发现，考虑时序信息的深度学习推荐算法由于能够综合用户时序交互数据中用户随时间顺序推移的隐含兴趣属性，在中小微企业服务平台用户交互数据集上相较于 item-based 算法及 NCF 算法精确率分别提高 7.24%、5.01%，证明了本算法在服务推荐研究的有效性。

➢ SaA06 - 6 14 : 15 - 14 : 30

[53]Self-organizing deep belief modular echo state network for time series prediction

张慧妍 北京工商大学
王立 北京工商大学
孙茜 北京工商大学
王昭洋 北京工商大学

A deep belief echo state network is an effective deep learning framework for solving time series prediction problems. The suitable structure of the hidden layers determines the prediction performance of the neural network. However, a neural network structure designed using artificial experience has difficulty meeting application requirements. To address this problem, this paper proposes a self-organizing deep belief modular echo state network (SDBMESN) model for time series prediction with high accuracy. The basic framework of this model includes two parts: a deep belief network for deep feature extraction and a modular echo state

network with subreservoirs for time series prediction. To find a suitable neural network structure, a neuron significance based on mutual information is designed to measure the degree of information of the neurons, and then a self-organizing mechanism is designed to realize the dynamic adjustment of the hidden layer neurons and subreservoirs. In addition, the robust loss function is used to improve the robustness of the prediction. The simulation results of nonlinear system modeling, sunspot prediction and algal bloom prediction demonstrate that the SDBMESN has good prediction performance and robustness.

➢ SaA06 - 7 14 : 30 – 14 : 45

[19]Water quality evolution mechanism modeling and health risk assessment based on stochastic hybrid dynamic systems

赵峙尧 北京工商大学
周宇琴 北京工商大学
王小艺 北京工商大学

Water quality assessment analysis is an important technical means for water pollution prevention and control. In this research area, mechanism models and real observation data of water quality evolution are always used to perform water quality assessment. However, the existing water quality evolution mechanism modeling researches commonly use a single time-invariant model to model the water quality evolution process. It is inappropriate to directly describe the complex behavior of long-term water quality evolution with the existing models, since the evolution process contain different feature states, and the water quality evolution characteristics under these states are different. In addition, the existing water quality assessment methods are mostly methods for directly processing and calculating the observation data of water quality. This makes the existing methods difficult to effectively compensate for the contingency and randomness in the water quality evolution process, which leads to deviations and errors in performing the water quality assessment. Considering these deficiencies, this paper proposes a water quality evolution mechanism modeling and health risk assessment method based on stochastic hybrid dynamic systems (SHDS). Firstly, a hybrid water quality evolution mechanism (H-WQEM) model is established based on SHDS, and a hybrid improved fruit fly optimization algorithm (H-IFFOA) is proposed to identify the unknown parameters of the H-WQEM model. Then, an improved interacting multiple model extended Kalman filter algorithm (IIMM-EKF) is employed to estimate the probability distribution of the hybrid state of the H-WQEM model, including the probability distribution of different feature states of water bodies and the probability distribution of water quality indexes under these states. Finally, the health degree of water quality is proposed as an indicator to achieve a quantitative assessment of the water health risk status. Real observation data from a monitoring station at Baiyangwan in China is used to validate the effectiveness of the proposed method. The results show that the method can effectively describe the complex water quality evolution process, and reasonably assess the water quality health risk status.

➢ SaA06 - 8 14 : 45 - 15 : 00

[781]基于残差优化多层 Bi-LSTM 的情感分类算法

郑志超 北京信息科技大学
陈进东 北京信息科技大学
张健 北京信息科技大学

情感分类已广泛应用于商品评论分析、舆情分析等场景。通过增加双向长短期记忆网络(Bi-LSTM)的层数，可使模型能够获取更多的文本特征，提升分类效果；但当网络层数过深时，由于梯度消失等原因会使得模型效果变差甚至无法收敛。本文针对多层 Bi-LSTM 在情感分类研究中模型退化问题，提出一种基于残差优化多层 Bi-LSTM 模型，基于残差网络(ResNet)的思想，将当前 Bi-LSTM 的隐层状态和细胞状态作为更深层的输入，使得在不断增加模型深度时，模型效果也会有所提升。采用 online_shopping_10_cats 数据集，对比 1 层、4 层、6 层、20 层和残差优化的 20 层 Bi-LSTM 分类精度，最终在验证集上的分类精度分别为 90.97%、92.23%、91.72%、50.67%和 92.66%。实验显示，当 Bi-LSTM 随着层数增加，收敛速度变慢，当达到 20 层时模型无法收敛；当使用残差优化的 20 层 Bi-LSTM 模型时收敛最快，且在验证集上的精度最高。

SaB01 15 : 15 – 17 : 30 白羊厅

腾讯会议：350-682-979

复杂系统的建模、分析和控制

主持人：陆国平 南通大学
主持人：谭远顺 重庆交通大学
➢ SaB01 - 1 15 : 15 - 15: 30

[829]Effects of official information and rumor on resource-epidemic coevolution dynamics

霍良安 上海理工大学
赵瑞芳 上海理工大学

Epidemic-related information and resources have proven to have a significant impact on the spread of the epidemic during the Corona Virus Disease 2019 (COVID-19) pandemic. The various orientation role of information has different effects on the epidemic spreading process, which will affect the individual' awareness of resources allocation and epidemic spreading scale. Based on this, a three-layer network is established to describe the dynamic coevolution process among information dissemination, resource allocation, and epidemic spreading. In order to analyze dynamic coevolution process, the microscopic Markov chain (MMC) theory is used. Then, the threshold of epidemic spreading is deduced. Our results indicated that the official information orientation intensity inhibits the epidemics spreading, while rumor orientation intensity promotes epidemic spreading. At the same time, the efficiency of resource utilization restrains the expansion of the infection scale. The two kinds of information are combined with resources respectively. Official information will enhance the inhibitory effect of resources epidemics spreading, while rumor will do the opposite.

➢ SaB01- 2 15 : 30- 15 : 45

[364] 混改企业融通发展高层梯队决策动力学仿真分析

焦忆雷 上海理工大学

本文采用系统动力学和博弈论混合的方法，采用 anylogic 软件将高层梯队权力结构与心理资本资本联合起来对混改企业融通发展的影响仿真研究，探索高层梯队权力结构对融通发展的影响。通过系统动力学和 anylogic 仿真研究高层梯队行为冲突和整合的演化过程，清晰刻画了高层梯队权力结构的交互作用，及其对混改企业融通发展的影响过程。针对混改企业高层梯队权力结构转型及优化设计，提出相关管理改进建议：1）高度重视混改企业高层梯队的权力结构转型，合理设计高层梯队的权力结构，针对不同类型的高层梯队，制定相应的政策。2）混改企业高层梯队的权力结构转型应注重策略的选择。3）关注混改企业高层梯队权力结构的生命周期对融通决策的影响。

➢ SaB01- 3 15 : 45- 16 :00

[740]Influence of heterogeneous nodes on oscillation in excitable networks

李涛 华侨大学

Studies of sustained oscillations on complex networks with excitable node dynamics received much interest in recent years. Understanding the effects of heterogeneous nodes in excitable neural networks on oscillations is critical. We found that the effects of different heterogeneous nodes on oscillations are completely different. The most obvious phenomenon is the cause of oscillation death and the change of the oscillation source. Here we employ a simple excitable model to explore how heterogeneous nodes within a network can influence oscillations. It was observed that there are three cases: not changing the oscillation, blocking the oscillation and changing the direction of the oscillation. For different heterogeneous nodes, we accurately found the conditions under which oscillations occur, the oscillation source was changed, and the two causes of oscillation death. And for different coupling methods, the same phenomenon was found. This shows that the role of heterogeneous nodes does not have much to do with the way the model is coupled. It also reveals the reasons for the coexistence of multiple oscillations and what kind of oscillation sources are formed under different topologies.

➢ SaB01 - 4 16 : 00 - 16 : 15

[432] 多层符号神经网络的领导跟随一致

陆国平 南通大学

研究了符号网络下具有多层有向拓扑的神经网络的领导跟随一致问题，同时考虑了结构平衡和结构不平衡两种拓扑结构。利用结构平衡理论和牵制控制策略，给出了多层符号神经网络的二分领导跟随一致的充分条件，该条件仅依赖于多层符号网络的节点动力学和拓扑结构，而与网络的层数无关。此外，本文还提供了一种可选方案来设计每一层的牵制节点和牵制增益，以实现多层符号神经网络的领导跟随一致。当网络拓扑结构不平衡时，通过将结构不平衡网络分解为结构平衡子网络和一些特殊边来研究多层符号网络的渐近稳定性。本文提出的条件也

适用于解决传统单层符号网络的一致问题。数值例子验证了所提出理论和算法的正确性和有效性。

➢ SaB01- 5 16 : 30 - 16 :45

[404]Stability and bifurcation in a predator-prey system with prey-taxis

邱焕焕 重庆交通大学

In this paper, we consider a generalized predator-prey system with prey-taxis under Neumann boundary condition, that is, the predators can survive even in the absence of the prey species. It is proved that for arbitrary spatial dimension, the corresponding initial boundary value problem possesses a unique global bounded classical solution when the prey-taxis is restricted to a small range. Moreover, the local stabilities of constant steady states (including trivial, semi-trivial and positive constant steady states) are investigated. A further study on the co-existence steady state implies that the prey-taxis term suppresses the global asymptotical stability and influence the steady-state/Hopf bifurcations (if they exist). Analyses of steady-state bifurcation, Hopf bifurcation, and even Hopf/steady-state mode interaction are carried out in detail by means of Lyapunov-Schmidt procedure. In particular, we obtain stable or unstable steady states, time-periodic solutions, quasi-periodic solutions, and sphere-like surfaces of solutions. These results provide theoretical evidences to the complex spatio-temporal dynamics found by numerical simulation.

➢ SaB01 - 6 16 : 30- 16 : 45

[833]Complexity and chaos control of a Cournot duopoly model with bounded rationality

谈文慧 中国地质大学
魏周超 中国地质大学（武汉）

The Cournot duopoly game with bounded rationality is studied based on the central manifold theorem and bifurcation theory. The results show that the model undergoes flip bifurcation and Neimark-Sacker bifurcation. An approximate expression of the invariant curve caused by the Neimark-Sacker bifurcation is given. In addition, numerical simulations are performed to support the theoretical results, such as bifurcation diagrams, maximum Lyapunov exponent diagrams, invariant curves, time-series diagrams, and chaotic attractors. Furthermore, the existence of codimension-2 bifurcation is obtained. Analytical and numerical methods of chaos in the sense of Marotto's definition are also shown. Finally, this paper presents two control methods to control the chaotic track from two perspectives of the decision-makers.

➢ SaB01 - 7 16 : 45- 17 : 00

[599]Collective dynamics of phase oscillator populations with three-body interactions

王璇 华侨大学

Many-body interactions between dynamical agents have caught particular attention in recent works that found wide applications in physics, neuroscience, and sociology. In this paper we investigate such higher order (nonadditive) interactions on collective dynamics in a system of globally coupled heterogeneous phase oscillators. We show that the three-body interactions encoded microscopically in nonlinear couplings give rise to added dynamic phenomena occurring beyond the pairwise interactions. The system in general displays an abrupt desynchronization transition characterized by irreversible explosive synchronization via an infifinite hysteresis loop. More importantly, we give a mathematical argument that such an abrupt dynamic pattern is a universally expected effect. Furthermore, the origin of this abrupt transition is uncovered by performing a rigorous stability analysis of the equilibrium states, as well as by providing a detailed description of the spectrum structure of linearization around the steady states. Our work reveals a self-organized phenomenon that is responsible for the rapid switching to synchronization in diverse complex systems exhibiting critical transitions with nonpairwise interactions.

➢ SaB01 - 8 17 : 00- 17 : 15

[492]Dynamic behavior of prostate cancer cells under antitumor immunity and pulse vaccination in a random environment

杨欢 重庆交通大学
谭远顺 重庆交通大学

Advanced prostate cancer (PCa) is usually treated with androgen deprivation therapy (ADT), which is initially effective but can lead to metastatic castration-resistant prostate cancer. The dendritic cell vaccine immunotherapy can enhance the antitumor immune

responses to help fight cancer and has been shown to be effective. A stochastic impulsive PCa model incorporating ADT and immunotherapy is developed in this article to analyze the elimination of androgen-dependent and androgen-independent cancer cells under the noise interference. Besides the existence, uniqueness and boundedness of global positive solution of the model, some sufficient conditions of extinction and persistence in mean of PCa cells are also obtained by using the Itô's formula and the comparison theorem of stochastic differential equation. Our study illustrates that high-intensity noise perturbation can inhibit the development of PCa and verifies theoretically and numerically that frequent vaccination can improve the survival time of the patient with ADT.

➢ SaB01 - 9 17 : 15- 17 : 30

[293]Finite-time dissipative control for memristor-based bidirectional associative memory neural networks with time-varying delays

杨金荣 武汉科技大学
陈贵词 武汉科技大学

In this paper, finite-time dissipativity analysis and dissipative control problems for memristor-based bidirectional associative memory neural networks (MBAMNNs) with time-varying delays are investigated. The switched memristive connection weights of MBAMNNs are explained via the interval matrix method, which is different from the existing method. Correspondingly, the MBAMNNs are translated into BAMNNs with interval parameters under the framework of Filipov solution and differential inclusions. Therefore, some sufficient conditions of finite-time bounded (FTB) and finite-time (Q, S, R)-γ dissipativity for MBAMNNs are obtained. Meanwhile, the finite-time dissipative controllers are designed through solving some linear matrix inequalities (LMIs). Finally, a numerical example with simulations is given to illustrate the correction of the proposed results and the effectiveness of the designed controllers.

SaB02 15 : 15– 17 : 30 金牛厅

腾讯会议：698-962-436

复杂网络上的动力学模型研究

主持人：顾长贵 上海理工大学
主持人：阮中远 浙江工业大学

➢ SaB01 - 1 15 : 15 - 15 : 30

[70]代谢网络冗余与进化年龄的关联

邓世果 上海工程技术大学

在不同的研究领域中，大量复杂的网络是由一个共同的复制和发散机制产生的，这种机制导致了冗余节点、边缘、路径和拓扑模式。因此，冗余可以反映进化信息。在本研究中，我们将一个复杂网络的邻接矩阵映射到一个多元系统的记录，即邻接矩阵的每一行都是一个特定实验中变量状态的记录，并以此定义了一个新的冗余概念来定量测量网络的冗余。本研究成功地检测到了储存在 DDM PPI 网络模型和人类代谢网络中的进化信息。随着 DDM 模型的演化，冗余度呈单调递减趋势。对于模型和经验网络中的群落，冗余度与群落大小呈显著的负相关关系，是一个很好的进化年龄工具变量。因此，冗余可以为我们提供进化年龄的可靠证据。

➢ SaB02 - 2 15 : 30 - 15 : 45

[9]主时钟网络结构对生物节律的影响

顾长贵 上海理工大学

生物钟调控着生理活动和行为活动的节律。然而在特殊情况下，例如衰老、时差，人的节律会变弱。我们寻找增强节律的途径，发现主时钟神经元的网络结构能影响节律的强度。在无标度网下，弱的节律比其他网络结构要强。我们的发现可能对增强节律有理论指导意义。

➢ SaB02 - 3 15 : 45 - 16 : 00

[841]复杂网络背景下绿色产品扩散机理研究

李明 上海理工大学
刘臣 上海理工大学
霍良安 上海理工大学

经济社会的快速发展，工业化程度的逐步提高，给社会带来了严重的环境污染问题，促使人们意识到环境保护的重要性。绿色环保产品因其具有环境友好性而受到越来越多的欢迎，消费者越来越青睐绿色产品，使得绿色产品成为企业生产商以及政府部门广泛关注的焦点。因此，研究绿色产品的扩散问题，分析影响绿色产品扩散的关键因素，探索绿色产品扩散的机理对企业生产商以及政府部门的管理具有重大的意义。本文在传统的产品扩散模型基础上，综合考虑消费者个体的活跃度、绿色环保意识等因素，基于 Bass 模型以及信息级联预测理论主要进行以下几个方面的研究：（1）消费者具有自身的特点，不同消费者对新事物的接受程度是不同的。而传统 Bass 模型假定潜在消费者是同质的，对消费

者个体的活跃度没有加以区分。因此，在传统的 Bass 模型基础上加入个体活跃度，构建绿色产品扩散模型，运用平均场理论研究绿色产品在单层复杂网络背景下的扩散过程，并分析了不同个体活跃度与外部媒体因素情景下的扩散状态。研究表明：个体活跃度对绿色产品扩散动力学具有重大影响，绿色产品扩散规模随着个体活跃度的增加而增加。（2）消费者的意识对其购买行为起着重大的决定作用，传统的 Bass 及其扩展模型对消费者心里因素的研究还有局限。对于绿色产品来说，个体绿色环保意识对自身的购买行为具有重大的影响。因此，借鉴双层复杂网络理论，在考虑个体活跃度的同时，引入个体绿色环保意识，研究了双层复杂网络理论背景下个体活跃度与个体绿色环保意识对绿色产品扩散动力学的影响。研究表明：个体的环保意识和行为状态在绿色产品扩散过程中起着重要作用，环保意识会增加个体选择绿色产品的偏好，个体行为状态会改变个体之间的互动模式，绿色产品的扩散规模与环保意识和个体活跃度成正相关关系。（3）随着社交网络的快速发展，政府以及企业生产商会通过网络途径宣传绿色环保信息，个体也会在社交网络获取并分享产品的绿色环保信息，具有绿色环保意识的个体对绿色产品扩散具有重大的影响。利用信息级联预测理论，对不同的绿色产品信息扩散机制建立起不同的扩散模型，并将真实的绿色产品信息扩散数据对模型进行拟合，从而准确估出计绿色产品信息扩散模型的参数，得到不同扩散机理下的绿色产品信息扩散模型。研究结果可为产品生产商以及政府相关部门的管理决策提供管理启示。通过将复杂网络理论引入传统 Bass 模型并对其进行扩展，分析了影响绿色环保产品扩散的条件以及具体影响因素，研究结果可以为绿色产品生产商的营销与经营提供管理启示。经过真实绿色产品扩散数据对模型参数进行拟合，研究结果进一步为绿色产品生产商的决策提供参考，具有重大的现实意义。

➢ SaB02 - 4 16 : 00 - 16 : 15

[507] 网络动力系统中的时空动力学理论及应用研究

李怡然 复旦大学

Network science characterizes topological properties of complex system and suggests the intertwined interplay between structure and collective dynamics. The investigation of the structure-dynamics relevance is crucial for the understanding of normal system functioning, but remains unclear due to various factors, in particular to low spatial-temporal resolutions from experimental recording. In this talk, we will mainly introduce our recent work on the characterization of convergent and divergent neurons of larval zebrafish. In particular, we recorded the activity of brain neurons in the larval zebrafish simultaneously with a battery of visual stimulations using a light-sheet imaging system, and identified neurons tuned to each stimulus type and motor output and discovered groups of neurons respond to different stimulations. The convergent and divergent neurons are defined according to the number of responsed stimulations. We analysized the statistical and temporal characterizations of these neurons, and find significant characterizations responsible for behaviors.

➢ SaB02 - 5 16 : 15 - 16 : 30

[645] The reconstruction of the network structure in flocking systems based on time series

梁靖婕 国防科技大学
祁明泽 国防科技大学
段晓君 国防科技大学

Swarm refers to a macroscopically self-organized collaborative and synchronous behavior, forming an orderly and stable state independently and it's also regarded as a system. The implementation of the characteristic depends on the interaction relationship between the entities in the swarm. However, these interactions are difficult to be observed directly from the outside. The problem we focus on is inferring the interactions in a swarm from the individual trajectories. Similar inference problems exist in other systems, called network reconstruction. It's a fundamental problem pervading research on complex systems. In this paper, we develop a new method for inferring direct interactions from the motion state of individuals in the cluster. Introducing a matrix of Euclidean distance representing the distance correlation, we sum all the matrices at each cross-section of the time series to obtain a weight matrix indicating the correlations. Then the network structure could be reconstructed by thresholding the weight matrix, where positions with higher weight values correspond to higher correlation probability. We verify the effectiveness of the proposed method in different system dynamics including the

Vicsek, and the Cucker-Smale models with different networks as communication topologies. Robust reconstruction is achieved in flocking systems with more control parameters, which is viable even in the presence of external noise. The proposed method uses a combination of time series analysis and cross-sectional analysis to provide a new perspective for reconstructing the communication network of a swarm, which helps to better understand and control swarms.

➢ SaB02 - 6 16 : 30- 16 :45

[87]Using the manifolds of discrete dynamical systems to understand the entrainment of circadian oscillators.

廖光源 重庆邮电大学

Circadian rhythms are endogenous oscillations, widely found across biological species, that have the capability of entraining to the 24-hour light-dark cycle. We study the dynamics of a hierarchical circadian system consisting of N peripheral oscillators coupled to a single central circadian oscillator. We introduce a systematic way to derive an N-dimensional entrainment map for this network where all oscillators are governed by the Kuramoto model.

➢ SaB02 - 7 16: 45 - 17 : 00

[54]Transfer entropy calculation for short time sequences with application to stock markets

邱路 上海师范大学

We investigate the estimation of transfer entropy (TE) for short time sequences by correlation-dependent balanced estimation of diffusion entropy employed in the transfer entropy (CBEDETE) method and the normal transfer entropy (NTE) method. Our finding shows that the CBEDETE method is more effective than the NTE method on TE calculation for short time series. Based on this conclusion, we use 38 important stock market indices from 4 continents to create successive financial networks with 10~60-day windows and 1-day step by the CBEDETE method. By extracting the evolution characteristics of out-/in-degree of stock networks, we obtain the most influential stocks RTS, KOSPI, PSI, NIKKE and AORD of Europe, Asia and Oceania and the most influenced stocks IBOVESPA, NYSE, NASD and MERV of America. Finally, by monitoring the ratio of link numbers of each network and smoothing the curves, we find an interesting result that almost all effective peaks in the smoothed ratio curves are prior to the financial crises, such as the global financial crisis in 2008, China's stock market crash in 2015, etc.

➢ SaB02 - 8 17 : 00 - 17 : 15

[10]Role of lurkers in threshold - driven information spreading dynamics

阮中远 浙江工业大学

The threshold model as a classical paradigm for studying information spreading processes has been well studied. The main focuses are on how the underlying social network structure or the size of initial seeds can affect the cascading dynamics. However, the influence of node characteristics has been largely ignored. Here, inspired by empirical observations, we extend the threshold model by taking into account lurking nodes, who rarely interact with their neighbors. In particular, we consider two different scenarios: (i) Lurkers are absolutely silent and never interact with others and (ii) lurkers intermittently interact with their neighborhood with an activity rate p. In the first case, we demonstrate that lurkers may reduce the effective average degree of the underlying network, playing a dual role in spreading dynamics. In the latter case, we find that the stochastic dynamic behavior of lurkers could significantly promote the spread of information. Concretely, slightly raising the activity rate p of lurkers may result in a remarkable increase in the final cascade size. Further increasing p could make nodes become more stable on average, while it is still easy to observe global cascades due to the fluctuations of the effective degree of nodes.

➢ SaB02 - 9 17 : 15 - 17 : 30

[86]Scaling up real networks by geometric branching growth

郑木华 江苏大学

Real networks often grow through the sequential addition of new nodes that connect to older ones in the graph. However, many real systems evolve through the branching of fundamental units, whether those be scientific fields, countries, or species. Here, we provide empirical evidence for self-similar growth of network structure in the evolution of real systems---the journal citation network and the world trade web---and present the Geometric Branching Growth model, which predicts

this evolution and explains the symmetries observed. The model produces multiscale unfolding of a network in a sequence of scaled-up replicas preserving network features, including clustering and community structure, at all scales. Practical applications in real instances include the tuning of network size for best response to external influence and finite-size scaling to assess critical behavior under random link failures.

SaB03　　15 : 15 – 17 : 30　　双子厅

腾讯会议：387-760-271

多智能体与量子系统中的优化与博弈方法

主持人：程书明　　同济大学

主持人：梁舒　　同济大学

➢ SaB03 - 1　　15 : 15 - 15: 30

[475]Detecting quantum entanglement with unsupervised learning

程书明　　同济大学

Quantum properties, such as entanglement and coherence, are indispensable resources in various quantum information processing tasks. However, there still lacks an efficient and scalable way to detecting these useful features especially for high-dimensional and multipartite quantum systems. In this work, we exploit the convexity of samples without the desired quantum features and design an unsupervised machine learning method to detect the presence of such features as anomalies. Particularly, in the context of entanglement detection, we propose a complex-valued neural network composed of pseudo-siamese network and generative adversarial net, and then train it with only separable states to construct non-linear witnesses for entanglement. It is shown via numerical examples, ranging from two-qubit to ten-qubit systems, that our network is able to achieve high detection accuracy which is above 97.5% on average. Moreover, it is capable of revealing rich structures of entanglement, such as partial entanglement among subsystems. Our results are readily applicable to the detection of other quantum resources such as Bell nonlocality and steerability, and thus our work could provide a powerful tool to extract quantum features hidden in multipartite quantum data.

➢ SaB03 - 2　　15 : 30 - 15 : 45

[369]Influence of Misperception on Zero – Determinant Strategies in Iterated Prisoner’s Dilemma

程朝阳　　中国科学院

陈冠溥　　中国科学院

洪奕光　　中国科学院

Zero-determinant (ZD) strategies have attracted wide attention in Iterated Prisoner's Dilemma (IPD) games, since the player equipped with ZD strategies can unilaterally enforce the two players' expected utilities subjected to a linear relation. On the other hand, uncertainties, which may be caused by misperception, occur in IPD inevitably in practical circumstances. To better understand the situation, we consider the influence of misperception on ZD strategies in IPD, where the two players, player X and player Y, have different cognitions, but player X detects the misperception and it is believed to make ZD strategies by player Y. We provide a necessary and sufficient condition for the ZD strategies in IPD with misperception, where there is also a linear relationship between players' utilities in player X's cognition. Then we explore bounds of players' expected utility deviation from a linear relationship in player X's cognition with also improving its own utility.

➢ SaB03 - 3　　15: 45 - 16 : 00

[362]Distributed sub-optimal optimization for generalized resource allocation problems

梁舒　　同济大学

Distributed optimization for resource allocation problems is investigated and a sub-optimal continuous-time algorithm is proposed. Our algorithm has lower order dynamics than others to reduce burdens of computation and communication, and is applicable to weight-balanced graphs. Moreover, it can deal with both local set constraints and coupled inequality constraints, and remove the requirement of twice differentiability of the cost function in comparison with the existing sub-optimal algorithm. However, this algorithm is not easy to be analyzed since it involves singular perturbation type dynamics with projected non-differentiable right-hand side. We overcome the encountered difficulties and obtain results including the existence of an equilibrium, the sub-optimality, and the convergence of the algorithm.

➢ SaB03 -4　　16 : 00 - 16 : 15

692 基于第一性原理的因果分析、信息流及其应用

梁湘三 复旦大学

因果分析是科学研究的核心问题，同时也是哲学上的重要问题,包括诺贝尔奖获得者 Granger、Angrist、Imbens 以及图灵奖获得者 Pearl 在内的科学家们已经为此努力了半个多世纪。我们的系列研究表明，因果性可用信息流衡量，而信息流是真实的物理概念，可由第一性原理严格导出、不必如传统方法那样以半经验的形式出现（如 Liang,2016, Phys. Rev. E, 94, 052201）。传统的因果分析在很多情况下验证不了这样一个被称为“零因果准则”的事实在这里以一个被证明的定理出现。尤为重要的是，所得因果量的形式对任意非线性变换保持不变，表明它刻画的是一种真实的物理性质。针对一些动力系统如 baker 变换、Hénon 映射等，我们已经得到一些解析解。对于线性系统来说，因果量的最大似然估计可以用两序列之间的样本协方差的组合表示。一个推论是：在线性条件下，有因果必有相关，但有相关不必有因果，用一个数学表达式明晰了自 Berkeley(1710)以来哲学上关于相关与因果的长期争论。我们的结果已经在众多现行的因果分析解决不了的问题中得到了验证，并成功地用到越来越多的学科中，如地球科学、脑神经科学、经济学、流体力学（湍流）、环境科学、机器学习等。2016 年，Stips 等发现二氧化碳与全球变暖的有着明确的、几乎单向的因果关系，对于最近一百多年来说，CO2 确实导致了全球变暖，但在一千年以上的古气候尺度上，这个因果关系可能完全颠倒过来，是全球变暖导致了 CO2 浓度的升高。作为例子，我将简单介绍最近关于 El Niño 智能预报的一项突破性进展（对 El Niño 进行一年以上的预报现已成为人工智能应用的一个具有挑战性的标杆）--我们发现，迄今为止，中太平洋 El Niño 至少能提前十年以上预报，可见准确的因果推断是认知、预报领域中关键的一环。

➢ SaB03 - 5 16 : 15 - 16 : 30

242Competitive Volleyball Algorithm for Global Optimization

孙硕 上海理工大学

The competition algorithm proposed in this paper is a metaheuristic technique based on swarm optimization. It is inspired by the competition between volleyball teams in a league and the improvement in players' overall abilities in order to win the Most Valuable Player award. Several specific terms relating to competition, such as pre-match reinforcement, single round robin mechanism, optimal strategy constitute the structure of the algorithm. The sensitivity of several parameters of the algorithm is analyzed and tested for three types of benchmark functions: uni modal, high-dimensional multimodal and low-dimensional multimodal functions. Through the use of these three types of test functions, the performance of this algorithm is compared with nine classical metaheuristic algorithms: Genetic Algorithm (GA), Differential Evolution (DE), Harmony Search (HS), Artificial Bee Colony (ABC), Particle Swarm Optimization (PSO), Sine Cosine Algorithm (SCA), Soccer League Competition (SLC), League Championship Algorithm (LCA) and Volleyball Premier League (VPL). CVA has been used to solve three real-world engineering problems. The results show that the performance of the CVA is behaviorally promising and better than the other classical metaheuristic algorithms.

➢ SaB03 - 6 16 :30- 16 : 45

477Quantum extreme learning machine

汪咏 同济大学

Extreme learning machine (ELM), with fast training speed and high generalization performance, has been widely used in the industry. However, it becomes inefficient to process the real-time data of extremely high dimensionality, under the practical and complex industrial situations. In this work, we introduce the advanced quantum technology to deal with the above issues and propose the model of quantum extreme learning machine (QELM). Particularly, we establish the framework to build up QELM, of which the parameters are efficiently obtained via Harrow-Hassidim-Lloyd algorithm. Moreover, we test our QELM on a wide range of datasets, including the daily demand forecast dataset, synthetic datasets, and other public datasets, and find that it can achieve the same or better prediction performance than the classical ELM. Further, it is tested on the IBM quantum simulator to demonstrate that the QELM is feasible within current technology and also admits high performance on real quantum computers. Finally, the theoretical analysis shows that the QELM is both space-saving and time-saving to process the high-dimensional data. Thus, our

work opens the way for using quantum technology to tackle the hard problems in the open environment and complex industry.

➢ SaB03 - 7 16: 45 - 17 :00

[367]Algorithm design and approximation analysis on distributed robust game

许戈辉 中国科学院
陈冠溥 中国科学院
齐洪胜 中国科学院

We design a distributed algorithm to seek generalized Nash equilibria of a robust game with uncertain coupled constraints. Due to the uncertainty of parameters in set constraints, we aim to find a generalized Nash equilibrium in the worst case. However, it is challenging to obtain the exact equilibria directly because the parameters are from general convex sets, which may not have analytic expressions or are endowed with high-dimensional nonlinearities. To solve this problem, we first approximate parameter sets with inscribed polyhedrons, and transform the approximate problem in the worst case into an extended certain game with resource allocation constraints by robust optimization. Then we propose a distributed algorithm for this certain game and prove that an equilibrium obtained from the algorithm induces an ϵ-generalized Nash equilibrium of the original game, followed by convergence analysis. Moreover, resorting to the metric spaces and the analysis on nonlinear perturbed systems, we estimate the approximation accuracy related to ϵ and point out the factors influencing the accuracy of ϵ.

➢ SaB03 - 8 17 : 00 - 17 : 15

[557]Optimization of Action Recognition Model Based on Multi-Task Learning and Boundary Gradient

徐一鸣 南通大学

Recently, people’s demand for action recognition has extended from the initial high classification accuracy to the high accuracy of the temporal action detection. It is challenging to meet the two requirements simultaneously. The key to behavior recognition lies in the quantity and quality of the extracted features. In this paper, a two-stream convolutional network is used. A three-dimensional convolutional neural network (3D-CNN) is used to extract spatiotemporal features from the consecutive frames. A two-dimensional convolutional neural network (2D-CNN) is used to extract spatial features from the key-frames. The integration of the two networks is excellent for improving the model’s accuracy and can complete the task of distinguishing the start‐stop frame. In this paper, a multi-scale feature extraction method is presented to extract more abundant feature information. At the same time, a multi-task learning model is introduced. It can further improve the accuracy of classification via sharing the data between multiple tasks. The experimental result shows that the accuracy of the modified model is improved by 10%. Meanwhile, we propose the confidence gradient, which can optimize the distinguishing method of the start‐stop frame to improve the temporal action detection accuracy. The experimental result shows that the accuracy has been enhanced by 11%.

➢ SaB03 - 9 17 : 15- 17 : 30

[374]Distributed Algorithm for Seeking Bayesian Nash Equilibrium in Subnetwork Zero - sum Games

张汉铮 中国科学院
陈冠溥 中国科学院
洪奕光 中国科学院

We consider a Bayesian Nash equilibrium seeking problem in subnetwork zero-sum games. The network consists of two subnetworks and agents in the same subnetwork collaborate to compete with other agents in the adversarial subnetwork. Each agent has its own cost function and receives information from neighbors through time-varying graphs. We propose a distributed algorithm for seeking a Bayesian Nash equilibrium and analyze on the convergence when the graphs are uniformly jointly strongly connected, and the cost functions are strictly convex. We illustrate the effectiveness of the proposed algorithm by a numerical example.

SaB04 15 : 15– 17: 30 巨蟹厅

腾讯会议：759-716-436

复杂网络

主持人：张雷 重庆交通大学
主持人：王海英 上海理工大学

➢ SaB04 - 1 15 : 15 - 15 : 30

[551] 考虑中间设施点的无人清扫车路线优化模型及算法

崔允汀 上海理工大学
何胜学 上海理工大学

当无人驾驶清扫车的容量一定、个数众多且有多个中间设施点时，合理规划行驶路线、减少不必要的行驶时间成为其推广的关键技术。利用超级网络理论将问题抽象为一个有向图上的弧路径问题，建立了无人清扫车路线优化模型。并根据问题和模型的特征，设计了对应的“单车↔双车”多级模拟退火算法进行求解。首先利用模拟退火算法优化单辆车路线；其次优化两条线路组合后车辆路线并重新分配给每辆车；然后返回上级，逐一优化单车路线并优化双车路线；反复迭代，获取总行驶时间最小的车辆行驶路线。通过算例分析发现车辆总行驶时间减少了 60%，验证了模型的正确性及算法的有效性。

➢ SaB04 - 2 15 : 30 - 15 : 45

[840]The influence of individual emotions on the coupled model of unconfirmed information propagation and epidemic spreading in multilayer networks

霍良安 上海理工大学
顾佳凤 上海理工大学

Epidemic outbreaks are often accompanied by the unconfirmed information propagation. Especially in the early stages of an epidemic outbreak, because of the lack of adequate verification, some unconfirmed information appears, which has a significant impact on the epidemic. Meanwhile, individuals under different emotions can also have different response to epidemics. In the paper, an interplay between epidemic spreading and unconfirmed information propagation model is established considering individuals' emotional factors in multilayer networks. The mean-field method is used to analyze the interaction dynamic propagation process and the threshold of epidemic is obtained. Finally, through the theoretical analysis and numerical simulations of scale-free network, the validity of the results is verified. The results show that the information, although unconfirmed, is still conducive to curb the spread of the epidemic. In addition, individuals with different emotions will adopt different self-protective behaviors, so as to further affect the spread of the epidemic.

➢ SaB04 - 3 15 : 45 - 16 : 00

[165] 基于酶调控网络的模体比较

林海鹏 中国科学院
韩靖 中国科学院

生物调控网络的功能与拓扑结构之间的关系是系统生物学的一个研究重点。本报告基于酶调控网络这一重要的生物调控网络，比较了一类三节点、四节点和五节点调控网络模体在周期性和适应性这两个重要特性，发现周期性最显著和适应性最高的是五节点强耦合对称网络模体：首先，该模体在参数空间中出现内禀周期振荡的频次最多，振幅分布和周期长度分布的范围最广，说明具有最显著的周期性，容易通过改变参数来调节周期的振幅和周期长度；其次，无论外界输入对网络是促进作用还是抑制作用，在调控网络收敛到不动点或者周期解的两种情形下，该模体的适应性表现都优于其它的网络模体，这意味着该模体更稳定，其收敛值不容易因为外界扰动而改变过大。

➢ SaB04 - 4 16 : 00- 16 : 15

[731]Epidemic dynamics on higher-dimensional small world networks

王海英 上海理工大学

Dimension governs dynamical processes on networks, but studies of spreading on finite-dimensional networks are usually restricted to one or two dimensions. To facilitate investigation of the impact of dimension on spreading processes, we define a flexible higher-dimensional small world network model and characterize the dependence of its structural properties on dimension. Subsequently, we derive mean field, pair approximation, intertwined continuous Markov chain and probabilistic discrete Markov chain models of a COVID-19-inspired susceptible-exposed-infected-removed (SEIR) epidemic process with quarantine and isolation strategies, and for each model identify the basic reproduction number R0. The results showing that both network properties and the outcome of Monte Carlo simulations vary substantially with dimension or rewiring rate, but predictions of continuous state models change only slightly.

➢ SaB04 - 5 16 : 15 - 16 : 30

[409]Frequency-Amplitude Correlation Inducing First-order Phase Transition in Coupled Oscillators

王降圣 上海理工大学
顾长贵 上海理工大学

First-order phase transition in coupled oscillators, which is different from the continuous phase transition,

have been widely concerned because of its discontinuity and irreversibility. In previous work, the stable occurrence of such phenomenon depends on a designed coupling mechanism between each network oscillator, such as the unique network topology or weighted coupling strength, which is related to nodal dynamics. Here, we propose a new first-order phase transition generation mechanism. To be specific, for the oscillator model containing amplitude information, a surprising explosive phenomenon emerges when dynamics of each node satisfies a complementary relationship between intrinsic amplitude and natural frequency, which does not rely on the frequency distribution. Our findings suggest that heterogeneous coupling of each networked oscillator is not a necessary condition for the existence of first-order phase transitions. Therefore, it provides a new perspective to understand such phenomenon from the correlation of intrinsic properties rather than heterogeneity of external coupling.

➢ SaB04 - 6 16 :30- 16 : 45

[494] 复杂电磁环境的构建与度量研究

王兴财 电子科技大学

电磁信号作为信息的传播载体，导致信息激烈交互的一定时间、空间内电磁环境呈现出复杂性。复杂的电磁环境对未来战场的态势感知、指挥控制以及武器的生存等带来严峻挑战，因此对复杂电磁环境的研究具有重要的意义。其中复杂电磁环境的构建与度量是对其进行研究的重要前提，亦是对军用设施进行技术检验的重要环境，因此本报告将对复杂电磁环境的构建与度量进行研究，利用时、频、空、能、极化等域进行辅助分析，结合电磁信号的不确定性以及同一个时空中不同辐射源构成的电磁网络复杂性来做理论分析与推导，得到空间电磁分布的基本特性，最后对环境中的电磁信号节点和电磁网络进行建模，实现电磁环境的构建与度量的总体方案。

➢ SaB04- 7 16 : 45 - 17 : 00

[872] A Dynamic Event-Triggered Mean-Square Consensus Control for Discrete-time Stochastic Multi-Agent System With System Uncertainties

夏遵安 安徽工程大学
刘宏建 安徽工程大学
陈麒文 安徽工程大学
章冉 安徽工程大学

In this paper, the mean-square consistency control problem of a class of discrete time-varying multi-agent systems with system parameter uncertainty and the dynamic event-triggering mechanism is studied. Using a dynamic event-based mechanism, each agent only updates the control input signal when it violates the pre-set triggering conditions. A mean-square consistent performance index is used to reflect the transient consistent behaviour of the deviation degree between each agent and the mean of the average state of the whole system. For a fixed network communication topology, the purpose is to design a time-varying feedback controller, so that the mean square consistency index of each agent in each time step can satisfy the given upper bound constraint under the disturbance of external disturbances in the closed-loop network multi-agent system. Then, the feedback gain is obtained by solving the solution of recursive linear matrix inequality. Finally, a simulation example is given to illustrate the authenticity and effectiveness of the proposed algorithm.

➢ SaB04- 8 17 : 00 - 17 : 15

[221] Motion modal recognition method based on Scharr operator

张雷 重庆交通大学

In the videos related to terrorism and violence, the behavior of character entities is always accompanied by aggressive hitting and waving, and the interaction of behaviors among multiple entities is often associated with violence. In order to extract the character's behavior characteristics from the video, this paper, based on the contour detection of the video frame, considers the modeling based on the action of the entity in the video, and constructs the action recognition mode. In addition, a ConvLSTM network was introduced and a motion recognition model based on contour detection was built for temporal correlation analysis of gradient feature images of multiple adjacent video frames. In the verification experiment, the influence of Sobel operator and Scharr operator on contour extraction and precision of motion recognition model is discussed respectively. The constructed Scharr-2DCNN-ConvLSTM motion recognition model achieves 91.6% accuracy in five-fold cross-validation.

SaB05　15 : 15 – 17 : 15　双鱼厅

腾讯会议：980-294-620

稳定性与鲁棒性理论研究(1)

主持人：杨志春　重庆师范大学

主持人：费晨　上海理工大学

➢ SaB05 - 1　15 : 15 - 15 : 30

[12]Delay-dependent Asymptotic Stability of Highly Nonlinear Stochastic Differential Delay Equations Driven by G-Brownian Motion

费晨　上海理工大学

Based on the classical probability, the stability of stochastic differential delay equations (SDDEs) whose coefficients are growing at most linearly has been investigated intensively. Moreover, the delay-dependent stability of highly nonlinear hybrid stochastic differential equations (SDEs) has also been studied recently. In this paper, by using the nonlinear expectation theory, we first explore the delay-dependent criteria on a class of highly nonlinear hybrid SDDEs driven by G-Brownian motion (G-SDDEs). Then, the (weak) quasi-sure stability of solutions to G-SDDEs is developed. Finally, an illustrative example is analyzed by the φ-max-mean algorithm for verifying our theory results.

➢ SaB05 - 2　15 : 30 – 15 : 45

[603]Robust cycles of Boolean control networks with finite disturbances

付世华　聊城大学

王建军　University of Camerino

When the dynamics of a logical network are affected by external disturbances, the structures of their cycles will be diverse, which is quite different from the logical networks without disturbance. In this paper, we introduce several types of robust control cycles (RCCs) for Boolean control networks (BCNs) affected by finite disturbances, and provide their computing methods. First, the cycles of a BCN are classified as strong RCCs and weak RCCs according to their ability to resist disturbances. Secondly, the properties of states on a cycle for the BCNs are revealed, based on which all the RCCs whose weak connecting degree is not more than one with certain length are obtained, and the corresponding state feedback controls are given. Finally, some examples are given to demonstrate the effectiveness of the obtained theoretical results, as well as to show the potential applications of these results. It is noted that all the RCCs are searched from a subset of the state space, which determined by the properties of RCCs obtained by this paper, rather than the full space. Finding the RCCs from a subset will be very helpful to reduce the computational complexity.

➢ SaB05 - 3　15 : 45 – 16 : 00

[105]Delay Tolerance of Hybrid Stochastic Differential Equations Driven by Lévy Noise

李文瑞　南京理工大学

费晨　上海理工大学

费为银　安徽工程大学

In this article we will study the delay tolerance for stable hybrid stochastic differential equations driven by Lévy noise (HSDEs-LN) under global Lipschitz continuous coefficients. Based on Lyapunov conditions, we will show that when the original HSDEs-LN without delay is p th moment exponentially stable, the system with small delays is still p th moment exponentially stable. We will also obtain explicit delay bounds for moment exponential stability. An example will also be provided to demonstrate the effectiveness of the theoretical results.

➢ SaB05 - 4　16 : 00- 16 : 15

[735]Optimal time-decay rates of the 3D compressible nematic liquid crystal flows with discontinuous initial data and large oscillations

王涵　广西师范大学

张映辉　广西师范大学

The global existence of low-energy weak solutions for the 3D compressible nematic liquid crystal flows with discontinuous initial data and large oscillations has been proved by Wu-Tan (J. Differential Equations 264 (2018) 6603-6632) under the assumptions that the initial energy is small and the initial density has positive lower and upper bounds. However, up to now, the time-decay rate of these solutions has remained an open problem since the solutions have low regularity, and particularly the density has no regularity. We resolve this problem by proving time-decay rates of the solutions in L^r-norm with $2 \leq r \leq \infty$. Moreover, if additionally the initial data satisfies some low-frequency assumption, the optimal lower bound decay rates of solution are also

obtained. Therefore, our decay rates are optimal in this sense.

➢ SaB05 - 5 16 : 15 - 16 : 30

[678]Global exponential stability of delay dynamical systems with impulsive effects due to logic choice

谢巧玲 重庆师范大学
杨志春 重庆师范大学

In this paper, we investigate the global exponential stability of delay dynamical systems with impulsive effects due to logic choice. First, we introduce delay dynamical systems with logic selected impulsive effects and establish impulsive-type Hanalay differential inequality. Furthermore, by using semi-tensor product and estimating Cauchy matrix of linear system, we obtain the criteria on global exponential stability of the nonlinear delay system under impulsive control suffered by logic choice. Finally, explicit steps on impulsive stabilization of the delay systems are presented. Examples and stimulations are given to illustrate the effectiveness of the results.

➢ SaB05 - 6 16 :30- 16 : 45

[303]Small-Gain-Based Fuzzy Adaptive Control of Interconnected Systems with Unmodeled Dynamics

徐博 青岛大学
李元新 辽宁工业大学

This paper presents a new stabilizing control scheme for a class of interconnected nonlinear systems subjected to unmodeled dynamics and unmeasurable states. Fuzzy logic systems are applied to approximate the unknown functions, and a fuzzy-based state observer is constructed. The interconnection of the overall system is completely compensated via the cyclic-small-gain condition theorem, and the small-gain theorem is introduced to overcome the unmodeled dynamics in each subsystem. Furthermore, assumptions from prior literature are relaxed and computing burden is reduced through the design of less adaptive laws. This paper proves that under the designed control scheme, the closed-loop systems are controlled to be input-to-state practical stable (ISpS) and that all signals are guaranteed to be semi-globally uniformly ultimately bounded (SGUUB). Finally, the paper's simulation section illustrates the effectiveness of the proposed approach through an example derived from a practical system model. In sum, this work's unique contributions are as follows: (1) For the first time, this paper investigates the stabilizing control problem for a class of interconnected nonlinear systems subject to unmodeled dynamics and unavailable states. A novel decentralized control scheme is proposed by introducing the small-gain approaches and the ISpS theory, thus establishing an efficient method for eliminating the coupling effects caused by the interaction and the unmodeled dynamics. This allows the designed controller to be applied to practical environments. (2) The small-gain theorem and the ISpS theory are incorporated into the adaptive fuzzy control framework to handle the unmodeled dynamics. (3) A direct method of adaptive law design is employed for this control scheme. And only the output information is available in this paper. This means that the approach is more suitable for practical systems with limited onboard sensors and unmeasurable states.

➢ SaB05 - 7 16 : 45- 17 : 00

[161]非线性多智能体系统的模糊自适应固定时间一致性跟踪控制

张丽丽 青岛大学

本文讨论了非线性多智能体系统的一致性跟踪问题，并利用模糊自适应技术提出了一种固定时间一致性跟踪控制协议。首先，建立了一种更为一般的固定时间稳定性准则。其次，根据所提出的稳定性准则，利用反推法设计了一种固定时间模糊自适应控制器。所提出的模糊自适应控制方案能够确保：1) 每个智能体的所有闭环信号都保持有界；2) 一致性跟踪误差在固定时间内能够收敛到原点的一个小邻域内。除此之外，将虚拟控制器设计为分段型函数来避免其导数的奇异性问题，同时利用曲线拟合的方法，使所设计的虚拟控制信号在分段点是可导的。最后，通过数值仿真来进一步证实所提出控制策略的有效性。

➢ SaB05 - 8 17 : 00 - 17 : 15

[44]基于策略迭代的多智能体系统自适应容错控制

Zhao Liang 东北大学
冀相晗 青岛大学
曹广田 青岛大学
马东升 青岛大学

本文研究了带有执行器漂移故障的非线性多智能体系统容错控制问题，设计了基于策略迭代学习的自

适应容错控制算法。为了补偿执行器故障，本文结合分布式投影算法提出了一种类协议的高增益观测器，并结合策略迭代学习算法设计了协同自适应容错控制器。通过给出评价网络和执行网络的整定算法，并设计合适的自适应参数，从而保证了闭环系统稳定性。

SaB06　　15 : 15– 17 : 15　　铂派厅

腾讯会议：969-344-238

稳定性与鲁棒性理论研究(2)

主持人：刘子建　　重庆交通大学

主持人：赵军圣　　聊城大学

➢ SaB06 - 1　　15: 15 - 15 : 30

[509]Adaptive output-feedback control for stochastic nonlinear systems with global practical output tracking

曹杨荷　　聊城大学

赵军圣　　聊城大学

This manuscript addresses the adaptive output-feedback stabilisation for a class of stochastic nonlinear systems with global practical output tracking. Firstly, we give sufficiently smooth pseudo-sign and pseudo-dead-zone functions, and introduce a new Lyapunov function. The developed pseudo-dead-zone function overcomes well the extra time variation and/or additive non-vanishing uncertainties due to the practical tracking. Then, based on the back-stepping method, a systematic design procedure are used to deal with parameters in both drift and diffusion terms. It is shown that a new controller is constructed can make the closed-loop equilibrium of interest is globally stable in probability. Specifically, the solution process can be regulated to the origin almost surely. Finally, a simulation example is submitted to illustrate the efficiency of the designed controller.

➢ SaB06 - 2　　15 : 30 - 15 : 45

[222]On the existence of the exact solution of quaternion-valued neural networks based on a sequence of approximate solutions

陈晓丰　　重庆交通大学

In many practical applications, it is difficult or impossible to obtain the exact solution of the mathematical model due to the limitations of solving methods and the complexity of the neural network itself. A natural problem is given as follows: does the exact solution of quaternion-valued neural networks (QVNNs) exist when successively improved approximate solutions can be obtained? Fortunately, the Hyers–Ulam stability happens to be one of the important means to deal with this problem. In this article, the issue of Hyers–Ulam stability of QVNNs with time-varying delays is addressed. First, inspired by the Hyers–Ulam stability of general functional equations, the concept of the Hyers–Ulam stability of QVNNs is proposed along with the QVNNs model. Then, by utilizing the successive approximation method, both delay-dependent and delay-independent Hyers–Ulam stability criteria are obtained to ensure the Hyers–Ulam stability of the QVNNs considered. Finally, a simulation example is given to verify the effectiveness of the derived results.

➢ SaB06 - 3　　15 : 45- 16 : 00

[435]Lipschitz-like property relative to a set and the generalized Mordukhovichcriterion

李明华　　重庆交通大学/重庆文理学院

In this paper we will establish some necessary condition and sufficient condition respectively for a set-valued mapping to have the Lipschitz-like property relative to a closed set by employing regular normal cone and limiting normal cone of a restricted graph of the set-valued mapping. We will obtain a complete characterization for a set-valued mapping to have the Lipschitz-property relative to a closed and convex set by virtue of the projection of the coderivative onto a tangent cone. Furthermore, by introducing a projectional coderivative of set-valued mappings, we establish a verifiable generalized Mordukhovich criterion for the Lipschitz-like property relative toaclosedandconvexset.We will study there presentation of the graphical modulus of aset-valuedmappingrelativetoaclosedandconvexsetbyusingtheouternormofthe corresponding projectional coderivative value. For an extended real-valued function, we will apply the obtained results to investigate its Lipschitz continuity relative to a closed and convex set and the Lipschitz-like property of a level-set mapping relative to a half line.

➢ SaB06 - 4　　16 : 00 - 16 : 15

[406]A novel one-layer recurrent neural network for solving interval-valued constrained optimization problem

李月秋 重庆交通大学

In recent decades, the neurodynamic approach is widely studied and applied in various optimization and engineering problems. This paper investigates the optimization problem with both interval-valued objective function and constraints. We present a novel one-layer recurrent neural network to solve the interval-valued optimization problem with nonlinear interval-valued constraints. By choosing suitable Karush-Kuhn-Tucker conditions we solve the interval-valued constrained optimization problem through the neurodynamic approach. It is indicated that the neural network model is not only stable in the sense of Lyapunov, but also globally convergent to the optimal solution. In the end, some simulation results are presented to prove the feasibility and effectiveness of this one-layer recurrent neural network.

➢ SaB06 - 5 16 : 15 - 16 : 30

[180]Modeling and Analysis of a Nonlinear Age-Structured Model for Tumor Cell Populations with Quiescence

刘子建 重庆交通大学

We present a nonlinear first-order hyperbolic partial differential equation model to describe age-structured tumor cell populations with proliferating and quiescent phases at the avascular stage in vitro. We assume that the division rate of the proliferating cells is nonlinear due to the limitation of the nutrient and space. We consider the model includes a proportion of newborn cells that enter directly the quiescent phase with age zero. We think that this proportion can reflect the effect of treatment by drugs such as erlotinib. We investigate the existence and uniqueness of solutions, the local and global stabilities of the trivial steady state and the existence and local stability of the positive steady state. We perform numerical simulations to verify the results and to examine the impacts of parameters on the nonlinear dynamics of the model.

➢ SaB06 - 6 16 : 30 - 16 : 45

[216]Mean-square stability of stochastic quaternion-valued neural networks with variable coefficients and neutral delays

宋乾坤 重庆交通大学
曾润湉 重庆交通大学
赵振江 湖州师范学院
刘玉荣 扬州大学

In this paper, the stochastic quaternion-valued neural networks model with variable coefficients and neutral delays is considered, and the mean-square stability criterion is provided via the method of mathematical analysis. In deriving stability criterion, the considered stochastic quaternion-valued neural networks model is implemented as an entirety form without separating the model into two complex-valued and four real-valued models. And the obtained result is valid for stochastic real-valued and complex-valued neural networks. A numerical simulation example is given to show the effectiveness of the obtained result.

➢ SaB06 - 7 16 : 45 - 17 : 00

[748]Adaptive Recursive Terminal Sliding Mode Control Based on Improved Fully Adjusted RBF Neural Network

张罗玉 南通大学
郭云翔 南通大学
张新松 南通大学
卢成 南通大学

This paper proposes an adaptive recursive terminal sliding mode (ARTSM) control based on improved fully adjusted RBF neural network for the uncertainty of angular velocity of the Micro Electromechanical System (MEMS) gyroscope. First, the mathematical model of the MEMS gyroscope is introduced, then an ARTSM controller is constructed. The sliding surface consists of a fast nonsingular terminal sliding surface and a recursive integral terminal sliding surface, which not only guarantees finite-time convergence but also reduces the arrival time by setting the initial value of the integral element. At the same time, the tracking error can ideally converge to zero. In addition, to overcome the dependence of the system on parameters, an improved fully regulated RBF neural network is used to approximate the time-varying parameters of the system. Simulation studies are implemented to verify the effectiveness of the proposed scheme.

➢ SaB06 - 8 17 : 00 - 17 : 15

[503]Prescribed-time Stabilization and Inverse Optimal of High-order Stochastic Nonlinear Systems

赵军圣 聊城大学

赵海娜 聊城大学

In this paper, the prescribed-time mean-square stabilization and inverse optimal control is proposed for a class of high-order uncertain stochastic nonlinear systems with strict feedback form. Firstly, a new non-scaling backstepping design scheme is developed by using the technique of adding a power integrator and a novel state feedback controller is successfully constructed. Then, a suitable adaptive fuzzy control strategy is proposed to deal with completely unknown drift terms and diffusion terms. In addition, based on the stochastic Lyapunov theorem, a control scheme of prescribed-time mean-square stability is established. Further, we redesign the controller and solve the prescribed-time inverse optimal mean-square stabilization problem. Compared with the previous literature, a novel design ingredient is that the time-varying function is not used to scale the coordinate transformations and is only suitably introduced into the virtual controllers, which makes a simpler controller results and the control effort is reduced. Finally, a simulation example is given to show the effectiveness of the proposed control strategy.

2022 年 11 月 13 日（周日）

SuA01　13 : 00 – 15 : 00　　白羊厅

腾讯会议：577-423-834

博弈论及其应用

主持人：孙昌浩　　中国空间技术研究院

主持人：韩小雅　　上海理工大学

➢ SuA01 - 1　　13: 00 - 13 : 15

[470] 基于随机模型的医疗资源最优预留服务能力策略的研究

陈燕婷　　上海理工大学

陈古艳　　上海理工大学

在某城市三甲妇幼医院中，由于孕产妇诊疗需求的随机性和除了常规检查产生额外检查需求的随机性，医院的 B 超诊疗中心往往需要对短期和长期的 B 超预约和资源设计进行优化安排。首先，本文基于实际数据分析现阶段孕产妇 B 超诊疗的需求现状和产生额外检查需求的比例；其次，为了降低医疗系统和孕产妇就诊的损失，建立随机模型确定短期和长期预留服务能力的最佳策略；最后，基于实际数据的预测，利用随机优化模型确定较长期的医疗资源优化设计方案。

➢ SuA01 - 2　　13 : 15 - 13 : 30

[562]Optimal decisions for the innovative enterprise considering brand goodwill and consumers' quality expectation

韩小雅　　上海理工大学

张会臣　　上海理工大学

The innovative enterprise entering a new market makes optimal decisions based on consumer behavior and market conditions. This study investigates product pricing strategy and quality strategy by considering the brand goodwill of the innovative enterprise and the consumers' quality expectation. The innovative enterprise is analyzed from three scenarios: single-product strategies, competitive pricing, and asymmetric-information case. Results show that the optimal price and quality level of the innovative product are not always positively correlated with the brand goodwill of the innovative enterprise. Moreover, to cope with a competitive market, optimal prices and production strategies are proposed. Faced with consumers insensitive to quality bias, the innovative enterprise with low brand goodwill can hardly gain an advantage in quality strategy. In a Bertrand competitive market, the optimal price and corresponding production strategy of an innovative product are somewhat different from that in a Stackelberg game market. In addition, information transparency is key to the success or failure of an innovative enterprise in a competitive market.

➢ SuA01 - 3　　13 : 30 - 13 : 45

[440] 考虑个体风险偏好的创新产品信息扩散问题研究

霍良安　　上海理工大学

谢笑笑　　上海理工大学

近年来，产品信息扩散的速度越来越快。企业所发布的创新产品容易受到个体风险偏好程度的影响，进而影响企业的利润，制定产品信息扩散策略对于企业来讲至关重要。报告在考虑个体对产品风险偏好程度的基础上，提出了一种改进的产品信息扩散模型，通过研究产品信息扩散模型的动态过程，计算了产品信息扩散的临界阈值。在此基础上，进一步考虑创新产品信息扩散影响力最大化问题，提出了一个最优控制问题，通过数学分析计算了最优控制的最优条件，并通过数值仿真验证了理论结果的正确性。研究发现，个体风险偏好程度、多种产品信息扩散的相互作用都会影响创新产品信息的扩散机制，并且产品的促销力度和宣传力度能够有效控制产品信息扩散并使得企业利润最大化。

➢ SuA01 - 4　　13 : 45 - 14 : 00

[657]Sharing the cost of cleaning a polluted river based on optimal pollutant control

雷雨晴　　上海理工大学

张广　　上海理工大学

This paper focuses on the polluted river problem related to regional conflicts and studies a cleaning cost allocation method in terms of optimal pollutant control. Since the upstream agents play essential roles in dealing with a polluted river, the river basin can be roughly considered as a permission structure, which means that only the upstream agents take part in cooperation the environmental problem can be solved properly. Underlying such restricted structure and to meet the national emission standard, an optimal control model is

firstly constructed to minimize the cost of controlling pollutants by considering the responsibility of a region for both its upstream and downstream neighbors. A dynamic approach, which is adapted from the procedural egalitarian solution in Dietzenbacher (2016), is then proposed to allocate the cleanup cost by integrating the permission structure. Later on, a numerical example of this study is presented to apply in Huaihe River Basin of China, which supports two insights: On one hand, by transferring pollutants through adjacent regions, the water quality attainment rate of the river basin achieved 100%. On the other hand, compared to the actual situation including regional environmental tax, the average optimal cost of each province was reduced by at least 26.52% in 2011 - 2015. Therefore, the proposed model is verified effective for the polluted river problem and demonstrates the application potential in other basins as well.

➢ SuA01 - 5 14 : 00 - 14 : 15

[88]Distributed Weighted Vertex Cover via Game-Theoretic Learning

孙昌浩 中国空间技术研究院

Focusing on the minimum weighted vertex cover (MWVC) problem in multiagent systems, we present a distributed algorithm from the perspective of learning in games. For self-organized coordination and optimization, we see each vertex as a potential game player, who makes decisions using local information of its own and the immediate neighbors. The resulting Nash equilibrium is classified into two categories and we show that the optimal solution must be a DNE. For better approximation ratios, local rules of perturbation and weighted memory are designed. By showing the existence of an improvement path from any INE to a DNE, we prove that our algorithm converges in finite time to DNEs. Finally, intensive comparison experiments demonstrate the superiority of the presented methodology to the state of the art, both in solution efficiency and computation speed.

➢ SuA01 - 6 14 : 15 - 14 : 30

[315]All - Against - One Stochastic adaptive Games

袁硕 中国科学院

All-Against-One game models a multi-player game where one player dissents from other players. A common example in All-Against-One games is the multi-pursuer one-evader pursuit-evasion game where a group of pursuers try to chase the evader who tries to escape. In real world game systems, there always existing uncertainties, which raises the difficulty of making decisions. When the system contains unknown parameters and random noise, how to design the game strategies combining with the idea of adaptive control is a meaningful research direction. In this paper, we focus on the All-Against-One linear stochastic game. We design adaptive game strategies for linear game systems with quadratic indexes, when the internal parameters of the systems are unknown. And we prove that the adaptive strategic profile makes the system globally stable, and reaches an asymptotic Nash equilibrium solution.

➢ SuA01 - 7 14 : 30 - 14 : 45

[6]Adaptive allocation rules for hypergraph games

张广 上海理工大学

Cooperative games with hypergraph structure, or hypergraph games, assume that all players in a hyperlink or conference have to be present before communication. Contrary to this situation, assuming that whenever players leave a conference the remaining players can still communicate with each other, adaptive allocation rules for hypergraph games, being alternative extensions of the Myerson value and the position value respectively, are introduced in this paper. Axiomatic characterizations are also provided by considering players' absence.

➢ SuA01 - 8 14 : 45 - 15 : 00

[456]Cooperative NS equilibria of games under uncertainty

张弦 上海理工大学

We introduce the notion of cooperative NS equilibria of games under un certainty, where the players know the domain of undetermined parameters and these parameters can vary but completely ignore their behaviors. Inspired by Zhao (1992), we first define the cooperation NS equilibrium in normal form games under un certainty which is a hybrid solution by combining the concepts of NS equilibrium and α-core. Second, we prove the existence theorem of cooperative NS equilibria by using the existence theorem of hybrid

solution in Zhao(1992).

SuA02　　13 : 00 – 15 : 00　　金牛厅

腾讯会议：709-369-373

系统运筹、优化及调度

主持人：彭再云　　重庆交通大学

主持人：张新功　　重庆师范大学

➢ SuA02 - 1　　13: 00 - 13 : 15

[480] 基于随机模型的具有长期诊疗需求病患诊疗安排的最优设计

陈燕婷　　上海理工大学

李胡蓉　　上海理工大学

以我国某城市三甲医院为例，许多重症病人（例如癌症病人需要长期化疗）和慢性病病人具有长期诊疗需求，针对此类现象，本文主要通过考虑病人预约就诊的满意度和医疗资源的优化使用，首先，基于实际数据，衡量现阶段针对具有长期诊疗需求病患预约和治疗的服务水平；其次，以病人预约就诊的满意度和医疗资源的优化使用为目标，同时考虑病人到达和诊疗服务的随机性，建立随机模型确定具有长期诊疗需求病患诊疗安排的最优设计方案。最后，本文将研究病人可能出现的迟到或者在预约的时间不出现等行为对随机服务系统的影响。

➢ SuA02 - 2　　13 : 15 - 13 : 30

[681] 基于最大边际的递归主动学习

古仕林　　国防科技大学

当未标记数据丰富但标记数据稀缺时，主动学习是缓解该问题的重要技术。它旨在选择最有价值的样本进行标记，以便在监督信息最少的情况下构建强大的预测模型。然而，在主动学习场景下，当数据具有高维性时，标注数据的有限性会导致模型参数很难得到可靠的估计。现有的解决策略大多是通过在主动学习之前学习数据的低维表示，但由于传统的降维技术和主动学习算法是独立设计的，因此该策略不能保证模型具有良好的性能。在本文中，我们提出了一种高效的混合主动学习算法，称为递归最大边际主动学习。我们在统一的框架下优化主动学习和半监督特征提取，以解决主动学习场景下数据的高维性问题，并在低维空间中选择最具代表性的样本进行人工标注。通过将半监督最大边际准则引入主动学习，我们可以在主动学习的每次迭代中递归地进行样本选择和特征提取，以学习更准确的模型。实验结果表明，所提出的方法在公开可用的数据集上优于几种最先进的主动学习方法。

➢ SuA02 - 3　　13 : 30 - 13 : 45

[217] A One-Layer Recurrent Neural Network for Interval-Valued Optimization Problem with Linear Constraints

胡进　　重庆交通大学

In this paper, the interval-valued optimization problem is converted to a general problem in the parametric form and its solution is efficient. We present a one-layer recurrent neural network for solving this interval-valued optimization problem with linear constraints. Based on this approach, we prove that the recurrent neural network is stable in the sense of Lyapunov and the equilibrium point of the neural network is globally convergent to the optimal solution. The proposed approach improves the algorithm for the interval-valued optimization and the model is easy to implement. Finally, two numerical examples are provided to show the feasibility and effectiveness of the proposed approach.

➢ SuA02 - 4　　13 : 45 - 14 : 00

[149] Painlevé-Kuratowski convergence of minimal solutions for set-valued optimization problems via improvement sets

彭再云　　重庆交通大学

The aim of this paper is to explore the stability of (weak)-minimal solutions for set valued optimization problems via improvement sets. Firstly, the optimality and closedness of solution sets for the set-valued optimization problem under the upper order relation are discussed. Then, a new convergence concept for set valued mapping sequences is introduced, and some properties of the set-valued mapping sequences are shown under the new convergence assumption. Moreover, by means of upper level sets, Painlevé-Kuratowski convergences of (weak) E-u-solutions to set-valued optimization problems with respect to the perturbations of feasible sets and objective mappings are established under mild conditions. The order that we use to establish the result depends on the improvement set, which is not necessarily a cone order. Our results can be seen as the extension of the related work established recently in this field.

➢ SuA02 - 5　　14 : 00 - 14 : 15

[229] The Sorted-waste Capacitated Location Routing Problem with Queuing Time: A Cross-entropy and Simulated-annealing-based Hyper-heuristic Algorithm.

尚春剑 上海理工大学

Waste sorting is an imperative and significant issue in China, of which sorted-waste collection and transportation are indispensable parts. Despite its vital yet practical significance, few studies research mathematical models or algorithms of waste collection and transportation from the perspective of waste sorting. To address this issue, we extend a novel transportation model for the waste management system, namely, capacitated location routing problem with queuing time (CLRPQT) and design a cross-entropy and simulated-annealing based hyper-heuristic algorithm (CE-SAHH) for it. The main idea of this paper is three-fold: 1) As a particular property of this problem, source nodes cannot but need to be served by more than one vehicle that causes queuing time between a heterogeneous fleet of vehicles, which is novel in terms of the proposed model; 2) For the methodological contribution, a character encoding scheme, new decoding procedure, and local search strategy are designed embedded in the proposed method; 3) An integration of simulated annealing strategy and the cross-entropy-based hyper-heuristic algorithm is developed to overcome the combinatorial optimization problem with a more complex solution of this study. Finally, the results and analysis of three numeric experiments on benchmark datasets, new instances of CLRPQT, and simulation data in Shanghai, China, verify the effectiveness and universality of the proposed model and method.

➢ SuA02 - 6 14 : 15 - 14 : 30

622Online scheduling of two flowshop with lookahead and incompatible job families

张新功 重庆师范大学

This paper considers online scheduling on two unit flowshop machines, which there exist unbounded parallel-batch processing of incompatible job families and lookahead intervals. The unit flowshop means that the processing time of any job on each machine is unit processing time. Based on overtime case, the objective is to minimize the maximum completion time. The lookahead model means that an online algorithm can foresee the information of all jobs arriving in time interval (t, t + β] at time t. There exist Incompatible job families, that is, jobs belonging to different families cannot be processed in the same batch. In this paper, we firstly give the lower bound of the proposed problem, and provide a best possible online algorithm of competitive ratio.

➢ SuA02 - 7 14 : 30 - 14 : 45

240A sample average approximation method based on a gap function for stochastic multiobjective optimization problems

赵勇 重庆交通大学

In this paper, we consider the sample average approximation method for stochastic multiobjective optimization problems without the scalarization parameters. By virtue of gap function, we transform stochastic multiobjective optimization problems into the stochastic optimization reformulation problems. Some properties of the reformulation problems are discussed. Furthermore, we propose a sample average approximation method for solving the reformulation problems, and the convergence and the rates of convergence of optimal values and optimal solutions of the approximation problems are investigated.

➢ SuA02 - 8 14 : 45 - 15 : 00

453A New Relaxed Method For Solving Split Feasibility Problem with Multiple Output Sets

朱亚 上海理工大学

In this paper, we consider the splitting feasibility problem of multiple output sets in Hilbert Spaces and use a new relaxation method to solve it. In our method, we change the projection onto the half-space to the projection at the intersection of the two half-spaces. Under the conditions given, we prove its convergence. In the last part, we give an application simulation experiment to prove the application of the algorithm in the field of actual research, so as to illustrate the effectiveness and practical significance of the algorithm.

SuA03 13 : 00 – 15 : 00 双子厅

腾讯会议：909-239-094

交通系统复杂性(1)

主持人：邝华 广西师范大学

主持人：张锐 西南交通大学

➢ SuA03 - 1 13 : 00 - 13 : 15

547 Optimal Control to Improve Reliability of Demand Responsive Transport Priority at Signalized Intersections Considering the Stochastic Process

梁士栋 上海理工大学

Bus priority has been proposed for many years to improve traffic congestion, energy conservation, and emissions reduction. Transit signal priority is a main measure of executing bus priority. Moreover, because the time that buses arrive at an intersection should be predicted quite precisely to make a signal control scheme in advance, bus lane is an important segment in transit priority at signalized intersections to avoid disturbances from other vehicles on the road. However, in practice, the bus route of demand responsive transport is widespread, which is not inappropriate to set bus lane for each bus route because of low frequency. Therefore, in this paper, a robust optimization control method is proposed to solve the bus priority problem at signalized intersections without exclusive bus lanes and improve reliability of demand responsive transport priority at signalized intersections. First, the bus delay probability density function is formulated based on the auxiliary line of the "bus delay contour line," which can be used to describe the interaction mechanism about the bus and other vehicles at the signalized intersection. Then, the accurate bus delay expectation and variance calculation mathematical models are formulated based on the bus delay probability density function. Furthermore, a robust optimal signal control method is proposed followed by the discussions of boundary conditions. Finally, simulation test and case study were conducted to illustrate the performance of the robust optimization control method proposed in this paper. The results show that the proposed control method could significantly improve bus delay compared to considering the bus operation process as stable, and there was little difference of signal timing change, especially when buses arrived at signalized intersections concentrated around the time of late greens and early reds.

➢ SuA03 - 2 13 : 15 - 13 : 30

623 城市交叉口动态直右车道设计及信号控制研究

梁士栋 上海理工大学
宁搏 上海理工大学

在城市交通问题中，交叉口交通问题是主要的问题之一，其中包含右转车道浪费，排队长度受限，车道数量不够等现象。为了提高交叉口的通行效率，缓解交叉口的交通问题，本文针对右转车道浪费现象，提出了一种“动态直右车道”的优化模型，该模型将右转车道分为动态可变车道和右转车道两部分，在预信号控制下，直行车辆可借用动态可变车道通过交叉口，从而在一定程度减少交叉口的延误，提高右转车道的利用率。最后利用仿真案例证明，右转车道为动态直右车道的交叉口相对右转车道为静态直右车道的交叉口延误减少 18.35%-47.95%，相对右转车道为专用右转车道的交叉口延误最大能减少 31.57%，结果表明，本文提出的“动态直右车道”的优化模型具有一定的可行性。

➢ SuA03 - 3 13 : 30 - 13 : 45

847 基于扩展 TPB 模型的城市居民绿色出行行为研究

陆欢 上海理工大学
干宏程 上海理工大学

积极引导城市居民选择绿色出行，有助于减少城市交通碳排放，助力我国“双碳”目标的实现。本研究以 TPB 为理论框架，在考虑 TPB 基本变量的基础上，通过引入出行习惯、环保意识、预期后悔 3 个扩展变量，构建了基于扩展 TPB 模型的城市居民绿色出行行为影响因素模型，采用偏最小二乘法结构方程模型进行变量间路径关系的检验，分析影响绿色出行行为的关键因素，并解析其直接和间接效应，利用问卷调查收集的行为数据进行实证分析。结果表明，基于扩展 TPB 研究绿色出行行为具有较好的可行性和适用性；出行态度、主观规范和环保意识对绿色出行行为的间接效应分别为 0.12、0.15 和 0.20；知觉行为控制的直接效应为 0.37，间接效应为 0.07，总效应为 0.44；出行习惯的直接效应为 0.25，间接效应为 0.05，总效应为 0.30；预期后悔的直接效应为-0.17，间接效应为-0.05，总效应为-0.22。本研究可为城市交通管理者制定绿色出行交通政策提供数据支持、政策见解及决策参考。

➢ SuA03 - 4 13 : 45 - 14 : 00

769 Simulation of High-speed Railway Train Operation Based on Cellular Automata

秦梦瑶 西南交通大学
帅斌 西南交通大学
许旻昊 西南交通大学

To accurately analyze the dynamic characteristics of train operations under different scenarios and provide valuable information for avoiding train delays, an improved cellular automata model is presented to simulate train operations under different scenarios. We

first build a CA model under the quasi-moving block system by combining the characteristics of railway lines and equipment in stations. Then we analyze the speed and location update rules of trains and the rules of trains entering and leaving the station. We propose innovation by decomposing the train route into two parts: the turnout group and the track, which effectively solves the train route conflict problem in the model and makes the model more realistic. Then we select an actual high-speed railway line for simulation under four scenarios. The results show that the simulation is consistent with the actual operation of the railway line, and the model can objectively and reasonably reproduce the dynamic characteristics of high-speed train operation. We analyze the relationship between the total train delay time and the equipment failure duration. The results indicate that the total train delay time grows in power with the equipment failure duration, and the redundancy time can help to mitigate the growth of train delays.

➢ SuA03 - 5 14 : 00 - 14 : 15

[808] 轴辐式高铁快运网络多级节点布局研究

孙宗胜 西南交通大学
帅斌 西南交通大学

高速铁路快捷货物运输以其时效性高、环保性强等优势备受瞩目，运营规模逐年扩大。为明确高铁快运网络多级节点布局方法，基于轴辐式理论展开研究。首先从经济发展、人口状况、消费水平、高铁发展、快递运量等五方面构建城市高铁快运综合竞争力模型，运用主成分分析法进行量化得出城市高铁快运综合竞争力。其次基于改进的引力模型建立高铁快运城市间吸引力模型，明确城市间高铁快运吸引强弱。最后通过构建城市间高铁快运隶属度模型进一步明确各城市间隶属关系，得出轴辐式高铁快运网络多级节点布局结果。研究结果表明，我国高铁快运网络应形成以北京、浙江、河南、广东、四川等为一级节点，天津、河北、山东、辽宁、上海、江苏等为二级节点，昆明、兰州、长春等为三级节点的“5+14+10”轴辐式高铁快运网络多级节点布局，以北京-成都、郑州-杭州、郑州-成都等为主干通道，以北京-天津、杭州-上海、郑州-武汉等为支线通道，以沈阳-长春、西安-兰州、重庆-贵阳等为集运通道的“8+13+10”高铁快运网络通道布局。研究结果能够为制定高铁快运节点规划提供理论指导与决策参考，为高速铁路快捷货物运输的高质量发展提供支撑。

➢ SuA03 - 6 14 : 15 - 14 : 30

[441] 不良气象对智能网联异质交通流的影响研究

叶杨 广西师范大学
高伟 广西师范大学
邝华 广西师范大学
白克钊 广西师范大学

随着通信技术和人工智能的快速发展，车辆的智能化和网联化已成为未来发展趋势。而在不良气象条件下，道路的能见度降低，车辆通信不畅以及车载探测设备发生故障等现象较易出现。本文基于此，建立了智能网联环境下考虑不良气象条件影响的元胞自动机混合交通流模型，重点研究了能见度、通信故障和探测故障对智能网联交通流的影响。研究结果表明：不同能见度下，随着智能车占有率增大，系统流量增大，但发生交通事故的概率会降低；通信故障率增大时，普通车发生交通事故的概率会升高，而智能车发生交通事故的概率几乎不变；能见度较低时，随着探测故障率增大，普通车和智能车发生交通事故的概率均增大，探测故障比通信故障对交通流的影响要更显著。

➢ SuA03 - 7 14 : 30 - 14 : 45

[464] 基于驾驶人交通违法行为记录与事故严重程度关联的重点交通违法行为筛选及识别研究

张锐 西南交通大学
帅斌 西南交通大学

本文以承担道路交通事故主要责任的机动车驾驶人群体为对象，将驾驶人在事故前的交通违法行为记录与后续事故的严重程度相关联，通过分析群体规律挖掘交通违法行为包含的潜在风险信息，并筛选重点交通违法行为。首先，采用修正互信息刻画事故严重程度类型与交通违法行为类型的关联关系，通过基于多次随机欠采样过程的假设检验，筛除与事故严重程度无显著正向关联的交通违法行为类型。其次，借鉴基于互信息的特征选择方法，重构优化备选特征间信息冗余的表达方法，构造面向潜在关联事故严重程度的重点交通违法行为选取算法。使用深圳市采集到的实际数据进行分析，分别得到死亡、伤人、财产损失事故相关联的重点交通违法行为，将筛选结果与基于发生频率选取的重点交通违法行为、基于传统事故致因分析选取的重点交通违法行为进行对比，并应用信息增益率评估了三者在识别驾驶人事故倾向中的有效性。对比结果表明，基于驾驶人历史交通违法行为记录与事故严重程度关联视角筛选得到的重点交通违法行为，涉及类型

更广泛，包含更为丰富的驾驶人事故风险信息，对于有效识别驾驶人的事故倾向具有重要作用。

➢ SuA03 - 8 14 : 45 - 15 : 00

[428] 空间分区效应对结伴行人应急疏散的影响研究

周昂 广西师范大学
刘晨 广西师范大学
邝华 广西师范大学
白克钊 广西师范大学

众所周知，家人、朋友等亲密熟悉人员之间经常结伴出行，他们在运动过程中往往表现出聚集、跟随、等待三种典型的行为现象。在应急疏散时，结伴行为通常会对人群疏散起阻碍作用，那么是否存在一种动态疏散策略，让结伴的行人在不同空间区域内依照不同的疏散策略运动，以达到疏散效率的最优化，这是一个尚未解决且有研究价值的新问题。为了探讨结伴运动在不同空间区域疏散策略对疏散效率的影响，本文在社会力模型的基础上，针对不同的空间分区，提出了不同的结伴耦合运动模式，确立了不同空间区域内结伴行人之间的不同局部相互作用规则及相应的疏散策略。数值模拟对比研究了结伴行人有、无采用空间分区疏散策略对疏散效率的影响，并重点分析、讨论了结伴行人受伤情况下所诱发宏观现象（如迂回、等待等）的形成机理。结果表明，空间分区疏散策略可以加强结伴行人运动的同步行为，有效降低行人受到的挤压力，大幅减少行人受伤率，从而导致整体疏散效率提高。

SuA04 13 : 00 – 15 : 00 巨蟹厅

腾讯会议：574-157-906

交通系统复杂性(2)

主持人：彭光含 广西师范大学
主持人：周亦威 上海理工大学

➢ SuA04 - 1 13 : 00 - 13 : 15

[835] T 型信号交叉口动态直右车道优化设计及仿真评价

储慧怡 上海理工大学
梁士栋 上海理工大学

在城市道路交通网络中，交叉口直右共用车道在红灯期间，前端排队的直行车辆会影响后方右转车辆通行，增加右转延误及交叉口总延误。为达到优化通行的目的，且不改变 T 型交叉口平面结构，本文基于预信号及可变车道设置思路，提出一种动态直右车道设计，在直右车道前提前设置预信号，根据原有道路交叉口信号灯配时给出相应控制策略，实现两车道间通行量再分配，使车道设计更加合理化，降低延误。根据对车流演变状态的分析，运用运动学理论及交通波理论，提出信号控制策略计算模型。最后通过 VISSIM 软件搭建相应仿真模型，通过改变直右车辆比，总车辆数，动态直右车道长度，信号周期及车辆速度分别分析优化前后的直行车延误，右转车延误及总延误，验证了本设计对于交叉口延误优化有一定的可行性。结果表明：优化后的直右车道相较于传统直右车道在延误方面有明显下降。

➢ SuA04 - 2 13 : 15 - 13 : 30

[708] Predictive feedback control in coupled map car-following model integrating the headway deviation effect

彭光含 广西师范大学
黎新海 广西师范大学

By integrating headway deviation, we in this study provide a new coupled map (CM) car-following model with the consideration of predictive feedback control. By utilizing the control theory, specific stability conditions are derived to maintain the stability of the traffic system, which contributes to acquiring the feedback gain range. Simulation results show that the new model with predictive feedback control not only mitigates traffic jams, but also it relieves CO2 emission by combining the headway deviation effect.

➢ SuA04 - 3 13 : 30 - 13 : 45

[416] Cooperative vehicular trajectory optimization for urban freeway on ramps

戚钧杰 上海理工大学
赵靖 上海理工大学
马晓旦 上海理工大学

This paper presents a vehicle trajectory coordinated control method to eliminate the conflict in the bottleneck area of the freeway ramp merging. Establish MER(Merge Optimization Control) model to solve this problem from two progressive aspects: The first is to completely eliminate the vehicle conflicts caused by the merger bottleneck of the freeway ramp. Secondly, based on the premise of conflict elimination, linear programming is used to maximize the driving efficiency of all controlled vehicles. Through case analysis, it is proved that the model can improve the average speed of vehicles to a certain extent, optimize driving efficiency, and at the same time can completely avoid the bottleneck conflict of freeway ramp merger. After

clarifying the important influencing factors, establish a sensitivity analysis to verify the applicability of the model, discuss the optimization effect of the model and the parameter relationship among the initial speed difference, acceleration lane length and the form of a single vehicle or platoon of the main line. Comparative analysis proves that the optimization effect of the MER model is more significant when the main line vehicles are denser and the layout is complicated.

➢ SuA04 - 4 13 : 45 - 14 : 00

463 出发旅客视角下的高铁车站衔接交通可达性分析

许旻昊 西南交通大学
帅斌 西南交通大学

对高速铁路可达性的评估不应局限于站到站的分析，“首末一公里”衔接交通的可达性及其波动性同等重要，但这却未被既有研究深入探讨。鉴于出发环节的衔接交通可达性对旅客出行决策具有重要影响，本文从出发旅客的视角，对可达性的时空分布特征进行多维度分析。数据获取方面，本文利用导航软件 API 接口，采集各人口栅格中心在较长周期内(70 天)，每天 5:00-23:00 不同时段，分别采用公共交通和私人交通前往高铁车站的行程信息。本文分别构建了可达性静态特征和动态特征的计量方法，前者包括时间可达性、经济可达性、广义成本可达性，后者则是利用变异系数量化行程时间的日常波动性和长周期波动性。并以成都、绵阳、乐山这三个具有不同规模和交通系统构成的城市为例，对高铁车站衔接交通可达性进行实证分析。研究结果表明，在静态特征方面，私人交通的时间可达性优势显著；当城市规模越大，两类出行方式广义成本优势平衡点处的时间价值越高，这体现了大都市中，旅客对公共衔接交通的依赖性更强；空间分布上，在高铁车站远离核心城区的一侧私人交通的可达性优势更加明显，另一侧公共交通的优势更加突出。在动态特征分析方面，公共交通的日常波动虽然总体弱于私人交通，但极端波动的栅格数量更多，而这部分栅格往往距离 HSR 车站距离较近；从长周期的波动来看，在早晚高峰时段，私人交通波动性较大的区域位于高铁车站朝向城市核心区域的一侧，而公共交通的波动幅度相对较小。上述发现都具有重要的政策意义，可为高铁车站的选址、衔接交通的规划与运营提供决策参考。

➢ SuA04 - 5 14 : 00 - 14 : 15

433Adaptive Signal Control for Overflow Prevention Based on Fuzzy Control

姚天宇 上海理工大学
赵靖 上海理工大学

With the increasing number of vehicles in the city, congestions at the intersections happen more frequently. In some cases, traffic hazards such as "Gridlock" at intersections may occur. Taking reasonable and optimal control measures of intersections is an important way to improve capacity of intersections and to reduce vehicular delays. An adaptive signal control model based on fuzzy control is proposed in this paper. In this model, the fuzzy control and rules coordinate the orderly release of the overflow vehicles, complementing the adaptive control. A numerical study demonstrates the impact of overflow situation and further analysis show that the proposed model perform well in terms of intersection efficiency and lower the risk of secondary overflow situations. Sensitive analysis indicates that the proposed model outperforms most of the scenarios.

➢ SuA04 - 6 14 : 15 - 14 : 30

403Dynamic dilemma zone protection through vehicular trajectory optimization and speed guidance

张范磊 上海理工大学
赵靖 上海理工大学

This paper develops a a model predictive control framework to optimize trajectories of vehicles approaching a yellow phase for dilemma zone protection under various arrival states, and makes the vehicle pass through the intersection as much as possible as well. In this paper, the mixed integer programming method is used to solve the model, and the nonlinear constraints in the model are linearized to satisfy the conditions of linear programming. This paper verifies the effectiveness of the model by giving multiple examples of single-vehicle and two-vehicle following cases. The results show that the model can give the optimal speed trajectory to make the vehicle pass through the intersection or stop in front of the stop bar safely. This paper calculates the critical distance that the vehicle can passes through the intersection under a certain input state. Finally, the dilemma zone is analyzed for the model, and gives the distance range for the model to effectively avoid the dilemma zone.

➢ SuA04 - 7 14 : 30 - 14 : 45

[405]Optimal control of automated left-turn platoon at contraflow left-turn lane intersections

赵靖 上海理工大学
杨寒煜 上海理工大学

The contraflow left-turn lane (CLL) intersections can provide additional capacity for left-turn traffic by dynamically changing the lane function of a part of the exit lanes. However, as an unconventional intersection design, its operation performance depends on the adaptability of drivers. The autonomous driving is a promising technology to deal with the heterogeneity of drivers. This study proposed a centralized optimal control model for automated left-turn platoon at CLL intersections. The lateral lane changing control and the longitudinal acceleration in the control horizon are optimized simultaneously with the objective of maximizing the running efficiency and smoothness. The proposed model is converted to be a mixed-integer linear programming problem and then solved by the branch-and-bound technique. The plausibility and effectiveness of the model is tested by a case study and numerous sensitivity analysis. The results show that the model can significantly improve the running efficiency of the intersection. The proposed model has a promising control effect under different geometric controlled conditions. Moreover, the proposed model performs stably under the various safety heady, the length of the contraflow left-turn lane and the green time of main signal.

➢ SuA04 - 8 14 : 45 - 15 : 00

[209]A spatial model with endogenous weight matrix for investigating travel flow differences between peak hours with massive mobile phone data

周亦威 上海理工大学
倪玲霖 浙江财经大学

Urban travel flow at peak hours has brought an extreme challenge to the transportation network and urban planning. However, urban travel flow between peak hours is not always the same. It is important to investigate travel flow differences between peak hours to capture travel flow patterns and influential factors. To account for possible endogeneity in spatial effects among traffic analysis zones (TAZs), this paper establishes a spatial model with an endogenous weight matrix to investigate the travel flow differences between morning peak and evening peak on both weekday and weekend based on mobile phone data in Hangzhou, China. A binary probit model is also established to provide a reference, and the results of both models are compared. The results indicate that the logarithm sum of supermarkets, shopping malls, and parks has positive impacts on travel flow differences on both weekday and weekend. The number of offices is negatively related to the travel flow differences on both weekday and weekend, while the logarithm number of hospitals is insignificant with travel flow differences. In addition, the results also confirm strong spatial effects with spatial autocorrelation coefficient 0.24 and significant endogeneity among TAZs with covariance -2.70. Moreover, the endogenous weight matrix on both weekday and weekend are successfully estimated and compared. It is found that weekday weight matrix has more TAZ pairs clustered spatially with higher spatial weights, while the weekend weight matrix contains almost uniformly low spatial weights. Besides, road density proves to be a good indicator of the interdependency structure, which is positively influenced by population density, number of metro stations and BRT stations. Based on the findings above, major policies from the 14th five-year plan (2021-2025) and long-range objectives through the year 2035 of Hangzhou are evaluated, and the impacts of relevant TAZs are analyzed. The above empirical analysis reveals the mechanism of spatial influence with endogeneity, deepens understanding of urban travel flow between peak hours, and facilitates urban planning and policy making.

SuA05 13 : 00 – 14 :45 双鱼厅

腾讯会议：756-310-383

系统理论及其应用

主持人：张宏军 中国船舶工业系统工程研究院
主持人：房志明 上海理工大学

➢ SuA05 - 1 13 : 00 - 13 : 15

[117] 基于子域法的表贴式永磁电机系统转矩分析

陈春涛 青岛大学
吴新振 青岛大学

为准确、快速地计算不同负载条件下平行充磁偏心

削极表贴式永磁电机系统输出的转矩值，采用改进的等效表面电流法对永磁体进行等效处理，并结合子域法与叠加原理解析计算了该系统的负载气隙磁场。首先采用改进的等效表面电流法将永磁体等效为电流层；其次利用子域法将电机系统分为两大子域，在每个子域中列写拉普拉斯方程或泊松方程，并采用分离变量法对其求解，从而得到电机系统的负载气隙磁场分布。利用麦克斯韦张量法计算了不同负载条件下的转矩值，并与有限元结果和实验结果进行了对比，验证了此转矩分析方法的正确性与准确度。

➢ SuA05 - 2 13 : 15 - 13 : 30

[853]Stabilization by Variable-Delay Feedback Control for Highly Nonlinear Neutral Stochastic Delay Hybrid Systems with Lévy Noise

李文瑞 南京理工大学
费晨 上海理工大学
沈明轩 安徽工程大学
费为银 安徽工程大学

In a recent publication [H. Dong, J. Tang and X. Mao, SIAM J. Control Optim., 2022], the stabilization problem by a delay feedback control is discussed for the Lévy noise driven stochastic delay hybrid systems (SDHSs) with more general polynomial growth drift and diffusion coefficients, but the jump coefficient satisfies the classical linear growth condition. This work aims to close the gap by imposing a super-linear growth on the jump coefficient for a class of highly nonlinear neutral stochastic delay hybrid systems with Lévy noise (NSDHSs-LN), where neutral-term implies the systems depend on derivatives with delays in addition to the present and past states. More precisely, under the local Lipschitz condition, the existence and uniqueness theorem, as well as the finiteness and boundedness of the moments of the solution to the highly nonlinear NSDHSs-LN are established. Using a non-differentiable time delay feedback control function, we demonstrate the qth moment exponential stability and almost sure exponential stability of highly nonlinear NSDHSs-LN. The neutral term and super-linear growth of the jump coefficient in the underlying system make the stability analysis significantly more difficult and demanding compared to the hybrid SDHSs. Several novel techniques and methods are developed to address such challenges. Numerical examples supporting the above conclusions are offered.

➢ SuA05 - 3 13 : 30 - 13 : 45

[565]T - S 模糊系统自适应积分滑模控制

孙兴建 南通大学
顾菊平 苏州科技大学

本文主要研究一类带有匹配未知扰动或不确定性的非线性系统的积分滑模控制问题。通过采用 T-S 模糊建模方法，对非线性系统进行逼近，然后引入径向基函数神经网络来估计具有未知上界的不确定性和外界干扰扰动。在模糊模型中，每个模糊规则的输入矩阵不再要求是一个相同的矩阵。 随后，利用李亚普诺夫理论分析了滑模动态的稳定性，并以线性矩阵不等式的形式给出了一组系统稳定性的条件。然后，利用自适应技术估计神经网络与非线性和不确定性之间的误差。通过设计自适应律，针对 T-S 模糊系统提出一种新的自适应积分滑模控制器方法。最后，通过数值算例对本文所提出的自适应积分滑模控制方法的有效性进行验证。

➢ SuA05 - 4 13 : 45 - 14 : 00

[870]基于数字孪生的汽车装配过程在线质量改进

吴锋 安徽工程大学

汽车装配过程中存在不确定性因素多，工序繁多等特点，实现实时设计变更、运行状态在线分析改进和监控预警尤为迫切，本文提出了一种基于数字孪生的汽车装配过程在线质量改进方法。首先基于 Kriging 模型和状态空间方程构建了面向汽车装配过程的数字孪生模型；其次，基于稳健参数设计方法提出实时在线设计变更策略；然后，建立自适应控制图实现装配过程在线监控和预警。最后，以某汽车装配过程为例，验证了所提方法的有效性和实用性。

➢ SuA05 - 5 14 : 00 - 14 : 15

[747]System Architecture Modeling Based on Business Process Management and Service-Oriented Architecture

谢衡 上海理工大学
倪枫 上海理工大学

Based on the characteristics that business process management can facilitate the optimization of business processes but cannot align the continuously changing business processes and IT systems, in order to solve the problems of the disconnection between concepts and modeling languages, the lack of richness in the

conversion methods from the Computing Independent Model to the Platform Independent Model, and the lack of interconnection between multiple views of systems in the field research of Business Process Management combined with Service-Oriented Architecture, the combination is used in Business Process Modeling of Service-Oriented Architecture. By dividing the meta-model into ontology meta-model in semantic layer and notation meta-model in syntactic layer, the mapping between semantic layer and syntactic layer is established respectively between the meta-models and implemented in two inference steps with BPMN and SoaML as specific modeling languages. Finally, the system structure modeling process of business processes for service-oriented system architecture is constructed and improved by combining the views in DoDAF, and the feasibility of the method is verified and illustrated by an amusement park smart bracelet system architecture modeling case.

➢ SuA05 - 6 14 : 15 - 14 : 30

328 基于规则的复杂工程系统设计方法

张宏军 中国船舶工业系统工程研究院
黄百乔 中国船舶工业系统工程研究院

信息、调节、控制、反馈，控制论的出现极大地扩展了人造工程系统能力的深度与广度，造就了工程技术全面发展的局面。但随着工程系统的主体的增多，致使其构成的关系越来越复杂，以精准控制为目标的工程系统设计遭遇到了不小的困境。一方面，大规模集群体系中精准控制体系内每一个主体并不现实；另一方面，过多的控制反而限制了主体的自主涌现，与群体智能的主旨相背离。为此，伴随着自然人工智能技术的新发展与智能化无人平台的普遍应用，我们提出一种基于规则的复杂工程系统设计新思路，类比生态体系自主演化的动力机制，提出生态工程体系概念，从复杂适应性系统（CAS）的视角为复杂工程系统的独立主体构建适应性规则，并研究提出规则的层级分类、规则进化的动力学机制与V++规则引擎模型，以指导复杂工程系统的设计与演进维护。在典型复杂工程系统中，我们不仅创新提出理论方法和模型，并对此进行了初步的实例验证。

➢ SuA05 - 7 14 : 30 - 14 : 45

720 基于复杂适应系统理论的韧性城市治理系统构建探究

张瑾 上海理工大学
叶春明 上海理工大学

以新冠疫情为例的风险社会的加剧对我们的城市治理系统提出重大考验，韧性城市治理系统构建成为重要的时代议题。运用复杂适应系统理论（CAS）来规划、建设和治理城市，提升城市韧性，为分析城市治理演进提供了分析框架和实践路径。综合城市韧性系统研究要素，依托“自然—构筑物—社会—信息”四元耦合型系统城市理论，建立城市韧性评价体系，并利用 CRITIC-熵权及 TOPSIS 方法构建城市韧性的评价模型。基于此模型，可以某个城市为研究对象，综合评价该城市韧性建设现状、存的问题和韧性建设需要提升的方向，也可以多个城市为研究对象，对比不同城市间韧性建设的差异，相互借鉴，促进韧性城市治理系统构建。

SuA06 13 : 00 – 15 : 00 铂派厅

腾讯会议：773-395-627

多主体系统与可靠性分析

主持人：宗小峰 中国地质大学
主持人：杨奕飞 江苏科技大学

➢ SuA06 - 1 13 : 00 - 13 : 15

202 基于河长制治理系统的河长制任务体系优化与重构----社会生态系统理论视角

杜海娇 南昌大学
邓群钊 南昌大学

河长制是具有中国特色的区域治理制度，其任务体系是河长制的重要基石，为河长制发挥治理效能指明了方向。目前，政界及学术界对河长制是否长期有效存在分歧，其科学问题是河长制的任务体系应该基于怎样的治理逻辑？本文基于社会-生态系统理论对河长制进行系统分析，构建了包括河流、资源用户、公共基础设施以及“河长制政策”等子系统的河长制治理系统，并以此为河长制任务体系构建的逻辑框架，基于脆弱性系统功能，明确影响河长制长效机制的关键元素及路径，并应用系统基模分析方法寻找系统的动力机制、稳定机制与主导结构，在此基础上，优化和重构河长制任务体系。

➢ SuA06 - 2 13 : 15 - 13 : 30

558 A Global Relative Similarity for Inferring Interactions of Multi-agent Systems

顾孔静 国防科技大学
段晓君 国防科技大学
祁明泽 国防科技大学
晏良 国防科技大学

Interactions and dynamics are critical mechanisms for multi-agent systems to achieve complex intelligence through the cooperation of simple agents. Yet, inferring interactions of the multi-agent system is still a common and open problem. A new method named K-similarity is designed to measure the global relative similarities for inferring the interactions among multiple agents in this paper. K-similarity is defined to be a synthetic measure of relative similarity on each observation snapshot where regular distances are nonlinearly mapped into a network. Therefore, K-similarity contains the global relative similarity information, and the interaction topology can be inferred from the similarity matrix. It has the potential to transform into distance strictly and detect multi-scale information with various K strategies. Besides, K-similarity shows strong stability against outliers, especially concentrated outliers whose performance decreases less than 0.06 with respect to Area Under Precision-Recall Curve (PR AUC) and 0.04 with respect to Area Under the Receiver Operator Characteristic Curve (ROC AUC) when the outlier proportion is 50\%. We compared our method with four benchmark similarity measurements to infer the interaction topology of the multi-agent system, and find that K-similarity outperforms benchmark methods in accuracy and stability on both simulated and real datasets. Furthermore, according to the property of K-similarity we develop a Gaussian Mixture Model (GMM) based threshold to select probable links. Our method contributes to not only similarity measurement in multi-agent systems, but also other global similarity measurement problems.

➢ SuA06 - 3 13 : 30 - 13 : 45

100 随机线性异质多自主体系统的协同输出反馈跟踪控制

李殿强 华东师范大学
李韬 华东师范大学

本文研究了随机线性异质多自主体系统的协同输出反馈跟踪控制问题。每个自主体具有状态不完全可量测的线性动力学,自主体间的信息交互同时带有加性和乘性噪声。我们提出了对跟随者自身状态和领导者状态进行分布式估计的容许观测策略和基于确定性等价原则的输出反馈容许协同控制策略。利用输出调节理论和随机分析方法，我们证明了若跟随者动力学能稳、能检测，领导者动力学能观测且领导者不稳定模态的实部和与乘性噪声强度的乘积小于通信拓扑图 Laplacian 矩阵的最小非零特征值的 1/4，则在相应的输出调节方程有解的条件下，存在容许的分布式观测策略和协同控制策略实现对领导者的均方有界输出跟踪。最后，我们利用数值仿真验证了控制策略的有效性。

➢ SuA06 - 4 13 : 45 - 14 : 00

66 鱼群涌现机制下集群机器人运动强化的迁移控制

陶宇 上海理工大学
刘磊 上海理工大学

采用鱼群模型驱动多智能体可以涌现出优良的运动特性，但是由于机器人与真实鱼类相比具有较大的差异性，使得鱼群模型难以迁移应用于真实机器人系统.为此，提出了一种结合深度学习与强化学习的迁移控制方法，该方法首先使用鱼群运动数据训练深度网络(Deep Neural Network, DNN)模型，以此作为机器人成对交互的基础，然后向后串联强化学习的深度确定性策略梯度方法(Deep Deterministic Policy Gradient, DDPG)来修正 DNN 模型的输出，设计集群最大视觉尺寸方法挑选关键邻居，从而将 DNN+DDPG 模型拓展到多智能体的运动控制. 集群机器人运动实验表明：所提方法能使机器人仅利用单个邻居信息就能形成可靠，稳定的集群运动，与单纯 DNN 直接迁移控制相比，所提 DNN+DDPG 控制框架既保存了原有鱼群运动的灵活性，又增强了机器人系统的安全性与可控性，使得该方法在集群机器人运动控制领域具有较大的应用潜力.

➢ SuA06- 5 14 : 00 - 14 : 15

766 复杂海洋装备系统健康演化机理与评估方法研究

杨奕飞 江苏科技大学
刘世界 江苏科技大学

海洋环境因素、设备属性、维护干预三要素及其相互作用，构成了以设备为中心的“工况-设备-维护”复杂海洋装备耦合系统，对其的认知是复杂装备健康管理的重要基础，其内涵包括各要素建模、要素间耦合作用机理及全生命周期动态演化规律。同时，针对传统的装备健康评估模型无法全面、准确地描述其状态演化要素，导致评估结果可信度低、维护策略科学性不足等问题，需要探索多属性、多元退化复杂装备系统的健康评估方法。本报告尝试建立工况、设备、维护耦合的多时变因素健康退化模型，并综合考虑复杂装备系统的结构、状态等多重属性，研究多属性复杂海洋装备系统的健康量化评估方法，

为科学维修决策提供支撑。

➢ SuA06 - 6 14 : 15 - 14 : 30

[128] 多主体回声状态网络及其在混沌动力系统预测中的应用

张一帆 昆明理工大学
刘文奇 昆明理工大学

在优选回声状态网络(ESN)的储备池内部神经元总数和储备池谱半径基础上，以回声状态网络为基本单元，提出了一种多主体回声状态网络(Multi-ESN)的模型．在该模型中，每个大规模的随机稀疏储备池被视为独立的学习主体．通过确定相关参数，使每个学习主体达到较好的学习状态．然后将所有主体学习到的信息反馈到信息融合中心进行集成学(I-Multi-ESN)或分布式学习(D-Multi-ESN)．以预测四川盆地极端降水为例进行实证分析，比较两种信息融合的预测结果发现，多主体回声状态网络按两种信息融合方式的预测结果都优于单个主体，且适当增加学习主体个数，交互学习的效果越好．因此，基于分布式多主体回声状态网络的非线性时间序列预测方法可以大幅提高动力系统的预测精度，增强模型的泛化能力.

➢ SuA06 - 7 14 : 30 - 14 : 45

[40]Finite-time stabilization of non-local Lipschitzian stochastic time-varying nonlinear systems with Markovian switching

赵桂华 上海理工大学
刘淑君 四川大学

We investigate the stochastic finite-time stability theory and finite-time stabilization of stochastic time-varying nonlinear systems with Markovian switching in the sense of weak solutions. In the first part, we present the stochastic finite-time stability theory under the framework of weak solutions: the existence of weak solutions and stochastic finite-time stability theorems for stochastic time-varying nonlinear systems with Markovian switching. In the second part, for a class of high-order stochastic nonlinear systems with Markovian switching, a finite-time stabilization controller is designed constructively, and the trivial weak solution of the closed-loop system is proved to be globally finite-time stable in probability. The effectiveness of the proposed finite-time control method is illustrated by a numerical example.

➢ SuA06 - 8 14 : 45 - 15 : 00

[730]Delay-Induced stochastic stability and Stochastic Consensus

宗小峰 中国地质大学

This report talks about the delay-induced stability of high-order stochastic systems and its applications to multi-agent consensus in the noisy environment. Firstly, with the help of the Taylor expansion with integral and the Lyapunov-Krasovskii theorem, the mean square and almost sure exponential stability criteria for the closed-loop linear systems based on delay-induced stability. Then, it is applied to establish the stochastic consensus of second-order multi-agent systems (MASs). It is revealed that the position measurements with a small time delay can be used to achieve delay-induced consensus even in the noisy environment when the velocity measurement is not available. Finally, numerical simulations are provided to verify the delay-induced consensus of second-order systems.

SuB01 15 : 15 – 17 : 30 白羊厅

腾讯会议: 168-314-381

复杂系统建模的应用(1)

主持人：王彪 江苏科技大学
主持人：孙梦迪 聊城大学

➢ SuB01 - 1 15 : 15 - 15 : 30

[688] 基于超生成对抗网络的无监督集成学习

曹文明 重庆交通大学

在这篇论文中，我们提出一个通过网络生成的无监督集成学习方法(UELNG)。我们首先采用HyperGAN去生成聚类集成网络的权重。我们通过评估子聚类网络对成对数据相似性构建一个图。如果所有网络认为某对数据来自同一个簇，这对数据被视为高度相似。我们先只关注一个数据子集并从中识别出k个紧凑的簇。簇内的数据被视为有高置信度的簇标签。其次，我们利用子聚类网络对非高置信度的数据和其增强数据进行簇标签预测，并锐化其簇标签。至此，数据被分为有高置信度簇标签的数据和有锐化标签的数据。再次，针对这两种数据，我们采用线性混合的方式，使混合后的数据与混合前数据有相同的簇标签，并定义一个组合损失函数。该组合损失函数与HyperGAN的损失函数进行交替优化。

➢ SuB01 - 2 15 : 30 - 15 : 45

[871]Outlier-Resistant State Estimation for Discrete-Time Delayed Complex Networks: A Partial-Nodes-Based

Approach

陈麒文 安徽工程大学
刘宏建 安徽工程大学
夏遵安 安徽工程大学
章冉 安徽工程大学

In this paper, an outlier-resistant state estimation problem is investigated for a class of discrete-time complex networks with time-varying delays and stochastic perturbations. Considering that the measurement output for state estimation only comes from a part of network nodes and is vulnerable to abnormal interference, the appearance of measurement outliers will deteriorate the estimation performance if directly included in the innovation of estimator design. In order to reduce the side effects of measurement outliers on estimation error dynamics, a confidence-dependent saturation function is proposed. By constructing specific Lyapunov-Krasovskii functionals and inequality manipulations, sufficient criteria are established for the existence of the outlier-resistant state estimator ensuring that the corresponding estimation error dynamics achieve the exponentially ultimately bounded in mean square. Then, the explicit characterization of the estimator gain is obtained by solving a convex optimization problem. Finally, numerical simulation is carried out to demonstrate the effectiveness of the derived theoretical results.

➢ SuB01 - 3 15 : 45 - 16 : 00

[85] 复杂环境下时间序列的混沌判别研究

淡儒斌 电子科技大学

时间序列预测中一个主要问题是判定时间序列是随机，周期性或混沌，从而选择合适的预测方法。然而复杂环境下产生的时间序列涉及到多维度，结构复杂并充斥大量噪声，若在原始时间序列上进行预测不但要花费高昂的时空代价，而且影响算法的准确性和可靠性。本文在此背景下，首先用排列熵计算时间序列的复杂度，接着对时序数据进行局部投影法降噪处理，然后检查信号是否过采样，如果时序过采样将会进行下采样处理，其次通过庞加莱截面法、0-1 测试法和最大 Lyapunov 指数法从定性和定量对处理后的时序数据进行混沌判别。最后，在复杂环境下由含噪量和维度的逐步增加，对多种随机序列，周期序列和混沌时间序列判别，所提方法均能够获得良好的判别结果。

➢ SuB01 - 4 16 : 00 - 16 : 15

[220]Event-Triggered μ-State Estimation for Markovian Jumping Neural Networks With Mixed Time-Delays

李兵 重庆交通大学

In this paper, the issue of event-triggered μ-state estimation is addressed for a class of Markovian jumping neural networks (MJNNs) with mixed delays. The mixed delays involve both the infinitely distributed delay and the time-varying delay without requiring the upper bound, which has a distinction in existing conclusions and makes the model be more comprehensive. An event-triggered mechanism (ETM) with mode dependence is adopted to determine the appropriate updating instants of measurement outputs so as to alleviate the transmission of signals. By constructing a novel time-varying L-K functional with a general convergency rate and employing several analysis techniques, a sufficient criterion is obtained for ensuring the stochastic μ-stability performance of error system, which is a more general stability performance including exponential stability, power stability as well as logarithmic stability as its special cases. Finally, three numerical examples are listed to demonstrate the effectiveness of the proposed method.

➢ SuB01 - 5 16 : 15 - 16 : 30

[461]Output feedback H∞ control for singular hybrid systems with time-varying delays via variable elimination technique

孙梦 聊城大学
尹月霞 聊城大学
王馨 聊城大学
庄光明 聊城大学

This paper addresses the H∞ dynamic output feedback control problem for a class of singular Markovian jump systems with time-varying delays. Firstly, by utilizing improved Lyapunov-Krasovskii functional, sufficient conditions that singular Markovian jump systems with time varying delays satisfy stochastic admissibility and H∞ performance index are derived. Secondly, a dynamic output feedback controller is designed to ensure that the resulting closed-loop system satisfies stochastic admissibility and H_∞ performance level. In addition, based on the variable elimination technique, the non-convex matrix inequality is transformed into

linear matrix inequality. Finally, two numerical examples including direct-current motor driving a load model are given to prove the effectiveness and practicability of the main results obtained. Singular systems, also known as implicit systems, differential algebraic systems or discrete systems, can represent a large class of physical systems better than regular ones and reserve the structure of practical systems. Markovian jump systems (MJSs) are highly practical in manufacturing systems, electric power systems, mechanical systems and other engineering fields . In practical application, the system parameters or system structure of singular system have abrupt change which arouses the study on singular Markovian jump systems. Due to the strong flexibility and practicability of dynamic output feedback (DOF) control in the field of industrial engineering, more and more attention have been paid to the research of DOF control. On the basis of our finite knowledge, there are few researches on DOF H∞ control for time-varying delay SMJSs (TVDSMJSs) in the existing literature. The contributions of this work are presented as follows: (1) By utilizing improved Lyapunov-Krasovskii (L-K) functional, sufficient conditions that SMJSs with time-varying delays satisfy stochastic admissibility with H∞ performance index are derived in terms of LMIs. (2) A DOF controller is constructed to ensure that the resulting closed-loop system satisfies stochastic admissibility and meets H_∞ performance index. (3) Non-convex inequalities are transformed into LMIs by using variable elimination technique which is based on matrix transformation method.

➢ SuB01 - 6 16 : 30 - 16 : 45

[484] 形态学算子的多模态场景拓展

孙梦迪 聊城大学
孙忠贵 聊城大学

本文提出了一种基于多模态图像的自适应引导形态学。首先，通过考虑输入图像和引导图像的联合信息进行结构元素构建，增强其对噪声的鲁棒性；其次，根据 3sigma 原则选取结构元素成员，使其与具体图像内容相适应；最后，利用稀疏矩阵的哈达玛积对结构元素施加对称性约束。理论证明和仿真实验均表明所提形态学的相应算子能够同时具备保序性和附益性等重要性质。在多模态图像上进行去噪实验，也验证了所提算法的有效性。

➢ SuB01 - 7 16 : 45 - 17 : 00

[468] An Underwater Acoustic Target Recognition Method Based on ARNet

王彪 江苏科技大学
张伟 江苏科技大学

The development and utilization of marine resources is an important way to achieve sustainable development. Underwater acoustic target recognition(UATR) technology can better help to carry out activities such as marine biological investigation and marine exploration. It is a kind of signal processing technology that uses passive target radiation noise received by sonar, active target echo, and other sensor information to extract target characteristics and discriminate target or ship type, which provides an important decision basis for human marine economic, and military activities. UATR can accurately, timely, and covertly detect the target in the water, provide accurate information for various systems and command departments which is of great significance to collaborative operations and seize combat opportunities. Meanwhile, it can be used to monitor the marine traffic situation and marine traffic management. The investigation of marine life categories and living habits also can be accomplished with the help of UATR technology. It is instructional to protect the marine ecological environment. As human activities in the ocean become more and more frequent, this technology is increasingly used, such as fisheries production operations, marine search and rescue, undersea surveys, various investigations, and scientific research. In this article, we propose an ARNet method based on RepVGG network with the convolution attention mechanism. It is proverbial that the multi-branch and residual structure can help solve the gradient vanishing problem. And convolution attention mechanism can focus on the important part and its location of the feature map. ARNet combines the advantages of the multi-branch network and convolution attention mechanism to extract and identify the effective feature of ship radiated noise in the acoustic spectrogram. The proposed method uses the time-frequency spectral images of signals as input data, and the classification model achieves an overall

accuracy of 99.04% on ShipEar database which outperforms traditional ML techniques as well as other state-of-the-art models.

➢ SuB01 - 8 17 : 00 - 17 : 15

749 一种灵活的鲁棒增强型彩色图像水印方案

王芳晓 广西师范大学
罗玉玲 广西师范大学
刘俊秀 广西师范大学
张顺生 广西师范大学

重复码被成功运用到二值水印中增强水印算法的鲁棒性，但其不适用于灰度水印。因为灰度图像由 256 种像素组成，在提取水印过程中水印像素各不相同时，无法由多数投票原则确定水印像素。针对这一问题，本工作提出一种基于离散小波变换和奇异值分解结构的水印方案。本方案将重复码巧妙地结合到彩色宿主图像的三个颜色通道中，并依据投票原则和像素均值提取水印。同时，本方案消除了水印固有尺寸的限制，可灵活地嵌入多种尺寸的水印。实验结果表明本方案可抵抗旋转、噪声、滤波等攻击，且归一化互相关值均大于 0.9。本方案还保证了良好的视觉效果，峰值信噪比都在 45dB 以上。与现有方法相比，本方案在实用性、不可见性和鲁棒性等方面具有优势。

➢ SuB01 - 9 17 : 15 - 17 : 30

360Optimal configuration of a wind-photovoltaic-hydrogen-gas-electric vehicles integrated energy system considering multiple uncertainties and carbon reduction

祝刚 上海理工大学
高岩 上海理工大学

Coupling renewable energy, electric vehicles (EVs) and hydrogen storage is an effective way for integrated energy systems (IES) to shift to a low-carbon approach. Optimizing the capacity configuration is critical to be addressed in the power sector. This paper proposes the influence of charging price on the charging behavior of Electric Vehicle Owners (EVOs), Moreover, the uncertainties of wind power, PV power and load demand are simultaneously considered, and the model is transformed into a deterministic problem by sequence operation theory and chance-constrained programming method, while the reliability level of spinning reserve power can be measured by setting a proper confidence level. Meanwhile, this paper constructs the objective function based on the optimization strategy of deviation preference, introduces two objectives of optimizing annual comprehensive cost (ACC) and annual carbon emission (ACE). The problem can be converted into a mixed-integer linear programming (MILP) model and the capacity configuration optimization of this IES is carried out. The study shows that the IES constructed in this paper has advantages in economic and environmental performance. The IES has significant advantages in carbon dioxide emission reduction (CDER); meanwhile, EVs show advantages in CDER and charging cost compared to non-IES.

SuB02 15 : 15 – 17 : 30 金牛厅

腾讯会议: 213-688-218

复杂系统建模的应用(2)

主持人：王其林 重庆交通大学
主持人：王艳 重庆师范大学

➢ SuB02 - 1 15 : 15 - 15 : 30

821On Tucker-Type Alternative Theorems and Necessary Optimality Conditions for Nonsmooth Multiobjective Optimization

冯敏 重庆交通大学

This paper concentrates on necessary conditions for properly efficient solutions in nonsmooth multiobjective optimization problems. We first present a generalization of Tucker's alternative theorem for conic nonlinear systems, provided that a closedness condition holds. Some sufficient conditions for the validity of such a closedness condition are given. As applications, under the weak Abadie regularity condition, we then establish the primal and the strong Karush/Kuhn--Tucker (dual) necessary optimality conditions for an efficient solution to be locally properly efficient in Borwein's sense. The primal and the dual conditions are formulated as an equivalent pair by means of the Tucker-type alternative results. Finally we give an example to illustrate that Borwein's locally properly efficient solution cannot be reduced to the only efficient one in the main results.

➢ SuB02 - 2 15 : 30 - 15 : 45

268Data-driven valued dominance relation in incomplete ordered decision system

官礼和 重庆交通大学

Dominance-based rough set approach is successfully

applied to analyze multicriteria decision problems. For the incomplete ordered decision system, its various extensions have been proposed. The valued dominance relation is such an extension. However, the general calculation of dominance degree between objects depends on a prior distribution of incomplete ordered decision system, and how to choose a suitable threshold is also difficult. To solve these problems, a data-driven valued dominance relation is proposed in this paper. First of all, an objective calculation method of dominance degree between objects is designed, which is based on probability statistics. Moreover, this method is more effective for big data sets with a large quantity of objects. Secondly, an automatic threshold calculation method is presented, which does not depend on any prior knowledge except data sets. Finally, some properties of this method are investigated. Experimental results show that this method is superior to other generalized dominance relations in dealing with incomplete information.

➢ SuB02 - 3 15 : 45 - 16 : 00

[201]A novel Collaborative Filtering recommendation approach based on Soft Co-Clustering

李曼 重庆交通大学

Collaborative Filtering (CF) recommendation algorithm has been widely applied into recommender systems. Many CF algorithms associate a user/an item with one of subgroups by explicit or implicit features. However, considering that users may have multiple personalities and items may have diverse attributes, it is more reasonable to associate a user/an item with more than one group. In this paper, we propose the Soft K-indicators Alternative Projection (SKAP) algorithm, which can efficiently resolve soft clustering problem with high dimensions, to generate a sparse partition matrix and further a Top-N recommendation list is given. Unlike fuzzy C-means clustering, the SKAP algorithm is independent on the selection of initial values. In addition to that, we integrate the item type information into recommender systems to improve recommendation accuracy. Experimental results show that the proposed approach behaves superior performance in Top-N recommendation in terms of classical metrics and further show that multi-label classification framework is a better description than classical Co-Clustering framework.

➢ SuB02 - 4 16 : 00 - 16 : 15

[188]Locality regularized latent low-rank representa tion for semi-supervised subspace clustering

梁仁莉 重庆交通大学

Graph-based semi-supervised learning (G-SSL) methods play an increasingly important role in machine learning systems. In this paper, we propose a locality regularized la tent low-rank representation model (LR-LatLRR) for semi supervised subspace clustering problems. This model incorporates two regularization terms into LatLRR by taking the local structure of data into account. Then, we develop an efficient splitting algorithm for solving LR-LatLRR. We also prove the global convergence of the proposed algorithm. Furthermore, we extend the LR-LatLRR model to a case of including the non-negative constraint. Finally, we con duct experiments on a synthetic data and three real data for the semi-supervised clustering problems. Experimental results show that our method can obtain high classification accuracy and greatly outperforms several state-of-art G-SSL methods.

➢ SuB02 - 5 16 : 15 - 16 : 30

[86]基于模型对象消除方法的多点协同温度控制系统设计与研究

聂鹏强 江苏科技大学
徐松 江苏科技大学
陈迅 江苏科技大学
蒋伟 扬州大学
Seiji Hashimoto 群马大学

当前“碳达峰、碳中和”大背景下对现代工业的节能减排提出了更高的要求，而热处理环节是现代工业不可或缺的尤其是在半导体产业中，热处理中温度控制的效率及精度将会直接影响到产品的成品率及生产效率，影响碳排放量。本文针对 现代工业中多点协同热处理温度系统，以系统辨识的手段研究温度系统响应特性对其响应时间、迟滞环节以及非线性耦合参数进行辨识，引入非线性增益补偿矩阵和前馈参考模型对多点协同温度系统模型进行零极点消除，在此基础上以 Z-N 设计消除后等效对象的自适应多点温度控制器。在 MATLAB/SIMULINK 环境中搭建系统仿真模型进行仿真验证。以 dsPACE 为核心控制器搭建四通道铝热处理温度平台进行实验

验证，所得结果与传统 PID 控制及 PID+非线性耦合补偿结果相比较，本文提出的控制策略具有更块的响应速度、无超调量及个通道之间温度的均一性实现温度的快速统一。

➢ SuB02 - 6 16 : 30 - 16 : 45

[299]An Integrated Surrogate Model Constructing Method: Annealing Combinable Gaussian Process

王柄霖 国防科技大学
晏 良 国防科技大学
段晓君 国防科技大学

Surrogate models are widely used to mimic complex systems to reduce the high experimental cost. As the system becomes high-dimensional and complex, there is an increasing demand for building relatively simplified surrogate models that capture key variables and represent complex interactions. This study proposes the annealing combinable Gaussian process, an integrated solution for identifying key variables and constructing the high-precision surrogate model. Firstly, to identify redundant variables, this study optimises variables selection with a modified simulated annealing algorithm over the complete model space. This process is called the outer loop. Secondly, to improve the model accuracy and structure, this study constructs a non-parametric Gaussian process model with additive or multiplicative kernel, effectively extracting high-order interactions. Simultaneously, a Markov chain is proposed to sample the model space. The conditional entropy is used as the scoring rule for the simulated annealing algorithm of the outer loop. It is named the inner loop. This study also discusses the rationality of conditional entropy as a criterion. The annealing combinable Gaussian process performs well in various application scenarios, including regression and classification problems. Finally, our method is implemented with the particle-in-cell simulation to find out the key physics parameters.

➢ SuB02 -7 16 : 45 - 17 : 00

[167]Second-order weakly composed adjacent-generalized contingent epiderivatives and applications to composite set-valued optimization problems

王其林 重庆交通大学

In the paper, we introduce the second-order weakly composed adjacent-generalized contingent epiderivative for set-valued maps. Then we gain a few crucial properties of the epi-derivative. Moreover, we obtain the sum and chain rules of the epiderivative. Finally, by virtue of the epiderivative, we establish the necessary optimality conditions and sufficient optimality conditions for Benson proper efficient solutions of unconstrained composed set-valued optimization problems. The main results of this paper are illustrated by many examples.

➢ SuB02 - 8 17 : 00 - 17 : 15

[722]医学图像分割的数学方法与临床应用

王艳 重庆师范大学

图像处理技术涉及到数学、计算机科学、物理学、信息论等多门学科，其中，数学在其中起着基础但非常重要的作用。本报告将以图像分割为例，讲述如何将图像分割问题转化为数学问题以及如何快速实现；同时，以医学影像为例，介绍数理医学的基本思想、核心技术、前沿进展及其在临床实践的一些成功案例。

➢ SuB02 - 9 17 : 15 - 17 : 30

[473]以慢响应为基准的多通道温度协同追踪控制系统

王峥 江苏科技大学
徐松 江苏科技大学
陈迅 江苏科技大学
蒋伟 扬州大学
Seiji Hashimoto Gunma University

随着现代工业进程的不断加快，各类产业(尤其是半导体产业)加工过程中对于温度控制的要求越来越高，尤其是对多通道温度系统控制的精度、响应速度以及效率等方面提出了更高的要求。本论文针对工业加热平台中多点协同加热平台的温度均一化控制问题，提出了以慢速响应为基准的多通道协同追踪控制方法。以分时阶跃响应系统辨识方法获取多通道协同加热系统温度响应模型，以所得出模型的响应时间将温度通道分为快速响应通道(较小的响应时间)及慢速响应通道，在此基础上提出以慢响应通道为基准的多通道温度协同追踪控制系统架构(Slow-Mode-Based Control)。通过史密斯预估器(Smith Predictor)对温度系统延迟时间进行补偿以及解耦控制器(Decoupling Controller)消除多通道温度系统之间的非线性耦合干扰，以比例的形式决定各个通道之间的参考温度关系实现即使各点温度不一的情况下也能实现温度的追踪控制。控制系统模型于 MATLAB/SIMUKLINK 环境中进行仿真验证，同

时在 dsPACE 为核心控制器的四通道铝热平台进行实验验证，通过与传统 PID 控制及 PID+解耦控制结果的比较证明了所设计的慢响应为基准的多通道协同追踪控制系统的优化效果。

SuB03　　15 : 15 – 17 : 15　　双子厅

腾讯会议：535-204-470

复杂系统建模的应用(3)

主持人：邱爱兵　　南通大学

主持人：倪枫　　上海理工大学

➢ SuB03 - 1　　15 : 15 - 15 : 30

339 基于 SSD 网络的电动车进电梯检测研究

黄鹏　　上海理工大学
房志明　　上海理工大学
黄中意　　上海理工大学

目前，我国电动车保有量不断增长，电动车违规操作引发的安全事故频频发生。为加强对电动车违规操作的高效监管，提出了一种基于深度学习 SSD 目标检测网络的电动车进电梯检测器。使用 3 种主干网络测试 SSD 电动车检测的可行性，包括 VGG16、EfficientNet、MobileNet。针对电梯轿厢内，空间狭小且电动车易遮挡等影响电动车检测精度的因素，提出了一种基于双摄的电动车进电梯检测方法，该方法使用电梯轿厢内外两台相机来扩大监控视野来实现对电动车的检测。测试结果表明，SSD 检测网络能够很好的适用于电动车检测；双摄检测方法的检测准确率均在 90%以上，故该方法能够更好地实现工业应用。

➢ SuB03 - 2　　15 : 30 - 15 : 45

398COVID-19 环境下封闭校园内人员流动的传染病模型

李海冰　　上海理工大学
房志明　　上海理工大学
黄中意　　上海理工大学

随着对疫情的防控管理，中国多数高校已经处于正常上课模式，在学校这种封闭式环境中人员长时间、多频次的接触加大了传染病爆发的可能。为了探究 COVID-19 在封闭校园内人群的传播过程，本文模拟了人员流动与病毒近距离接触的传播过程。不同于传统的 SEIR 模型，在模拟中不是确切的感染人数，而是通过个体的感染率得到人员整体感染率，再得到一定范围内的感染人数。通过模拟，得到了不同防护场景下人群的整体感染率，还得到了人员在校园的接触分布及接触次数分布。此外，在基本防护场景下还考虑了出口干预和区域干预两种干预措施对病毒传播的影响。该研究为校园疫情防控提供了理论依据。

➢ SuB03 - 3　　15 : 45 – 16 : 00

447 耦合行人运动的疾病传播模型研究

刘晨　　广西师范大学
蒋婵静　　广西师范大学
刘哲　　广西师范大学
邝华　　广西师范大学
白克钊　　广西师范大学

大规模流行性疾病(如 COVID-19)传播问题是复杂系统领域研究的重要课题之一，其研究对突发公共卫生事件的应急管理具有重要意义。以往的研究主要从宏观层面的大尺度上探讨疾病传播的空间扩散特征，而从微观层面小尺度上的日常交互，例如建筑物中的行人行为对疾病传播的影响知之甚少。本文针对类似排队购票的服务大厅，以社会力模型为基础，引入感染距离和疾病传播因子，确立了行人之间相互作用的疾病传播规则，构建了耦合行人运动的疾病传播模型，重点研究了不同感染率、服务点个数、窗口服务时间和疾病传播因子等因素对疾病传播的影响。通过数值模拟，探讨了人群运动对行人感染过程的演化规律，揭示了疾病传播的扩散机理，获得了疾病在人群中传播快慢的主要因素。研究表明，疾病传播快慢受多种因素共同影响。其中，疾病传播快慢与感染率、疾病传播因子呈正相关；而疾病传播快慢与服务点个数、窗口服务时间呈负相关。最后，提出了加强疾病传播防控的对策建议，对精准防控具有较好的指导作用。

➢ SuB03 - 4　　16 : 00 - 16 : 15

806 基于旅客异质性的高铁车站旅客到达规律分析

刘洪义　　西南交通大学
帅斌　　西南交通大学

高铁车站作为城市门户与主要客运枢纽，承担了汇集多数出行旅客的功能，也面临客流聚集动态性、多变性带来的挑战。考虑旅客异质性的旅客到达规律分析不仅有助于提高短期到站旅客人数预测的精度，优化站内设施设备与人员调配，同时也为智慧化车站的发展提供数据支撑。本文以某大型铁路枢纽脱敏客票数据作为数据支撑，通过分析多次出行旅客历次到站时间量化该旅客出行习惯，提出基于数据聚类的旅客到站习惯异质性分类方法，最终结合列车类型、发车时间段等其他出行信息构建旅客到站规律分析模型，提高短期到站旅客人数预测的精度。

➢ SuB03 - 5 16 : 15 - 16 : 30

[682] 面向特征继承性增减的在线学习算法

刘兆清 国防科技大学

近年来，在线学习由于其巨大的实际应用价值，已经受到人们广泛的研究．然而，在许多开放环境应用场景下，当前时刻数据可能会增加新的特征，而下一时刻只有部分原有特征得以继承．例如，在环境监测中，新的传感器部署会产生数据新特征；下一时刻部分旧的传感器失效，部分原有特征被保留．这样的数据被称为特征继承性增减的流式数据．传统的在线学习算法大多建立在数据特征空间稳定不变的基础之上，无法直接处理此种情形．针对上述问题，提出了一种面向特征继承性增减的在线分类算法(Online Classification with Feature Successively Increasing and Decreasing, OFID)及其两种变体．当新特征出现时，通过结合在线被动-主动方法与结构风险最小化原则分别更新原始特征与新增特征上的分类器；当旧特征消失时，对数据流使用 Frequent-Directions 算法进行补全，使得旧分类器得以继续更新迭代．从理论上证明了 OFID 系列算法的损失上界，同时通过大量的实验验证了本文所提算法的有效性。

➢ SuB03 - 6 16 : 30 - 16 : 45

[559] A novel feedback controller design with robust fault isolation ability

邱爱兵 南通大学
李雪 南通大学
顾菊平 苏州科技大学

This work proposes a novel feedback controller design scheme which can achieve fault isolation based on the control signal or its embedded signal, i.e., with the self fault-isolation ability. First of all, according to the well-known Youla parameterization, a controller structure consisting of state and residual joint feedback is developed. Then, the residual feedback gain and observer gain are designed to make the residual feedback signal have fault isolation ability. Some design freedoms in the two gains are further utilized for robust self-fault-isolation. Moreover, the state feedback gain is designed, in the framework of switched system, to realize the self-fault-diagnosis and isolation, based on the control signal directly. The proposed control structure also has the advantage of cooperative fault tolerance. Finally, the simulation of HVAC (Heating, Ventilation and Air Conditioning) system, composed of four rooms in one story building scenario, is carried out to demonstrate the effectiveness and superiority of the proposed feedback controller design approach.

➢ SuB03 - 7 16 : 45 - 17 : 00

[600] Multiple Instance Learning for Unilateral Data

汤西嘉 国防科技大学
徐超 国防科技大学

Multi-instance learning (MIL) is a popular learning paradigm rooted in real-world applications. Recent studies have achieved prominent performance with sufficient annotation data. Nevertheless, acquisition of enough labeled data is often hard and only a little or partially labeled data is available. For example, in web text mining, the concerning bags (positive) is often rare compared with the unrelated ones (negative) and unlabeled ones. This leads to a new learning scenario with little negative bags and many unlabeled bags, which we name it as unilateral data. It is a new learning problem and has received little attention. In this paper, we propose a new method called Multiple Instance Learning for Unilateral Data (MILUD) to tackle this problem. To utilize the information of bags fully, we consider statistics characters and discriminative mapping information simultaneously. The key instances of bags are determined by the distinguishability of mapped samples based on fake labels. Besides, we also employed an empirical risk minimization loss function based on the mapping results to learn the optimal classifier and analyze its generalization error bound. The experimental results show that method outperforms other existing state-of-art methods.

➢ SuB03 - 8 17 : 00 - 17 : 15

[422] Business process modeling based on i-BPMN

周宇秀 上海理工大学
倪枫 上海理工大学

As a mainstream system architecture modeling method, BPMN still has shortcomings in the description of smart teaching business architecture. In this paper, we propose an i-BPMN modeling method that completely covers the business architecture ontology of the system. It is based on the ACF meta-model in TOGAF, combined with the currently widely used IDEF0, IF-ELSE statement and IDEFX modeling method, through its

convergence with the BPMN model in the AF architecture description to establish a meta-model mapping relationship, through the meta-model mapping method to the BPMN model is difficult to describe and the process of complex events through the IDEF0 meta-model, BR (Business Rule) meta-model, IDEF1x meta-model for the perspective of supplementation, Finally, the description model corresponding to the meta-model is flexibly customized under the meta-model data specification, that is, the scenario process model , activity model , rule model and data entity model to form a clear i-BPMN model group that integrates scenes, rules, functions and data perspectives. Through the iterative modeling process, the semantic and granular alignment between the described models is realized.

SuB04　　15 : 15 – 17 : 30　　巨蟹厅

腾讯会议：542-552-880

复杂系统建模的应用(4)

- 主持人：房志明　　上海理工大学
- 主持人：牟　鱼　　重庆交通大学
- SuB04 - 1　　15 : 15 - 15 : 30

[342]Effects of expected distance and companionship on individual descent speed in the stairwell

樊蕊　　上海理工大学
房志明　　上海理工大学
黄中意　　上海理工大学

With the increase of super high-rise buildings, people pay more and more attention to the super-long evacuation distance in the stairwells. A single-person evacuation experiment was conducted in a 12-storey office building. The results showed that the pedestrian evacuation speed would decrease with the increase of the expected distance. In order to compare with the single-person evacuation experiment and study the effect of companionship on evacuation efficiency, here we carried out the evacuation experiment of male and female in the same office building. In the single-person experiment, male's speed decreased significantly faster than female's. However, in this study, the downward trend of the speed of male and female is basically the same. Compared with the single-person experiment, the speed of male in the two-person experiment decreased by 16.49%, while that of female increased by 15.97%, and the evacuation time of male increased by 16.27% and that of female decreased by 6.78%. The heart rate of the participants in the two-person experiment did not rise as fast as that of the participants in the single-person experiment. Most importantly, different from the results of single-person experiment, this paper did not find the impact of psychological expectation on long-distance evacuation, and two-person evacuation is more effective than single-person evacuation.

- SuB04 - 2　　15 : 30 - 15 : 45

[864] 众新冠疫情线上和线下预防行为的动机研究

黄叶琳　　安徽工程大学
张雪峰　　安徽工程大学
杜林　　安徽工程大学

面对新冠疫情，公众的预防行为对降低疫情的不良影响和控制疫情扩散具有重要作用。预防行为主要包括线上行为如信息搜寻、选择、传播和线下行为如佩戴口罩、保持社交距离、注意个人卫生等。动机是公众采取线上和线下预防行为的驱动因素，然而当前对公众动机及其对行为的影响机制研究相对较少。为此，本文基于问题解决情境理论和社会动机理论，探究情境动机、自我关心和关心他人动机对公众预防行为的影响机制。利用偏最小二乘法-结构方程模型对 423 份调查问卷结果进行分析，发现：公众线上预防行为对其线下行为的实施具有积极影响；情境动机对公众线上行为有显著正向影响；自我关心和关心他人动机显著影响公众线下预防行为，然而只有关心他人动机对公众线上预防行为的影响正向且显著；此外公众对新冠疫情的问题认知、约束认知和涉入认知等三个情境因素对三个动机具有显著的影响。研究发现进一步丰富了新冠疫情下公众行为的研究成果，也为公众新冠疫情预防行为的引导和管理提供决策依据。

- SuB04 - 3　　15 : 45 - 16 : 00

[716]Two-Stage Transit Signal Priority Control Method to Improve Reliability of Bus Operation Considering Stochastic Process

梁士栋　　上海理工大学
冷荣梦　　上海理工大学

When bus priority control is implemented, if there is a bus station between upstream detector and downstream signalized intersection, it will lead to the uncertainty of bus dwell time caused by the uncertainty of number of passengers waiting at the station. This uncertainty will

result in that bus arriving time at the intersection cannot be predicted quite accurately. As a result, signal priority control strategy made in advance may fail, thus negatively affecting bus and vehicle operation at the intersection. To solve this problem mentioned above, this paper proposes a two-stage transit signal priority control method. The first stage is robust optimal control, the aim is minimizing bus delay expectation and variance. Bus delay expectation and variance calculation models considering the uncertainty of bus dwell time and the uncertainty of queue length in the exclusive bus lane are proposed based on mathematical statistics theory to formulate the stochastic process of bus operation. However, extreme situations cannot be avoided by the first-stage control completely. In order to make up for the deficiency of robust optimal control, this paper adds the second level real-time priority control, which ensure the priority of public transit when the first-stage control fail.Through the simulation experiments, this two-stage transit signal priority control method (TTSP) can better preform in reducing bus delay expectation，variance and improve reliability of bus operation. At the same time, conducting the sensitivity analysis of TTSP to find out the more suitable scenario of this method.

➢ SuB04 – 4 16 : 00 - 16 : 15

[189]Dynamics of microorganism cultivation with delay and stochastic perturbation

牟鱼 重庆交通大学

In the microorganism cultivation process, delay and stochastic perturbations are inevitably accompanied, which results in complicated dynamical behaviors for microorganisms. In this paper, a mathematical model with discrete delay and random perturbation is constructed to understand how the dynamics of microorganisms in the turbidostat can be characterized. The existence, uniqueness and boundedness of the positive solution are first determined for the mathematical model. Furthermore, sufficient conditions for microorganism extinction and permanence in the turbidostat are obtained with the theory of stochastic differential equations. The system has the stationary distribution under a low-level intensity of stochastic perturbation from the environment; that is, microorganism in the turbidostat is persistent fluctuating around a positive value. On the contrary, microorganisms will be extinct with a strong enough intensity of noise. Several numerical simulations are applied to validate the theoretical results for the dynamics of the system.

➢ SuB04 - 5 16 : 15 - 16 : 30

[314] 以人口年龄结构数据来衡量国家发展的普遍模式和发展状况

沈 忱 北京师范大学
李红刚 北京师范大学

国家的发展是一个抽象的复合概念。长期以来，人类发展指数(HDI)作为一种复合指标得到广泛使用。而 HDI 作为以预期寿命、教育水平、生活质量为基础的综合指标，其分指标的选取和加权方式常被批评过于主观。本研究以人口年龄结构数据为基础，不去先验地假设何为发展，而是通过 PCA 降维手段将不同国家数十年的人口流变表现为一个高维空间中的轨迹，并进一步提出该轨迹中体现的全球国家发展的三种基本模式。该发展模式与由经济指标或 HDI 来衡量的国家发展排序具有高度相关性，表明国家人口年龄结构与其发展水准存在耦合，是一个国家发展水平的有效量度。鉴于年龄数据的普遍易得性，该方法得以用相对易获取且高通用的数据来描绘国家（或更细层级）发展，提出不基于西方话语体系下衡量发展的替代性方案。

➢ SuB04 - 6 16 : 30 - 16 : 45

[472] 基于循环神经网络的多通道协同温度控制系统研究与设计

王震林 江苏科技大学
徐松 江苏科技大学
黄巧亮 江苏科技大学
陈迅 江苏科技大学
蒋伟 扬州大学
Seiji Hashimoto Gunma University

随着人工智能技术的高速发展，越来越多的工业生产线开始对智能化应用进行投入与研究，而温度系统作为现代工业不可或缺的组成部分，尤其在半导体芯片等高端工业生产线中，温度控制的效果将直接影响成品率。本论文针对多通道协同工作的加热平台温度控制问题，提出基于循环神经网络的多通道协同温度控制方法，以循环神经网络的时间序列处理能力进一步提升多通道温度控制系统的精度及时效性。以分时阶跃响应系统辨识理论对多通道加

热平台进行温度响应系统参数辨识，得出多通道温度系统传递函数以及通道间非线性耦合扰动模型。引入循环神经网络控制策略建立多通道协同温度控制系统架构，对多通道加热温度进行精准控制，以循环神经网络时间序列处理能力进行温度系统延迟环节处理，根据多通道温度模型，建立参考模型为循环神经网络提供超参数训练基准信号，实现多通道加热平台温度的动态控制。所提出的控制系统在 MATLAB/SIMULINK 中建立仿真模型对控制效果进行验证，同时在以 dsPACE 为核心的四通道铝热平台进行实验验证，仿真及实验结果都与传统 PID 的多通道温度控制系统结果相比较，最终比较的结果验证了所提出的基于循环神经网络的多通道温度协同控制系统的优越性。

➢ SuB04 - 7 16 : 45 - 17 : 00

714 虚拟学术社区用户交互行为特征研究：基于两类学科的比较

张伟 江苏科技大学

探究虚拟学术社区中不同学科用户交互行为的特征，提出针对性意见。以经管之家中代表成熟学科的博弈论和代表前沿学科的数据挖掘板块为研究对象，分别使用采用文本挖掘 LDA 主题模型和社会网络分析方法对用户的交互内容和交互网络进行分析。成熟学科用户交互主题相对较少，但覆盖的内容较多；前沿学科用户主题相对较多，但多为领域内的细分化；成熟学科的知识共享行为较多，核心用户分布更加均匀；前沿学科用户的知识交流欲望更强，但整个社区过于依赖少数核心用户；但二者网络都较为疏散，且具有小世界效应。

➢ SuB04 - 8 17 : 00 - 17 : 15

474 基于参考模型驱动的神经网络动态温度控制方法研究

赵黎明 江苏科技大学
徐松 江苏科技大学
陈迅 江苏科技大学
蒋伟 扬州大学
Seiji Hashimoto Gunma University

随着在数字化、智能化进程的不断发展智能控制系统在工业当中的应用也越来越广泛，而对于温度系统这一长延迟、大迟滞及强耦合等非线性特性集于一体的非常规系统来说智能控制应用起来有一定的难度，本文就神经网络控制方法于温度控制系统中的应用，提出了一种参考模型驱动的神经网络动态温度控制方法，以神经网络控制器结合传统的积分-比例-微分(I-PD)补偿网络对温度系统进行精准控制。以阶跃响应系统辨识方法对单通道温度系统进行模型辨识，在模型准确性达标的基础上提出神经网络动态温度控制架构，引入基于对象模型基础的参考模型对神经网络进行驱动，以参考模型输出与实际输出的差值作为神经网络学习信号，从而实现神经网络快速学习。在 MATLAB/SIMULINK 环境中搭建所提出的神经网络动态控制架构仿真模型，并搭建以 dsPACE 为核心控制器的单通道加热平台进行实验验证，仿真与实验结果与传统的 I-PD 控制方法进行对比，验证了所提出的控制方法的有效性及控制精度。

➢ SuB04 - 9 17 : 15 - 17 : 30

388 Examining the overconfidence and overreaction in China's carbon markets

周欣星 上海理工大学
高岩 上海理工大学

This paper proposes a novel integrated approach combining structural vector autoregression model, impulse response function with event study to examine the overconfidence and overreaction in China's carbon markets. The structural vector autoregression model and impulse response function are adopted to measure the overconfidence and the relationship between market return and trading volume. The event study method is adopted to detect the overreaction. We make the empirical tests for the events of the United Nations Climate Change Conference and the proposal of China's carbon-neutral target. It is the first to explore the overconfidence and overreaction in China's carbon markets. The empirical results show that overconfidence exists in Fujian, Tianjin, Chongqing, Beijing, Shanghai, and Guangzhou carbon markets, while Shenzhen and Hubei carbon markets have no overconfidence. Carbon market trading volume is positively correlated with market return. Beijing, Guangdong and Shenzhen carbon markets have overreactions to the United Nations Climate Change Conference during 2014-2019. Guangdong carbon market has overreaction over China's carbon-neutral target.

SuB05 15 : 15 – 17 : 30 双鱼厅

腾讯会议：553-917-486

经济复杂系统建模(1)

主持人： 梁湘三 复旦大学
主持人： 何胜学 上海理工大学

➢ SuB05 - 1 15 : 15 - 15 : 30

99 学习的语言思维物象学结构巨型系统理论

陈才天 物象信息科技（湖北）有限公司

本文以语义物象假设为前提，研究通过语言理解的学习，实现间接认知世界事物的物象学思维结构的系统认知理论。“物象”是大脑神经系统对世界事物信息加工形成的记忆思维认知心理样态，物象具有与世界事物同一性的属性，即语义是大脑相关功能区以物象形态的表征。从文字符号到语音符号至语义物象，经历两次“象征”的物象转换。个体能够写文章是“十二元体”系统的语言思维物象学结构。熟练第二语言者，是“二十一元体”系统的语言思维物象学结构。通过语言学习获得知识，都是在大脑神经巨型系统结构中各种类物象相互转换的记忆思维过程。学习的语言思维物象学结构的脑神经细胞系统，完全遵循开放性、自组织性、复杂性，整体性、关联性，等级结构性、动态性、时序性的系统逻辑。

➢ SuB05 - 2 15 : 30 - 15 : 45

570 考虑智能客服系统中顾客行为的多服务台优先级人工客服排队系统

陈燕婷 上海理工大学
陈嘉颖 湖南大学

当前以聊天为基础的智能客服大量取代了传统的电话客服，但由于大多智能客服的回复较单一，所以人们往往倾向于选择转接人工客服进行问题咨询。而进行人工客服咨询时，经常会出现排队人数多、网络中断等现象。因此，本文以此为背景研究了带有止步、中途退出和负顾客的多服务台优先权排队系统。首先,以人工客服为例，在经典的强占优先权策略下建立了包含顾客在排队过程中出现止步和中途退出行为的排队系统，同时将网络中断模拟为排队系统中的负顾客。其次，通过矩阵分析法推导出了两类顾客的稳态分布并计算了相关的系统性能指标。进一步利用数值实例说明了止步、中途退出和负顾客三种因素对系统性能指标的综合影响是不可忽视的。最后，本文分析了个人及系统效益并提供了系统优化控制建议。

➢ SuB05 - 3 15 : 45 - 16 : 00

526 求解乡村邮递员问题的信息量模型及合圈算法

崔允汀 上海理工大学
何胜学 上海理工大学

乡村邮递员问题(RPP)是运筹学领域的一个基础问题，在现实生活中具有广泛应用。为满足 RPP 中邮递员遍历路网中部分街道至少一次后回到邮局的需求，利用信息量的概念从全新视角为有向 RPP 建立了数学模型。该模型通过强制要求所有邮递员需要服务的街道之间存在信息交互，保证邮递员最终路线的连通性。并以指派问题为核心多次构造指派问题，利用经典的最短路算法和匈牙利算法求解指派问题生成圈、合成圈，得到邮递员最终回路，为有向 RPP 设计出一个具有多项式时间复杂度的精确算法。通过理论证明和算例分析证实了模型的正确性和算法的收敛性。

➢ SuB05 - 4 16 : 00 - 16 : 15

867ESG 下的代币平台运行机制研究

费为银 安徽工程大学
李任重 安徽工程大学
费晨 上海理工大学

我们建立了一个代币平台发展模型，在这个模型里开发者在初始时刻售出部分代币为平台发展融资，代币作为平台的交易媒介可以给用户带来交易效用，也可能给用户带来现金收益而具有证券性，ESG 通过用户 ESG 偏好、发展成本和政府支持对平台发展产生影响. 我们得到了 ESG 影响下的代币定价公式和最优的代币派息水平，代币定价和代币派息水平还受到融资约束和代理冲突的影响. 我们发现，在一定水平的用户 ESG 偏好和政府干预下，ESG 表现差的平台难以运营，较低或较高 ESG 得分的平台有着相对较低的平台价值. 我们还对影响平台发展的其他因素进行了分析。

➢ SuB05 - 5 16 : 15 - 16 : 30

693The role of individual stocks in contributing to the vulnerability of a stock market in terms of cumulative information flow and causality on a rigorous basis

梁湘三 复旦大学

The robustness/vulnerability of a stock market depends on different factors, many of which remain unknown. Certain companies running in trouble may trigger a chain of reactions that lead to the collapse of the whole market, such as the subprime mortgage meltdown in the 2007-2008 crisis. A quantitative evaluation of the contribution of individual stocks in producing the collective behavior of a stock market is thence of great importance; it allows us to understand the potential damage to the structure integrity on a global scale due

to the local failure(s). We here show that this can be fulfilled based solely on the available series of stock prices. A natural way to do this is to find the information flowing (IF) from the stock of concern to the rest of the market, taking advantage of the recently established theory of information flow from first principles (e.g., Liang 2016, Phys. Rev. E, 94, 052201; Liang 2014, Phys. Rev. E, 90, 052150). In this study, we show that this can be cast within the framework of a stochastic dynamical system. With a linear assumption, a maximum likelihood estimator can be obtained, allowing us to estimate the information flow in an easy way. It is observed that this 'cumulative information flow' does not equal to the sum of the information flows to other individual stocks, reflecting that the macrostate of a network is not just a simple addition of the individual states, unless all the individuals are independent. To validate, we have examined a network made of Stuart-Landau oscillators. Depending on the topology, the computed information flows may differ. In some situations, the most crucial nodes, i.e., those with the largest cumulative information flow, do not need to be hubs; suppression of these nodes will cause the collapse of the entire network. The above theory is thence applied to the diagnosis of the 2008 financial crisis. With the time series of daily return, it is shown that, from 2000 through 2008, Fannie Mae (FNMA) and her little brother Freddie Mac (FMCC), and the financial institutions such Lehman Brothers (LEH), U.S. Bancorp (USB), Goldman Sachs (GS), Wells Fargo (WFC), AIG dominated the market. Companies other than Wall Street firms generally did not carry much weight, except a few in the utilities (e.g., ED) and healthcare (e.g., JNJ) sectors. In 2007, four financial institutions, Bank of America (BAC), Freddie Mac (FMCC), Goldman Sachs (GS), and Lehman Brothers (LEH) became overwhelmingly dominant in the market. An observation is that, compared with Bear Sterns, Lehman Brothers had a cummulant IF ten times larger from 2000 through 2008, and an IF almost twice in 2007. That is to say, Lehman Brothers then was much important to the global stock market than Bear Sterns, a financial firm bailed out by US Federal Reserve perhaps due to the fact that it was larger in size. This seems to indicate that Lehman Brothers really should have been bailed out, while, unfortunately, it was not; its fall hence shook the global financial market, with many regions in the world plunged into recession.

➢ SuB05 - 6 16 : 30 - 16 : 45

583 基于小波分析碳排放权价格和石油价格的交互效应研究

龙会典 广东外语外贸大学

探究碳排放权市场的价格机制，对建立健全我国碳排放权市场，实现"碳达峰"和"碳中和"目标，推动绿色经济发展模式具有重要意义。本文从 wind 数据中选择了广东省碳排放权价格、大庆原油价格和布伦特原油价格，利用连续小波、离散小波和格兰杰因果关系检验理论，分析我国碳排放权价格与国内外石油价格的交互效应。结果表明：在中高频率内，碳排放权价格与石油价格相干性强，且都是同向变动；在高频范围内，碳排放权价格领先石油价格，在中频范围内，碳排放权价格逐渐滞后石油价格。

➢ SuB05 - 7 16 : 45 - 17 : 00

856 混合随机波动模型下带随机工资的 DC 型养老金最优投资策略

邵艳宇 安徽工程大学
夏登峰 安徽工程大学
费为银 安徽工程大学

为实现养老金的保值增值，研究具有利率风险和波动风险的 DC 型养老金最优投资问题。假设金融市场包含一种无风险资产和一种股票，其中股票价格服从混合随机波动 (Heston-Hull-White) 模型。此外，养老金计划成员的工资是随机的。基于考虑终端财富预期效用最大化标准，在 CARA 效用函数下，通过建立相应的 HJB 方程，求解出最优投资策略。最后，通过数值算例分析主要模型参数对最优投资策略的影响。结果表明：风险规避系数的增大会导致投资者对股票的投资比例下降，利率风险和波动风险对 DC 型养老金的最优投资策略有显著影响。所得结果对基金管理者具有一定的指导作用。

➢ SuB05 - 8 17 : 00 - 17 : 15

836 The emergence of cooperation from shared goals in the governance of common pool resources

屠澄轶 浙江理工大学

Sustainable use of common-pool resources is a major environmental governance challenge because of their possible over-exploitation. Communities devise self-governing institutions that avoid overuse and attain

long-term benefits of cooperation. It is still unclear, however, what conditions allow cooperation to emerge, leading to greater long-term benefits. Until recently, study of the sustainable governance of common-pool resources has overlooked feedback between user decisions and resource dynamics and failed to test ability of shared goals to actually induce cooperation. Here we develop an online game to perform a set of experiments in which users of the same common-pool resource decide on their individual harvesting rates, which in turn are influenced by the resource dynamics. We show that, if users share common goals, a high level of self-organized cooperation emerges, leading to a long-term resource sustainability. Otherwise, selfish/individualistic behaviors lead to resource depletion. To explain these results, we develop a model of resource-decision dynamics based on optimal control theory and show how it is able to reproduce empirical results. We find that players self-organize and engage in collective action conducive to a sustainable governance of common-pool resources by trade-off strategies that balance individual and collective payoff and short-term as well as long-term rewards.

➢ SuB05 - 9 17 : 15 - 17 : 30

[518]Multi-agent reinforcement learning based real-time pricing for regional energy microgrid management

王菁祺 上海理工大学

Achieving power balance between supply and demand is one of the key tasks of smart grid, demand response has gradually become an effective method to improve grid reliability and reduce grid costs. Based on the demand-side real-time pricing problem under the regional energy microgrid, a new multi-agent real-time pricing optimization method is proposed to couple demand-side energy and regional energy microgrids. Based on the concept of regional energy microgrids, this paper considers the power load distribution under grid-connected and off grid conditions. It provides a more realistic scheduling problem than a single power supplier. Due to the intermittent nature of renewable energy generation, carbon allowance trading is considered to promote renewable energy consumption and reduce carbon emissions. The sales price of the power supplier can directly motivate the user's electricity consumption through the preference of power consumption behavior. Different low-carbon incentive mechanisms have been formulated for different users' power consumption behavior. Consider the social welfare under the regional energy microgrid, including different types of loads and multiple types of power suppliers. Due to the nonlinearity, non-convexity and complexity of the problem, the optimal solution of the problem can be better realized by using multi-agent reinforcement learning algorithm. The simulation results show that the regional energy microgrid management is better than the existing centralized transaction. The proposed algorithm can effectively balance the supply-demand relationship in the power market, and has better peak shaving and valley filling performance, thereby effectively improving the reliability of the power system.

SuB06 15 : 15 – 17 : 15 铂派厅

腾讯会议：956-940-490

经济复杂系统建模(2)

主持人：潘海峰 安徽工程大学

主持人：容逸能 复旦大学

➢ SuB06 - 1 15 : 15 - 15 : 30

[862]通胀与跳扩散下的企业最优杠杆策略

鲍琳琳 安徽工程大学

费为银 安徽工程大学

潘海峰 安徽工程大学

合理的资本结构可以有效地提高企业价值，如何做好企业的融资决策直接影响到企业的市场价值。在通胀环境下建立了企业的杠杆动态模型。首先利用随机微分方程刻画现金流过程、短期债务和通胀变化等；然后通过伊藤公式和动态规划原理推导出企业价值的哈密尔顿-雅克比-贝尔曼方程；最后通过数值模拟分析预期通胀率和通胀波动率分别如何影响公司的股权价值、企业价值 和杠杆水平等，进而对公司的杠杆选择和融资决策产生怎样的影响。研究结果表明：在跳扩散环境和考虑股权发行成本的情况下，高预期通胀率导致低企业价值，而高通胀波动率环境对应着高企业价值；高通胀波动率带来审慎的杠杆政策，而高预期通胀率却可能使得公司在杠杆管理方面更加激进。研究结论为企业的融资选择和杠杆管理提供了有效证据，有利于降低企业的经营风险，预期通胀率和通胀波动率因素的引入为现有公司资本结构理论发展提供了有益补充。

➢ SuB06 - 2 15 : 30 - 15 : 45

865 气候变暖下企业碳减排对经济增长的影响

费为银 安徽工程大学
李婧雅 安徽工程大学
潘海峰 安徽工程大学

以全球变暖为主要特征的气候问题逐渐走入我们的视野，本文在此背景下，用泊松跳刻画由于全球变暖造成的自然灾害的到达，家庭和企业可以动态的更新对灾害到达率的认知，为了缓解全球变暖，企业付出一定份额的成本来减少生产过程中的碳排放。本文讨论了社会计划者均衡和自由竞争均衡，分别得出两种背景下价值函数的哈密尔顿-雅克比-贝尔曼（HJB）方程。接着对方程进行数值模拟，得出结论：在同一悲观程度下，企业的投资和价值，家庭的消费都随着减排率的上升而下降，整体社会福利相较于不付出减排成本的情况几乎没有变化。进一步，为了解决减排对经济产生的短期不利影响，在模型中引入政府补贴因素，结果表明在同一悲观程度下，政府补贴可以带动投资和消费的增长，同时也使得付出减排率的企业价值提升，经济增长率有了一定程度的提高，社会福利仍然几乎保持不变。

➢ SuB06 - 3 15 : 45 - 16 : 00

857 ESG 数字平台的代币定价机制研究

费为银 安徽工程大学
谢成成 安徽工程大学
费 晨 上海理工大学

我们建立了一个代币平台发展模型，在这个模型里开发者在初始时刻售出部分代币为平台发展融资，代币作为平台的交易媒介可以给用户带来交易效用，也可能给用户带来现金收益而具有证券性，ESG 通过用户 ESG 偏好、发展成本和政府支持对平台发展产生影响. 我们得到了 ESG 影响下的代币定价公式和最优的代币派息水平，代币定价和代币派息水平还受到融资约束和代理冲突的影响. 我们发现，在一定水平的用户 ESG 偏好和政府干预下，ESG 表现差的平台难以运营，较低或较高 ESG 得分的平台有着相对较低的平台价值. 我们还对影响平台发展的其他因素进行了分析.

➢ SuB06 - 4 16 : 00 - 16 : 15

290Panel Data Causal Inference Using a Rigorous Information Flow Analysis for Homogeneous, Independent and Identically Distributed Datasets

容逸能 复旦大学

Panel data, which consist of observations on many individual units over two or more instances of time, have gradually become an important type of scientific data. Subsequently causal inference for panel data has attracted enormous interest from many fields as well as statistics. In this study, the rigorously formulated information flow analysis for time series, which is very concise in form and has been successfully applied in different disciplines, is generalized to identify the causality from homogeneous and independent identically distributed panel data. The resulting formula bears the same form as that for the former, though the meanings of the symbols differ. An algorithm is then proposed for panel data causality analysis, which has been validated with both linear and nonlinear problems. It has also been put to application to examine the causal relations among economic growth, energy consumption, trade openness, and energy price based on 15 Asian countries. Clearly identified are a strong bidirectional causality between economic growth and energy consumption, and a strong causality from import and export trade to economic growth. Energy price has no direct impact on energy consumption; it, instead, exerts a weak effect on the latter through influencing economic growth.

➢ SuB06 - 5 16 : 15 - 16 : 30

514Fixed-time formation tracking for multiple nonholonomic wheeled mobile robots based on distributed observer

孙凤兰 重庆邮电大学
李浩 重庆邮电大学

This paper studies the distributed fixed-time formation tracking problem of multiple nonholonomic wheeled mobile robots system over directed fixed and switching topologies. Through a classical nonlinear transformation, the formation control problem is transformed into a consensus problem. New control protocols based on a distributed observer are proposed. The directed communication topology between multiple nonholonomic wheeled mobile robots is considered. Some sufficient conditions of multiple robots achieving the desired formation shape are given. All follower robots can form the desired formation shape within a fixed settling time and make the leader in the geometric center of the formation. By adopting graph theory and

fixed-time stability theory, an upper bound of settling time that is independent of the system's initial states is obtained. Finally, four examples are presented to illustrate the correctness of the main results.

➢ SuB06 - 6 16 : 30 - 16 : 45

[373] 识别国际贸易系统中的碳排放关键行业

易虹汝 上海理工大学

减少国际贸易系统中关键行业的二氧化碳排放对减缓全球气候变化具有重要意义。本文结合复杂网络理论与结构路径分析，构建了最终需求引致的国际贸易隐含碳转移网络，并对全球国际贸易中碳排放的关键节点进行识别。结果表明，中国的电力行业、中国的金属行业与俄罗斯的电力行业是隐含碳入强度最高的前三个行业；中国的建筑行业、美国的公共行政和国防行业以及中国的电子产品行业是隐含碳出强度最高的前三个行业；中国的金属行业、中国的电力行业以及中国的电子产品行业是国际贸易隐含碳转移介数最高的前三个行业。本文通过识别国际贸易网络中关键碳排放行业，为政府制定行业层面的碳排放控制措施提供参考。

➢ SuB06 - 7 16 : 45 - 17 : 00

[160] A global branch approach to normalized solutions for Schrodinger equations

张建军 重庆交通大学

In this talk, we present a novel approach to study the existence, non-existence and multiplicity of prescribed mass positive solutions to Schrodinger equations. This approach permits to handle in a unified way nonlinearities which are either mass subcritical, mass critical or mass supercritical. Among its main ingredients is the study of the asymptotic behaviors of the positive solutions as the parameter goes to zero or infinity and the existence of an unbounded continuum of solutions. This is based on a joint work with Prof. Louis Jeanjean and Prof. Xuexiu Zhong.

➢ SuB06 - 8 17 : 15 - 17 : 30

[157] The evolution of the cross-broader venture capital network:1970 –2018

张欣 上海海事大学
许鹏达 上海海事大学

Cross-broader venture capital is typically considered to be a channel for transferring both physical capital and intangible assets, such as technology, innovation model, management experience, among countries. Many of the fastest-growing global ventures are backed by cross-border venture capitalists. We construct venture capital network in which the node represents the countries and link venture capital flow. While the previous analysis focused on the static and country-level version of the venture capital network, here we address its full evolving and global. We investigate the evolution property of cross-broader venture capital syndication networks, relying on comprehensive deal-level data sources, covering five decades and about 100 countries. We document major shifts in the nature of innovation international flows.

摘要集（线上）

2022 年 11 月 12 日（ 周六 ）

SaA01　　13 : 00 – 15 : 00

腾讯会议：602-343-832

复杂系统的奇异态与部分同步

主持人：郑志刚　　华侨大学

主持人：刘宗华　　华东师范大学

➢ SaA01 - 1　　13 : 00 - 13 : 15

[648]Impact of network motifs on response dynamics

纪鹏　　复旦大学

Many collective phenomena such as epidemic spreading and cascading failures in socio-economic systems on networks are caused by perturbations of the dynamics. How perturbations propagate through networks, impact and disrupt their function may depend on the network, the type and location of the perturbation as well as the spreading dynamics. Previous work has analyzed the effects that nodes along propagation paths induce, suggesting few transient propagation "scaling" regimes as a function of the nodes' degree, but regardless of higher-order motifs such as triangles. Yet, the majority of empirical networks consists of small loops and motifs in a great percentage, which permit the proper functioning of the system. Triangles, for instance, can enhance the stability against perturbations in power grids, and play a central role in the emergence and maintenance of social networks. Here, we show that triangles and higher-order motifs along the propagation path may jointly determine the previously proposed regimes of distance-limited propagation and degree-limited propagation – or even cease their existence. Our analysis suggests not only a radical departure from these scaling regimes but provides a deeper understanding of the interplay of self-dynamics, interaction dynamics, and topological properties. This allows us to identify the hidden universal propagation patterns for a range of prototypical complex systems and empirical networks. In particular, we show how network motifs determine the response times to perturbations as a function of the network structure and its dynamics, by disentangling the joint effects.

➢ SaA01 - 2　　13 : 15 - 13 : 30

[575]Understanding the mechanisms of brain functions from the angle of synchronization and complex network

刘宗华　　华东师范大学

The human brain is the most complicated and fascinated system and executes various important brain functions, but its underlying mechanism is a long-standing problem. In recent years, based on the progress of complex network science, much attention has been paid to this problem and many important results have been achieved, thus it is the time to make a summary to help further studies. For this purpose, we here make a brief but comprehensive review on those results from the aspect of brain networks, i.e. from the angle of synchronization and complex network. First, we briefly discuss the main features of human brain and its cognitive functions through synchronization. Then, we discuss how to construct both the anatomical and functional brain networks, including the pathological brain networks such as epilepsy and Alzheimers disease. Next, we discuss the approaches of studying brain networks. After that, we discuss the current progress of understanding the mechanisms of brain functions, including the aspects of chimera state, remote synchronization, explosive synchronization, intelligence quotient, and remote propagation. Finally, we make a brief discussion on the envision of future study.

➢ SaA01 - 3　　13 : 30 - 13 : 45

[641] 头皮脑电图对癫痫发作的检测与识别

卢小杰　　安徽师范大学

黄守芳　　安徽师范大学

张季谦　　安徽师范大学

癫痫是由于大脑神经细胞群突然异常超同步放电行为所引起的一种常见的慢性神经系统疾病。利用多通道头皮脑电图数据构建脑功能网络，从全脑的角度，利用非线性特征对异常同步脑电信号进行分类和识别。具体而言，使用 Hilbert-Huang 变换和卷积神经网络更准确地识别癫痫脑电信号，并利用网络分析工具箱和 Kuramoto 模型探索癫痫发作的无创识别标志。基于多通道脑电信号的仿真结果具有较好的实际意义和临床应用价值，可以为癫痫发作提供有效的物理指标。

➢ SaA01 - 4 13 : 45 - 14 : 00

[676]Topological - heterogeneity induced chimera states in excitable scale - free networks

钱郁 宝鸡文理学院

自 2002 年 Kuramoto 和他的同事，在耦合相振子模型中发现奇异态现象以后，奇异态问题研究已成为当前复杂性科学领域中的热点课题。不同类型的奇异态现象，分别在相振子模型、可激发模型等模型中，陆续被学者们发现和报道。但是在这些工作中，旋转耦合矩阵被认为是产生及维持奇异态的主要原因。于是我们会问，除了旋转耦合机理之外，是否还存在其它产生和维持奇异态的机制？本报告以可激发无标度网络模型为例，揭示了在可激发复杂网络中的一种全新的奇异态现象及机制，即由网络结构异质性诱导的奇异态。理论上，我们提出了一个不依赖于具体网络结构的普适性分析方法，对可激发系统能否产生此类奇异态做出了理论分析与并实现了对所需临界条件的理论预测。

➢ SaA01 - 5 14 : 00 - 14 : 15

[668]Transient cluster synchronization in ecological networks

王新刚 陕西师范大学

Transients are fundamental to ecological systems with significant implications to management, conservation and biological control. We uncover a type of transient synchronization behavior in spatial ecological networks whose local dynamics are of the chaotic, predator–prey type. In the parameter regime where there is phase synchronization among all the patches, complete synchronization (i.e. synchronization in both phase and amplitude) can arise in certain pairs of patches as determined by the network symmetry—henceforth the phenomenon of 'synchronization within synchronization.' Distinct patterns of complete synchronization coexist but, due to intrinsic instability or noise, each pattern is a transient and there is random, intermittent switching among the patterns in the course of time evolution. The probability distribution of the transient time is found to follow an algebraic scaling law with a divergent average transient lifetime. Based on symmetry considerations, we develop a stability analysis to understand these phenomena. The general principle of symmetry can also be exploited to explain previously discovered, counterintuitive synchronization behaviors in ecological networks.

➢ SaA01 - 6 14 : 15 - 14 : 30

[332]Fault Detection Problem for Discrete-Time Impulsive System Using Mixed Dissipativity Approach

要猛 上海理工大学
魏国亮 上海理工大学

This paper studies the fault detection problem for a class of discrete-time impulsive systems using mixed dissipativity theory. First, under the impulsive effects, a fault diagnosis observer is designed such that it is *insensitive* to disturbances, and *sensitive* to faults. Then, a mixed dissipativity concept is introduced to deal with impulsive effects, disturbances insensitivity condition and faults sensitive condition in one framework such that the impulsive error dynamic is dissipative with respect to the proposed mixed supply rate. Based the proposed mixed supply rate, sufficient conditions are obtained to guarantee the dissipativity of the impulsive estimation error dynamic. Moreover, sufficient conditions are established for the existence of the desired fault observer. The corresponding solubility conditions for the designs of the desired observer are also obtained. Finally, simulation results are proposed to demonstrate the effectiveness of our proposed strategy.

➢ SaA01 - 7 14 : 30 - 14 : 45

[651]Topological homogeneity-heterogeneity competition and wave dynamics in excitable networks

郑志刚 华侨大学

We will give a brief report on our recent studies on collective sustained oscillations and wave dynamics in excitable networks. Specifically, we focus on the roles of Winfree loop topology and node heterogeneity. We reveal that the sustainability of oscillation depends

strongly on the competition between these two ingredients ambedded in the network topology.

➢ SaA01 - 8 14 : 45 - 15 : 00

[652]Explosive synchronization by Cartesian product operation

邹勇 华东师范大学

Implementing a positive correlation between the natural frequencies of nodes and their connectivity on a single star graph leads to a pronounced explosive transition to synchronization, additionally presenting hysteresis behavior. From the viewpoint of network connectivity, a star has been considered as a building motif to generate a big graph by graph operations. On the other hand, we propose to construct complex synchronization dynamics by applying the Cartesian product of two Kuramoto models on two star networks. On the product model, the lower dimensional equations describing the ensemble dynamics in terms of collective order parameters are fully solved by the Watanabe-Strogatz method. Different graph parameter choices lead to three different interacting scenarios of the hysteresis areas of two individual factor graphs, which further change the basins of attraction of multiple fixed points. Furthermore, we obtain coupling regimes where cluster synchronization states are often present on the product graph and the number of clusters is fully controlled. More specifically, oscillators on one star graph are synchronized while those on the other star are not synchronized, which induces clustered state on the product model. The numerical results agree perfectly with the theoretic predictions. -- New Journal of Physics, 21, 123019, 2019.

SaA02 13 : 00 – 15 : 00

腾讯会议：197-804-905

网络传播动力学与新冠肺炎疫情研究

主持人：唐明 华东师范大学

主持人：许小可 大连民族大学

➢ SaA02 - 1 13 : 00 - 13 : 15

[187]Model - based evaluation of alternative reactive class closure strategies against COVID - 19

刘权辉 四川大学

There are contrasting results concerning the effect of reactive school closure on SARS-CoV-2 transmission. To shed light on this controversy, we developed a data-driven computational model of SARS-CoV-2 transmission. We found that by reactively closing classes based on syndromic surveillance, SARS-CoV-2 infections are reduced by no more than 17.3% (95%CI: 8.0–26.8%), due to the low probability of timely identification of infections in the young population. We thus investigated an alternative triggering mechanism based on repeated screening of students using antigen tests. Depending on the contribution of schools to transmission, this strategy can greatly reduce COVID-19 burden even when school contribution to transmission and immunity in the population is low. Moving forward, the adoption of antigen-based screenings in schools could be instrumental to limit COVID-19 burden while vaccines continue to be rolled out.

➢ SaA02 - 2 13 : 15 - 13 : 30

[72] 基动态接触网络的新型冠状病毒肺炎疫情模拟与防控研究

唐明 华东师范大学

COVID-19 的爆发席卷全球，对人类社会造成了巨大冲击，导致数百万人死亡，并造成了巨大的经济损失。揭示流行病传播的内在机制和关键影响因素，构建合理的传播模型，从而为流行病传播的预警和防控提供理论支持，是一个重要的研究课题。我们提出了一种基于个体接触动态网络的时滞传播模型，可以具体地描述病毒携带者地接触网络。我们的模型考虑了三种防疫措施：出行管控策略、基于个体接触的追踪隔离策略和疫苗接种策略。我们使用蒙特卡洛模拟了病毒感染规模、持续时间、确诊峰值、二次爆发概率和经济代价，从疫情态势和经济损失两个方面对防疫措施进行评估。我们发现，加强出行管控策略的强度，可以有效地抑制病毒传播，而经济损失随着出行强度的提升出现先增长后下降的趋势。在管控措施较严地情况下，追踪隔离策略地影响甚微；而出现管控较松时，增加追踪隔离率能够明显地抑制病毒扩散速度，降低医疗压力，但会导致疫情持续时间增长。此外，较高的接种率能有效抑制病毒传播，但是，当接种率没有达到 100%时，还需要结合追踪隔离策略才能较好地控制疫情。

➢ SaA02 - 3 13 : 30 - 13 : 45

[84] 面向新冠肺炎疫情的非药物干预措施理论研究

王冰 上海大学

新冠肺炎疫情严重威胁了人类健康，随着疫情的发

展演化，政府采取了不同程度的干预措施，从封城、交通管制到对个体的检测、追踪隔离等，个体的行为方式也发生了变化（如戴口罩、社交距离）等，这些非药物干预措施对疫情起到了一定的抑制作用，但对其有效性尚缺少定量的分析和结论。为此，本报告围绕影响流行病传播的若干干预措施进行数学建模和定量分析，从而为有效控制流行病传播，制定合理的干预策略提供理论指导。

➢ SaA02 - 4 13 : 45 - 14 : 00

[37] 数据与计算传播学

吴晔 北京师范大学

计算传播学是计算社会科学的重要分支，主要指以传播网络分析、传播文本挖掘、数据科学等为主要分析工具，(以非介入的方式)大规模地收集并分析人类传播行为数据，挖掘人类传播行为背后的模式和法则，分析模式背后的生成机制与基本原理。本报告将交流北京师范大学计算传播学研究中心在2020-2021 年里关于健康传播，视觉传播等若干研究进展。

➢ SaA02 - 5 14 : 00 - 14 : 15

[266] 复杂网络中的诱导渗流

谢家荣 中山大学
王向荣 南方科技大学
胡延庆 中山大学

Percolation theory has been widely used to study phase transitions in network systems. It has also successfully explained various macroscopic spreading phenomena across different fields. Yet, the theoretical frameworks have been focusing on direct interactions among nodes, while recent empirical observations have shown that indirect interactions are common in many network systems like social and ecological networks, among others. By investigating the detailed mechanism of both direct and indirect influence on scientific collaboration networks, here we show that indirect influence can play the dominant role in behavioral influence. To address the lack of theoretical understanding of such indirect influence on themacroscopic behavior of the system, we propose a percolation mechanism of indirect interactions called induced percolation. Surprisingly, our model exhibits a unique anisotropy property. Specifically, directed networks show first-order abrupt transitions as opposed to the second-order continuous transition in the same network structure but with undirected links. A mix of directed and undirected links leads to rich hybrid phase transitions. Furthermore, a unique feature of the nonmonotonic pattern is observed in network connectivities near the critical point. We also present an analytical framework to characterize the proposed induced percolation, paving the way to further understanding network dynamics with indirect interactions.

➢ SaA02 - 6 14 : 15 - 14 : 30

[109] 密集人群环境下新冠肺炎防控措施的仿真与分析

许小可 大连民族大学

在后疫情时代，如何制定和实施防控措施以控制新冠疫情的发生、发展是一个重要问题。校园、医院、工作场所等密集人群环境支撑着现代社会中教育、医疗和生产的进行，然而密集人群环境中个体之间密切的接触使得它们成为疫情爆发的高风险区域，并且复杂的人际接触情况使得被广泛使用的防控措施可能无法应对环境内部的防疫工作。因此，我们使用密集人群环境内真实的人际接触数据集，提出与新冠肺炎实际传播相符的连续感染模型仿真密集人群环境内多种防控措施的实施，并分析防控措施的防疫效果。本研究提出的连续感染模型可以使研究人员更准确地仿真新冠肺炎的传播，针对多种措施的分析可以为密集人群环境的疫情防控工作提供理论支持，进而防止疫情的爆发和恢复人民的正常生活秩序。

➢ SaA02 - 7 14 : 30 - 14 : 45

[287] Dynamics of the Thrshold Model on Hypergraphs

许新建 上海大学

The threshold model has been widely adopted as a prototype for studying contagion processes on social networks. In this paper, we consider individual interactions in groups of three or more vertices and study the threshold model on hypergraphs. To understand how high-order interactions affect the breakdown of the system, we develop a theoretical framework based on generating function technology to derive the cascade condition and the giant component of vulnerable vertices, which depend on both hyperedges and hyperdegrees. First, we find a dual role of the hyperedge in propagation: when the average hyperdegree is small, increasing the size of the hyperedges may make the system fragile, while the average hyperdegree is relatively large, the increase of

the hyperedges causes the system to be robust. Then, we identify the effects of threshold, hyperdegree, and hyperedge heterogeneities. The heterogeneity of individual thresholds causes the system to be more fragile, while the heterogeneity of individual hyperdegrees or hyperedges increases the robustness of the system. Finally, we show that the higher hyperdegree a vertex has, the larger possibility and faster speed it will get activated. We verify these results by simulating meme spreading on both random hypergraph models and hypergraphs constructed from empirical data.

➢ SaA02 - 8 14 : 45 - 15 : 00

[89] 时序网络上的结构和功能差异性研究

张子柯 浙江大学

量化时序网络的结构和功能差异是复杂网络领域一个基本且具有挑战性的问题。本次报告将介绍一种时序网络差异化比较的时间差异度量方法。实验结果表明，该方法可以通过很好地具有不同时序特征的网络结构，捕捉其各种拓扑和时间特性。此外，所提出方法可以很好地区分时序网络的功能差异性应用：网络分类和传播能力。本研究对于复杂网络结构和功能研究有一定的启示意义。

SaA03 13 : 00 – 15 : 00

腾讯会议：666-623-362

复杂系统涌现及自组织行为研究

主持人：张希昀 暨南大学

主持人：高见 安庆师范大学

➢ SaA03 - 1 13 : 00 - 13 : 15

[177] Network-energy-based predictability and Link-corrected prediction in complex networks

柴浪 武汉科技大学

涂俐兰 武汉科技大学

Link prediction is essential in the research of complex networks. Firstly, in this paper, we propose a new network predictability index based on network normalized energy. The proposed index is further extended by incorporating the network structural consistency index, and another better predictability index is presented. Secondly, we also put forward a new link prediction algorithm (LCPA) which iteratively perturbs the network topology and then correct them by maximum likelihood probability. Numerical experiments on real and generative networks and comparisons with the existing algorithms confirm that in most case the LCPA algorithm proposed in this paper outperforms the prediction precision of the existing algorithms. Finally, this paper takes the prediction precision value obtained by the LCPA algorithm as the link structural predictability value of the network and verifies the validity and reasonableness of the two proposed predictability indexes. It is seen that these two indexes efficiently characterize the network predictability. The second index has better performance and show a clear linear relationship with the network predictability.

➢ SaA03 -2 13 : 15 - 13 : 30

[13] Turing patterns induced by the random aggregation of spatial compositions

高见 安庆师范大学

Turing patterns are typical spatiotemporal ordered structures in various systems driven far from thermodynamic equilibrium. Turing's reaction-diffusion theory, containing a long-ranging inhibiting agent and a local catalytic agent, has provided an explanation for the formation of Turing patterns. Numerous experimental and theoretical studies about Turing patterns are generally focused on systems driven far from thermodynamic equilibrium. The local dynamics of this type of systems is usually very complex, which brings great difficulties to the researches of Turing patterns. Here, we investigated Turing patterns in a type of thermodynamic equilibrium system experimentally and theoretically, and put forward new ideas on the formation mechanism of Turing patterns. Specifically, we observed Turing patterns in starch solutions, and studied the effect of concentration on the structure of patterns. The experimental results show that, with the increase of concentration, Turing pat terns change from spots to inverse spots, and labyrinthine stripe patterns appear in the intermediate regions of values of the concentration. We analyzed and modeled the formation mechanism of Turing patterns observed in these experiments, and the simulation results agreed with the experimental results. Our conclusion indicates that the random aggregation of spatial compositions leads to the formation of Turing

patterns, and the proportion of spatial compositions determines the structure of Turing patterns. The findings shed light on the formation mechanism of Turing patterns.

➢ SaA03 - 3 13 : 30 - 13 : 45

[799] 无人机边缘网络离散人工蜂群缓存策略研究

洪钖 北京信息科技大学
张月霞 北京信息科技大学

无人机边缘网络（UAV Edge Network，UEN）能够减轻核心网缓存负载并提高系统性能，为用户提供高效的内容服务。针对 UEN 中内容流行度的时变特性导致流行度预测准确率低和无线信道条件的容量限制导致的传统缓存策略缓存命中率下降的问题，本文提出了一种无人机边缘网络离散人工蜂群缓存策略(Discrete Artificial Bee Colony Cache Strategy of UEN，DABCCSU)。首先，建立了无人机边缘网络信息动力学传播模型（Information Dynamics Dissemination Model of UEN，IDDMU），推导了信道容量与 IDDMU 中服务率的耦合关系，讨论了服务率变化对内容传播过程产生的影响，并利用状态迭代矩阵预测了 UEN 中内容的流行度。然后，提出了一种离散人工蜂群缓存（Discrete Artificial Bee Colony Cache，DABCC）优化算法，将人工蜂群的行动函数设计为基于历史缓存方案的随机行动，将离散化缓存策略作为优化变量，利用 IDDMU 得到的流行度预测结果，最大化缓存命中率，为 UEN 提供最优的缓存方案，有效提高了 UEN 的缓存命中率。仿真结果表明，DABCCSU 缓存策略在流行度预测上的准确率超过 90%，达到了很好的预测效果。在缓存性能方面，DABCCSU 的平均缓存命中率达到 91.62%，优于 LRU（Least Recently Used）策略的 51.09%与 GA（Greedy Algorithm）的 89.27%，此外，DABCCSU 在不同缓存容量下的缓存命中率也优于 LRU 策略和 GA 策略，拥有比较稳定的性能。

➢ SaA03 - 4 13 : 45 - 14 : 00

[843]Network-Based Approach for Forecasting East Asian Summer Monsoon Rainfall

邵海明 昆明理工大学

Despite the development of complex statistical and dynamic climate models, due to the strong internal variability of the monsoon system and the nonstationarity of climate driving factors, a relative long-term and reliable prediction of East Asian summer monsoon rainfall is still a challenging problem. In recent years, complex network theory has proved its great potential as the dynamics of complex systems. In order to achieve this goal, we construct a physical climate network and discussed the monsoon forecasting skills by analyzing the global near surface and different pressure heights air temperature field from 1950 to 2020. We find that some characteristics of the directed weighted climate network can be used as effective long-term predictors of the East Asian summer monsoon rainfall forecast and predict it in a unique way. The developed forecasting method is generated by using the data of the previous calendar year and has a lead time of nearly half a year. The results and methods reported in this paper can be used to improve the prediction level of national flood climate disasters, reduce the economic losses caused by climate disasters, and also can be used to investigate other climate variables.

➢ SaA03 - 5 14 : 00 - 14 : 15

[69] 个体有限移动的原理及应用

李文静 浙江水利水电学院

基于网络博弈，个体的有限移动有利于合作涌现，即在未被破坏的网络互惠与移动机制的共同作用，合作达到了前所未有的高度。在社会困境中，在促进合作的手段中，与奖励合作者或惩罚背叛者相比，个体的有限移动更能有效地节约公共资源。既然少数人移动有利于合作行为的传播，那么什么样的移动行为应该被支持？首先，从人力资源分配角度分析，研究发现：能够为新社区带来比原社区收益更高的个体移动能够形成大规模合作团簇。理论上，社区的平均收益与社区内个体的合作数量呈正比。实际上，通过移动到更有利于发挥自身优势的社区以获得竞争优势的个体促进了新社区的合作行为扩散。其次，我们发现低收入人口的有限流动可以促进合作，具体地，人均流动率低至10^{-3}数量级上时，网络互惠仍然活跃。网络互惠性和移动之间的这种协同作用有利于大规模合作集群出现。此外，我们发现背叛者的移动是合作难以维持的主要原因。相反，合作水平几乎随着低收入合作者的移动率呈正比。为个人提供脱贫的途径，亦可使整个社会摆脱经济僵局。

➢ SaA03 - 6 14 : 15 - 14 : 30

[607] 弛豫时间作为向富营养化湖泊状态临界转变的预警指标

马智钦 昆明理工大学

曾春华 昆明理工大学

湖泊生态系统表现出非线性反应，并可能经历灾难性的转变，导致从灾难性的状态恢复到另一相反的状态是困难的。最近的理论和实验发展表明，描述生态系统的恢复力可以提供一种预测临界转变的方法。在本文中，我们提出了一种新的和实用的方法来衡量弹性，即弛豫时间作为向富营养化湖泊状态临界转变的指标。此外，本文还通过随机共振的方法探讨了这些发现的可能机制，即当噪声强度固定时，在信噪比和系统参数的函数关系中出现一个极大值。结果表明，弛豫时间对临界转变的预测是一个有效的指标，并且在一个临界阈值附近发生了随机共振。随机共振可能是临界转变的背后机制。我们的发现为预测生态系统的临界转变提供了一个新的视角。

➢ SaA03 - 7 14 : 30 - 14 : 45

[48]Structure of Autocorrelation in Time Series

任恒刚 泰山学院
张国锋 泰山学院

Autocorrelation is one of the basic concepts in time series analysis and attracts persistent attentions for more than one hundred years. Correlations in time series induce complicated patterns and their interdependent relationships. Hence, the autocorrelation has a network structure, in which the nodes are the patterns and the edges the interdependent relationships between the patterns. However, in the standard procedures for estimating autocorrelation the network structure is lost in the procedure of statistical average. In the present paper we propose a concept called local pattern interdependent (LPID) network to display the structure of the autocorrelation. It is found that the series generated with the theoretical models of the Autoregressive Process and the fractional Brownian motion, and the series of empirical records of stock market indices share several behaviors. Their differences come from the weights, among which the self-linkage of a specific pattern is significantly large and can take subsequently a measure to distinguish the series. Hence, the LPID network provides a unified framework to investigate time series generated by different mechanisms. What is more, the results tell us that this network structure of autocorrelation stores a kind of high-order correlation compared with the traditional definition of autocorrelation.

➢ SaA03 - 8 14 : 45 - 15 : 00

[126]基于复杂网络的人体生理病理状态新定义

张希昀 暨南大学

人体是一个由不同器官相互耦合形成的复杂网络，这个网络是否正常工作影响着人体是处于健康状态还是病理状态。在传统的医学和生理学研究中，对生理状态和病理状态的定义大多只基于单个器官的生理指标，而忽视了器官间耦合网络的信息。为了探索生理网络与人体生理、病理状态的关系，我们采用新设计的时间序列分析方法，构建了人体器官耦合网络。通过对大量数据的分析，我们发现这个器官耦合网络的结构与人体的不同生理状态一一对应，而病理状态的产生也能对应于该网络的变化。因此器官耦合网络可以成为人体生理、病理状态的诊断新指标。

SaA04 13 : 00 – 15 : 00

腾讯会议：611-131-939

复杂网络分析方法及在社会经济等系统中的应用

主持人：王有贵 北京师范大学
主持人：贾韬 西南大学

➢ SaA04 - 1 13 : 00 - 13 : 15

[205]全球海运网络的重叠社团结构及其国际贸易格局关联特征

邓文慧 大连理工大学
徐梦俏 大连理工大学

海上运输承担 90%以上中国国际贸易货运量、90%以上全球国际贸易货运量，其中，集装箱班轮运输承担全球约 70%的海运货物价值量，对各国的对外贸易和经济发展尤为重要。港口在全球海运网络结构中的连通性与其所在国家的国际贸易发展密切相关。本研究基于全球集装箱班轮航线历史数据，构建全球集装箱海运网络，挖掘其重叠社团结构特征。研究发现，网络的重叠社团结构特征对全球港口之间的高效运输起着重要作用；进一步开发港口节点中心性指标，发现其在港口集装箱吞吐量预测上具有较高精度。全球各港口的集装箱货物吞吐量是国际贸易格局在港口节点层面的微观反映，本研究创新性地定量刻画了全球海运系统结构与国际货物贸易格局之间的关联机制。

➢ SaA04 - 2 13 : 15 - 13 : 30

[144]Cycle structure in networks and its application

范天龙 University of Fribourg
吕琳媛 电子科技大学

A cycle is the simplest structure that brings redundant paths in network connectivity and feedback effects in network dynamics. An in-depth understanding of which cycles are important and what role they play on network structure and dynamics, however, is still lacking. Here we highlight a significant difference between the distribution of the shortest cycles in real and model networks, and apply it to the importance characterization of individual nodes. Specifically, we define the cycle number matrix (Fig. 1b), a matrix enclosing the information about cycles in a network, and the cycle ratio (Fig. 1b), an index that quantifies node importance. Experiments on real networks suggest that cycle ratio contains rich information in addition to well-known benchmark indices. For example, node rankings by cycle ratio are largely different from rankings by degree, H-index, and coreness, which are very similar indices (Figs. 1c & 1d). Numerical experiments on identifying vital nodes for network connectivity (Fig. 1e) and synchronization (Fig. 1f) and maximizing the early reach of spreading (Fig. 1g) show that the cycle ratio performs overall better than other benchmarks. In addition to the shortest cycles, cliques, as a more general cycle structure, also play an indispensable role in various network structures, functions and applications. We propose a fast and accurate maximum cliques and maximal cliques search algorithm based on graph decomposition, which requires only approximate linear time complexity and is independent of network size (Figs. 2b & 2c). We believe our in-depth analyses on cycle structure may yield insights, metrics, models, and algorithms for network science.

➢ SaA04 - 3 13 : 30 - 13 : 45

[286] 信息流动异质性对投资成败的影响性研究

管青 中国地质大学（北京）

投资经验是否以及如何影响投资人的成功，一直是学者们关注的问题。投资人对初创企业各轮融资的投资行为形成了复杂系统，已有研究大多独立地度量各轮融资信息，仅关注每轮融资中投资人合作行为对投资成败的影响，忽略了各轮融资间的信息关联。然而，多轮融资间实际是存在信息流动的，已有的融资信息会对后续投资人决策产生影响，因此需要将投资人间信息流动的异质性纳入研究模型。本研究基于 1962-2019 年全球初创企业投资数据，构建了刻画投资信息流动的异质网络模型，通过界定融合时效信息和异质连边信息的网络模体，挖掘投资信息流动的潜在规律，并识别投资人在信息流动中的角色对其投资行为及投资效果的影响。研究将为投资人发展提供建议。

➢ SaA04 - 4 13 : 45 - 14 : 00

[146] 基于相对性指标的经济系统分析

韩筱璞 杭州师范大学

传统经济指标大多数属于绝对性指标，该类指标一般仅表征绝对意义的产出或投入，而没有排除影响其经济表现的因素差异。绝对性指标的缺陷在于，一些有着巨大影响的实质性差异常常会被巨大的绝对差异所湮没。针对这一问题，我们构建了一系列的相对性指标来进行经济系统的分析，包括基于专利申请、论文产出、研发投入等数据的多类相对性区域创新指数、基于进出口数据的相对性贸易指数、针对高校科研产出的高校创新能力指数等。通过基于这些相对性指标的分析，观察到一系列迥异于传统认知的现象，例如中国极强的创新能力、有着长期社会主义制度史国家的整体创新能力较高、国际贸易与经济增长的回旋加速现象等，并重构了中国及中国高校在国际上的创新能力排名。这些发现显示出这类相对性指标在经济分析中的有效性。

➢ SaA04 - 5 14 : 00 - 14 : 15

[134] Quantifying the maximum capability of a topological feature in link prediction

贾韬 西南大学

Link prediction aims to predict links that are not directly visible due to incomplete information of the network, which has profound applications in biological and social systems. Recent studies on the link predictability of a network shed light on the extreme performance that any prediction tool could ever reach. Yet, it is still unclear to what extent a specific topological feature can be leveraged to infer the missing links. Moreover, a feature can be utilized in a supervised or unsupervised manner. However, the inherent performance difference between the two approaches remains unexplored. Here, we show that the maximum capability of a topological feature follows a simple yet theoretically validated expression, which depends on the extent that the feature is held in missing and nonexistent links, but is independent of how the feature is quantified by an index. Hence, a family of indexes based on the same feature share the

same upper bound, allowing us to estimate the potential of all others from one single index. The maximum capability by the supervised approach is higher than that by unsupervised manner, whose improvement can be mathematically quantified. Hence, the benefit of applying machine learning algorithms can be known in advance. Our work benefits from a large corpus of 550 structurally diverse networks, from which the universality of the pattern uncovered is empirically verified. Taken together, we reveal previously unknown regularities underlying the link prediction task. The finding can be applied to optimize the feature selection and stacking, and also advances our understanding of network characteristics associated with the utilization of a topological feature in link prediction.

➢ SaA04 - 6 14 : 15 - 14 : 30

197 宏观金融的集成网络方法

王有贵 北京师范大学

主流货币金融学的基础框架取自实物经济学，使得它与现实经济严重脱节，也无法为当前经济困境提供有效的政策建议。我们基于存量流量一致性原理构建了金融系统运行的基础性框架，它包括银行决策、信贷市场、资产市场、信贷创造和总需求分解五个模块。明确了每个模块的输入输出以及模块之间的关联，给出了一个宏观金融的集成网络。这一网络不仅可以用来理解各类宏观经济政策的传导机制，还可以辨识金融加速器的存在机理，更重要的是可以用来探讨金融系统稳定性的根基。

➢ SaA04 - 7 14 : 30 - 14 : 45

278 高阶网络上的竞争流行病传播研究

王伟 重庆医科大学

生物学和社会学系统中的相互作用并不局限于两两之间，而是可以以任意大小进行的群体交互。大量研究表明，群体相互作用对网络系统的传播动力学有显著影响。竞争传播动力学，即多种流行病同时传播并相互竞争，已经在现实世界中被广泛观察到，然而群体相互作用影响竞争传播动力学的方式仍然缺乏系统的研究。本文提出了一个由单纯复型表示的高阶系统上两种相互竞争的单纯（SIS）易感—感染—易感流行病模型，并分析了模型的临界现象。在所提出的模型中，易感节点只能被两种流行病中的一种感染，感染节点向邻居的传播可以通过成对的（即边）和高阶的（如二阶单纯型）交互同时发生。通过平均场理论分析和数值模拟，我们表明该模型表现出依赖于二阶单纯型感染强度的丰富动力学行为。当二阶单纯型感染强度较弱时，模型的相图与简单图一致，由三个区域组成：每个流行病的绝对优势区域和无流行病区域。随着二阶单纯型感染强度的增加，出现了一个新的区域，称为交替占优区域。在这个区域，一种流行病的存活取决于初始条件。我们的理论分析可以合理预测每个区域的时间演化和稳态爆发规模。此外，我们进一步探讨了当二阶单纯型感染强度对称和不对称时模型的相图。结果表明，二阶单纯型感染强度对系统相图有显著影响。

➢ SaA04 - 8 14 : 45 - 15 : 00

275 风险投资机构的共股东网络研究

姚卿 北京师范大学
李睿琪 北京化工大学

复杂网络作为模拟人类社会活动和自然界异质性的建模手段在各个领域都取得了突破性的成果：从生物蛋白网络到社交网络、交通网络等。本项目通过复杂网络的方法研究了中国金融一级市场的投资行为。投资网络中的节点是风险投资机构（VCs），连边代表每次投资行为。以此为基础，如果某两个机构在同一时期投资了同一家公司，建立新的共股东网络。首先，我们研究了共股东网络的度分布、社团大小分布、聚类系数等，发现 VC 的供股东网络是一个小世界网络，其度和社团大小都有较好的标度性，这与国内外其他共股东系统行为相似。其次，我们进一步研究了 VC 共股东网络结构和风险投资机构投资成功率的关系。每个机构的成功率定义为成功进入下一轮融资、IPO 或是成功被并购的企业数量占所投标的的百分比。随后，基于每笔投资的投资阶段（投资阶段包括种子轮、A 轮、B 轮和 pre IPO 等），我们构造了阶段的专业程度指数，指数越接高说明投资机构的阶段专业性越高，量化分组分析了投资专业程度和成功率在网络结构上的分布，发现网络连接对于个体 VC 进入新的投资阶段与新的产业具有重要的影响。最后，我们构造了网络上的莫兰指数（moran index），从网络结构的角度揭示了风险投资机构的投资行为中存在的“成功者俱乐部”。

SaA05 13 : 00 – 15 : 00

腾讯会议：947-476-910

博弈驱动的动态系统的进化和控制

主持人：穆义芬 中国科学院
主持人：张建磊 南开大学

➢ SaA05 - 1 13 : 00 - 13 : 15

[346]Stability and bifurcation analysis for a nitrogen-fixing evolutionary game with environmental feedback and discrete delays

程海辉 山东科技大学

In this paper, a nitrogen fixation game system with two time delays under nitrogen limitation is investigated. Firstly, we discuss the existence and local stability of the equilibrium points for non-delay system. Then the nitrogen fixation delay and strategy-dependent delay are used as bifurcation parameters to analyze the local stability and the Hopf bifurcation. In addition, we also obtain the direction of Hopf bifurcation, the change of the period for periodic solution and the stability of periodic solution via centre manifold theory and normal form method. Finally, numerical simulation is employed to visualize the theoretical analysis results and we find that the nitrogen fixation strategy is the dominant strategy when the values of the two time delays are large enough.

➢ SaA05 - 2 13 : 15 - 13 : 30

[855]Pricing and Return Mode Decision of Dual-Channel Supply Chain Considering Second-hand Market

程晋石 安徽工程大学

The return behavior of consumers will inevitably affect the decision-making of dual channel retailers, and the resale service of second-hand platform will inevitably affect the purchase behavior of consumers and the return decision-making of dual channel retailers. By depicting the factors such as cross revenue (the revenue obtained by retailers due to consumers' additional purchase behavior when returning to the store), resale price (the price of consumers when dealing with inappropriate products in the second-hand market). We construct a dual channel supply chain decision-making model considering the second-hand platform and return mode, and explore the impact of the changes of resale price and cross revenue on retailers' pricing and profits under different second-hand platform operation decisions and return modes. First, under the traditional return model, operating a second-hand platform will increase the cost of retailers, resulting in loss of their own profits. Second, when operating the second-hand platform and the suitability rate of consumers to buy products is too high, it will damage the total profit of retailers, and the resale price of second-hand products will significantly increase the total profit of retailer. Third, when the product cost is low, whether retailers adopt partial return mode or no return mode, operating second-hand platforms will be more conducive to ensuring its own profits.

➢ SaA05 - 3 13 : 30 - 13 : 45

[33]The optimal strategy against Fictitious Play in infinitely repeated games

董洪成 中国科学院
穆义芬 中国科学院

With the rapid development of Artificial Intelligence(AI), the game between human and machine/AI becomes more and more common and important. In this paper we will investigate such infinitely repeated games. We will study the optimal play of the human given the machine/AI adopting the Fictitious Play(FP) for all different kinds of 2 × 2 games under the assumption of a payoff parameter being rational. We give the optimal strategy of human which is proven to lead the system into a cycle after finite times. The results show that FP algorithm can be exploited easily and heavily. Analysis in this paper might shed some light on the result for more general and complicated situations.

➢ SaA05 - 4 13 : 45 - 14 : 00

[544]具有流结构的合作博弈及其应用

葛静沂 上海理工大学
张广 上海理工大学

本文讨论了一类具有联盟受限的合作博弈问题，在经典可转移效用合作博弈的基础上引入有向网络结构，提出了具有流限制的合作博弈模型，简称流博弈. 随后，基于 Shapley 值和有向图限制结构定义了流博弈的一个解，并对其性质进行了分析. 通过对有效性以及公平性等性质的扩展，给出了流博弈分配规则的一个公理刻画. 最后，将流博弈及其分配规则应用在跨国公益物资运输问题中，构建了成本运输分摊博弈模型，并通过算例分析了流博弈及其分配规则的合理性.

➢ SaA05 - 5 14 : 00 - 14 : 15

[49]The Optimal Play against Hedge Algorithm in Finitely Repeated Two - Player Zero - Sum Games

郭鑫祥 中国科学院
穆义芬 中国科学院

With the rapid development of artificial intelligence (AI), the game between human and machine/AI becomes more and more common and the theoretical analysis becomes significant and necessary, which however is still rare. In this paper, we investigate the optimal play of one player (player Y, human) when its opponent (player X, machine/AI) adopts a given algorithm (Hedge) in a finitely repeated 2 × 2 zero-sum game. The payoff values in the one-shot game are assumed to be integers. By defining the state and the State Transition Triangle Graph, we find that this problem is equivalent to the Shortest Path Problem in the graph. First, we prove that the game system will behave in a periodic way when player Y adopts the myopic best response as his updating rule. Based on the myopic path and the recurrence relation between the optimal actions at time-adjacent states in the Bellman Optimality Equation, we can solve the optimal play of player Y, which is proved to be periodic on the time interval truncated by a tiny segment and has the same period as the myopic path. Method and results in this paper might help the solution for the optimal play in general cases.

➢ SaA05 - 6 14 : 15 - 14 : 30

[616]Inferences about input - output - to - state stability across related systems

李睿 北京大学

There have been efforts to simplify analysis of a complex system by relating it to a simpler system through certain system relations. In this paper, we consider continuous-time systems related by a graph simulation relation and focus on preservation of input-output-to-state stability (IOSS) and its integral variant, integral IOSS (iIOSS). We establish that, under mild continuity and boundedness assumptions on some appropriately defined set-valued functions, the (i)IOSS property for the simulating system can lead to the (i)IOSS property for the original simulated system. The results thus demonstrate the possibility of inferring the (i)IOSS of a system by analyzing a potentially simpler system.

➢ SaA05 - 7 14 : 30 - 14 : 45

[336]Exploring the inducement for social dilemma and cooperation promotion mechanisms in structured populations

刘思媛 南开大学
张建磊 南开大学

Investigating and addressing the issue of social dilemma is a continuing concern within the subject of behavioral sciences and collective cooperation. The research to date has mostly focused on outside control methods dealing with the existing dilemma rather than exploring the reason resulting in that inside. This work probes into the inherent inducement for cooperation dilemma. We construct a gaming environment in which thousands of random memory-one strategies interact with each other on different complex topologies and record dominant strategies winning out from self-organized evolution. After clustering and analyzing evolutionary results, we find that the randomness and heterogeneity of population structure will strengthen the fitness of defectors. Besides, the cooperative willingness of individuals in betrayal situation has a decisive impact on the cooperation level of groups at equilibrium state. Further, we present two innovative treatments, enforcement and punishment mechanisms, to promote collective cooperation. The promoting effect is checked on various spatially networked topologies in the iterated prisoner's dilemma game. Simulation results indicate that irrespective of the underlying interaction network, the introduced promotion mechanisms are universally effective in subduing the evolutionary advantage of defectors, which favors the emergence and sustainability of cooperative behaviors. Our novel conclusions may provide some new perspectives for enhancing cooperation and elevating social welfare within biological systems and human societies.

➢ SaA05 - 8 14 : 45 - 15 : 00

[756]Migration based on environment comparison promotes cooperation in evolutionary games

张黎明 北京邮电大学
李海红 北京邮电大学
代琼琳 北京邮电大学
杨俊忠 北京邮电大学

Human beings and natural creatures often migrate in search of better environments. When both local and global environments can be perceived by individuals, they may determine whether to migrate or not based on

the comparison. If the individuals realize the local environments are worse than the global ones, they are more likely to leave their original place. Otherwise, they may choose to stay still. Considering these, we study the evolutionary games in a dynamically changing population on a square lattice, in which the players migrate based on the comparison between local and global environments. The simulation results show that cooperation can be significantly promoted. By examining the strategy patterns during the evolution, we find there exist two evolutionary stages that account for the enhancement of cooperation. One is the clustering of cooperators, in which cooperator clusters get strengthened by slow migration of cooperators and fast migration of defectors. The other is the coalescence of cooperator clusters, which induces further increment of the cooperation level. Besides, we investigate the effects of two different types of noises on cooperation, which are introduced in migration and in strategy imitation, respectively. The results reveal that cooperation could be enhanced by low migration noise whereas high strategy-adoption noise.

SaA06　　13 : 00 – 15 : 00

腾讯会议：211-318-977

网络群体智能分布式优化进展与展望

主持人：孙宁　　南开大学

主持人：芦安洋　　东北大学

➢ SaA06 - 1　　13 : 00 - 13 : 15

758 基于遗传算法与蒙特卡洛模拟的边坡稳定性分析方法及应用

何理　　武汉科技大学

赵永明　　武汉科技大学

边坡失稳滑坡是我国最主要的地质自然灾害之一，对边坡进行合理的稳定性分析极具现实意义。考虑到边坡稳定性分析方法主要规为极限分析法和数值分析法两大类，其中极限分析法原理简单易理解，是工程边坡稳定性分析的首选，但该方法仍具有一定局限性，滑动面只能人为定义和搜寻，计算量普遍很大，且容易出现局部最优的情况。为解决此类问题，本文结合某边坡工程实例，基于简化的 bishop 法原理建立基函数并以安全系数最小 Fs(min)作为目标函数，利用遗传算法搜索边坡潜在最危险滑动面的剪出口和剪入口位置，在确定最终安全系数时，基于 Geostudio 利用蒙特卡方法洛模拟内聚力和内摩擦角的分布，试图研究其在不同滑动面的概率分布规律，建立了一种改进的岩石边坡稳定性分析方法，并利用较常用的几类极限平衡法、传统有限元强度折减法、双强度折减法和本文所提分析方法对边坡稳定性进行研究。对比分析结果表明，本文所提分析方法计算结果与双强度折减法计算结果相近，可更好的揭示岩石边坡渐近破坏机理及强度参数劣化机制，验证了本文所提方法的有效性，用于边坡稳定性分析切实可行。

➢ SaA06 - 2　　13 : 15 - 13 : 30

721Ultra-long time identification and prediction of global temperature system

刘潇奕　　东南大学

陈都鑫　　东南大学

Long-term trend identification and short-term accurate prediction of global temperature system are two vital indexes in meteorology. It is of great significance for research like preventing natural disasters and calculating sea level rise. Most of the existing prediction methods are based on neural network, which can only effectively predict the temperature in a short time due to the difficulty to find the law of temperature cycle. This report proposes a model named as Identification and Prediction Switches with the Four Seasons (IPSFS). IPSFS divides the global temperature into periodic axis, trend axis and abrupt axis for identification and prediction respectively. Periodic axis and trend axis are used to identify the long-term temperature trend which can be switched with four seasons, while the abrupt axis will be superimposed with the identification data for short-term accurate prediction. IPSFS combines the identification method with the neural network, obtaining a good prediction effect. We use IPSFS to predict the global temperature in 20 years and 1 year. The MAE of them are 1.82℃ and 1.68℃ respectively, which is better than the results of most current prediction models.

➢ SaA06 - 3　　13 : 30 - 13 : 45

723DoS 及稀疏攻击下分布式系统的安全问题

芦安洋　　东北大学

信息物理系统由于集成了信息技术和自动控制技术，有着的广泛的应用范围。但对网络的深度依赖也使得信息物理系统面临前所未有的安全挑战，因此研究其安全问题显得尤为重要。本次报告针对分布式

系统安全问题进行一定的研究和探讨。首先，针对分布式系统的一致性控制问题，充分考虑了各个节点通信受独立 DoS 攻击的情况，给出了具有一般性的 DoS 攻击下一致性可达的条件。基于得到的条件，可以快速判断系统对 DoS 攻击的鲁棒性，为增强系统安全性提供理论依据。其次，针对稀疏攻击下的分布式安全状态估计问题，通过极端值移除技术，实现了在攻击干扰下，准确地获取系统整体状态信息。相比于已有的遍历搜索方法，所提出的安全状态估计策略能够快速移除异常信息进而及时获取系统状态信息。

➢ SaA06 - 4 13 : 45 - 14 : 00

[732]On Exponential Consensus of Linear Systems over Switching Networks

马麒超 中国科学技术大学

We revisit the consensus problem of linear systems from a novel geometric perspective. The underlying topology of these systems is assumed to be piecewise fixed. Moreover, it is allowed to be disconnected at any time but hold a quite mild joint connectivity property. The system matrix does not contain divergent modes and the input matrix is not of full row rank. We work out the necessary and sufficient condition for exponential consensus. It turns out that exponential consensus can be realized globally and uniformly if and only if a jointly (δ,T)-connected condition and an observability condition are satisfied.

➢ SaA06 - 5 14 : 00 - 14 : 15

[707]Distributed Online Optimization against Adversarial Attacks

韦梦立 东南大学
侯华舟 东南大学

We consider distributed constrained optimization by a collection of agents, where some agents do not follow the prescribed update rule due to failures or malicious intrusions by adversarial attacks. Accordingly, the collective goal is to minimize the sum of the unattacked agents' objective functions under the constraint restriction. To deal with the constrained optimization problem under adversarial attacks, a distributed projected gradient descent online optimization algorithm that achieves sublinear individual regret for each agent is developed, where the difference between the online and offline solutions is called regret. Compared to existing works, we need not determine the maximum number of attacked agents in advance. Further, we also extend the problem with a closed convex set constraint such that the regret of the proposed online algorithm still converges sublinearly, and the specific bounds for both individual regret and network regret are given. Finally, numerical results are presented to illustrate the effectiveness of the proposed algorithm.

➢ SaA06 - 6 14 : 15 - 14 : 30

[653]Neural Network-Based Adaptive Control for Underactuated Systems Subject to Transient Performance Constraints

杨桐 南开大学
孙宁 南开大学

Regarding a class of underactuated systems with prescribed performance for both actuated and unactuated variables, this paper designs an adaptive tracking controller to realize exponential convergence results, where a data-driven concurrent learning method improves the accuracy of parameter/weight estimates. Particularly, by making full use of the recorded history and current data, this paper constructs a group of concurrent learning-based estimates to compensate for unknown dynamics and disturbances, without the additional conditions of persistency of excitation and linear parametrization. Then, the proposed controller makes the actuated states exponentially converge to their desired values, rather than only asymptotic stability or boundedness results. Meanwhile, the unactuated states converge to a small enough bound by adjusting control gains. Based on the prescribed performance control frame, the maximum motion ranges and convergence speed of actuated/unactuated states are both guaranteed to further improve safety and efficiency. Additionally, a disturbance judgment mechanism is introduced to merely eliminate the detrimental impacts of external disturbances. As far as we know, for general underactuated systems with uncertainties/disturbances, it is the first time to ensure exponential convergence speed for both actuated and unactuated states based on prescribed performance control, and simultaneously, obtain the exponential tracking result of actuated motions. A series of

theoretical analysis and simulation verification both illustrate the effectiveness of the designed controller.

➢ SaA06 - 7 14 : 30 - 14 : 45

[686]Learning decentralized linear quadratic regulator with partially nested information structure

叶林涛 华中科技大学
池明 华中科技大学
刘智伟 华中科技大学

In large-scale control systems with a network structure, the control policy is often required to be decentralized in the sense that different controllers may only use partial state information, when designing their local control policies. For example, a given controller may only receive a subset of the global state measurements, and there may be a delay in receiving the measurements. In general, finding a globally optimal control policy under information constraints is NP-hard, even if the system model is known at the controllers. This has led to a large literature on identifying tractable subclasses of the decentralized control problem, such as problems with partially nested information structure. However, in practice the system model is usually unknown a priori, and the existing decentralized controller design algorithms do not apply. In this work, we study the problem of control policy design for decentralized state-feedback Linear Quadratic Regulator (LQR) with a partially nested information structure, when the system model is unknown. We propose a model-based reinforcement learning algorithm to the problem, which consists of two steps. First, we estimate the unknown system model from a single system trajectory of finite length, using least squares estimation. Next, based on the estimated system model, we design a control policy that satisfies the desired information structure. We show that the suboptimality gap between our control policy and the optimal decentralized control policy (designed using accurate knowledge of the system model) scales linearly with the estimation error of the system model. Using this result, we provide an end-to-end sample complexity result for learning decentralized controllers for a linear quadratic control problem with a partially nested information structure. Despite the existence of the information constraints imposed on the controllers, our sample complexity result matches with that of learning centralized LQR for unknown system model without any information constraints.

➢ SaA06 - 8 14 : 45 - 15 : 00

[736]煤矿救援多机器人自主探索方法

张延庆 中国矿业大学
杨春雨 中国矿业大学

论文研究基于无向图的煤矿救援多机器人自主探索问题。首先，使用激光雷达传感器获取点云数据，通过特征提取、后端优化以及光线追踪等方法实时构建局部八叉树地图。其次，提出一种生成无向图的方法，该方法在可通行区域进行观测点采样并通过A*算法建立叶节点与根节点之间的连接关系。然后，提出一种安全、高效的路径增益计算方法，以增益值作为最终选取路径的判断依据。最后，采用增强的基于冲突的搜索(ECBS)算法实现多机器人高效、无冲突地获取运动路径，并在煤矿巷道仿真环境下，验证本文提出的自主探索方法的有效性。

SaA07 13 : 00 – 15 : 00

腾讯会议：562-245-152

网络群体智能分布式协同控制与优化新进展

主持人：付俊杰 东南大学

主持人：张东培 重庆交通大学

➢ SaA07 - 1 13 : 00 - 13 : 15

[590]Distributed MPC based robust collision avoidance formation tracking of constrained multi-robot systems

付俊杰 东南大学
温广辉 东南大学

In this talk, we first review several recent works on formation control of multi-agent systems subject to input and state constraints. Then, the distributed MPC based collision avoidance formation control problem for nonhonomomic robots subject to unknown input disturbances is considered. A robust distributed MPC based control strategy is proposed which employs time-delay observers to estimate the unknown input disturbances online. The more complex dynamic models of the robots are considered and collision avoidance constraints are explicitly handled under both velocity and input constraints. The new control algorithm is given and simulation experiments are carried out to investigate the performance of the proposed controller.

➢ SaA07 - 2 13 : 15 - 13 : 30

[764]Spatio-Temporal Causality Graph Convolutional

Transformer: A Deep Learning Approach for Renewable Power Forecasting

贺岩岩 东南大学
陈都鑫 东南大学
朱然 东南大学
虞文武 东南大学

Long-term forecasting of wind power plays an essential role in both planning and operation of power systems, which is a challenging task due to the inherent uncertainty and variability in wind. Traditional machine learning methods, ignoring the variation law of datasets and nonlinearity, suffer a poor performance in the mid and long-term wind power forecasting tasks. In recent years, deep learning has been widely used for time series prediction to capture long-term dependence to some extent. The mainstream methods are based on artificial neural network architecture, from classical RNNs to newer Transformers. However, previous works have poor performance in long-term sequence modeling due to the absence of jointly modeling the spatio-temporal dependence, especially resulting in low accuracy in wind power forecasting. Hence, we propose a Spatio-Temporal Causality Graph Convolution Transformer model (STCGCT) to cope with the long-term wind power prediction. Instead of conventional convolution and recurrent operation, the spatio-temporal dependence of wind power is considered on graphs, so the model has fewer parameters and a faster training speed. With the help of transformer blocks, STCGCT inherently enables model long sequence dependence. The wind power data is aggregated every 10 minutes. STCGCT enables flexible model configurations to deal with different tasks. A large number of experiments on real data sets demonstrate that STCGCT model is suitable for modeling the wind power circumstance, and achieves competitive results compared with the state-of-the-arts in modeling long-term dependence. Ablation experiments indicate the effectiveness of graph convolution networks, spatial attention, temporal attention, and causality mechanism in modeling complex spatio-temporal correlations.

➢ SaA07 - 3 13 : 30 - 13 : 45

[611]Distributed event-triggered generalized Nash Equilibrium seeking in multi-coalition noncooperative games with coupling constraints

李亚梅 南京信息工程大学
朱亚楠 南京信息工程大学
李涛 南京信息工程大学
郑柏超 南京信息工程大学

This paper is concerned with a multi-coalition noncooperative game with coupling equality constraints. Each coalition is a player consisted of multiple agents in noncooperative games, and desire to minimize its own objective function based on local information. Each agent as actual decision-maker in the same coalition is to optimize the objective function of the coalition cooperatively. To seek a generalized Nash Equilibrium(GNE) of the multi-coalition game, a distributed continuous-time algorithm is developed. Moreover, to further reduce the communication among agents and coalitions, an event-triggered mechanism (ETM) is introduced for the multi-coalition game. By using ETM, a novel distributed GNE seeking algorithm is proposed, where agents and coalitions are allowed to exchange estimation information with neighbors only when the triggering condition is satisfied. Remarkably, the proposed event triggered scheme introduces internal variables to regulate its threshold dynamically, which excludes Zeno behavior. By Lyapunov analysis, it is proved that the coalitions' decision variables converge to a GNE in both algorithms. Finally, the effectiveness of the proposed methods is validated by numerical simulations.

➢ SaA07 - 4 13 : 45 - 14 : 00

[724]Funnel AsymptoticTracking of High-Order Nonlinear Multi-Agent Systems with Unmatched Uncertainties

闵笑 东南大学
Simone Baldi 东南大学
虞文武 东南大学
王和 东南大学

This work investigates the asymptotic consensus tracking for high-order uncertain nonlinear multi-agent systems (MASs), in the presence of pre-speci ed funnel constraint, unmatched uncertainties and possibly discontinuous dynamics. A new distributed discontinuous funnel controller is constructed to ensure asymptotic convergence of the consensus errors with

satisfaction of the funnel boundary. The controller is analyzed using non smooth analysis. The presented solution extends funnel control results proposed in the literature for matched uncertainties and first/second-order dynamics. A numerical study finally illustrates the method.

➢ SaA07 - 5 14 : 00 - 14 : 15

[725] Longitudinal and Lateral Control of Heterogeneous Vehicular Platoon with Consideration of Collision Avoidance

邱蒙 东南大学
Simone Baldi 东南大学
虞文武 东南大学
王 和 东南大学

This work is dedicated to addressing the longitudinal and lateral control of heterogeneous vehicle platoon driving in the curved road under the decoupled framework. For longitudinal platooning, a second-order adaptive sliding mode strategy was proposed for avoiding the possible rear-end collision between the adjacent vehicles. The proposed controller possessed the contraction property which can prohibit the collision assuredly even under the negative effect of disturbances. For lateral platooning, the new tracking errors based on time gap were utilized for vehicle following which can compensate for the cutting corner phenomenon. On the whole, the string stability analysis was performed for both longitudinal and lateral control. Numerical experiments were also carried out to validate the robustness and effectiveness of the proposed protocol.

➢ SaA07 - 6 14 : 15 - 14 : 30

[759]Output Containment of Heterogeneous Multi-Agent Systems under External Disturbances

王庆 北京航空航天大学

Practical output containment problem for heterogeneous nonlinear multi-agent systems under external disturbances generated by exosystem is investigated in this paper. It is required that the outputs of followers converge to the predefined convex combination of leaders' outputs. One of the major challenges in solving such a problem lies in dealing with the coupling among different nonlinearities, state dimensions, and system matrices of heterogeneous agents. To overcome the aforementioned challenge, a distributed observer-based control protocol is developed and employed. Firstly, an adaptive state observer for estimating the states of all the leaders is constructed based on the neighboring interactions. Secondly, two new classes of observers are constructed for each follower exploiting the output information of the follower, in which the adaptive neural networks (NNs) based approximation is exploited to compensate for the unknown nonlinearity in the followers' dynamics. A practical output containment control protocol is then generated by the proposed observers, where the control parameters are determined by an algorithm including two steps. Furthermore, with the help of Lyapunov stability theory and output regulation method, the practical output containment criteria for the considered closed-loop system under the influences of external disturbances are derived on the basis of the presented control protocol. At last, the derived theoretical results are illustrated by a simulation example.

➢ SaA07 - 7 14 : 30 - 14 : 45

[498]Dynamic transitions for the S-K-T competition system

张东培 重庆交通大学

This paper is concerned with dynamical transition for biological competition system modeled by the S-K-T equations. We study the dynamical behaviour of the S-K-T equations with two different boundary conditions. For the system under non-homogeneous Dirichlet boundary condition, we show that the system undergoes a mixed dynamic transition from the homogeneous state to steady state solutions when the bifurcation parameter cross the critical surface. For the system with Neumann boundary condition, we prove that the system undergoes a mixed dynamic transition, a jump transition and a continuous transition when the bifurcation parameter cross the critical number. Finally, two examples are provided to validate the effectiveness of the theoretical results.

➢ SaA07 - 8 14 : 45 - 15 : 00

[571] 基于区块链隐私保护的智能电网实时定价

张同辉 上海理工大学
李军祥 上海理工大学

当前智能电网实时定价机制未考虑隐私信息泄露对用电量和电价的影响，且忽略了供电商与用户之间

的利益均衡。为兼顾隐私保护和供需双方的利益均衡，将区块链隐私信息保护的机制融入到智能电网实时电价的策略之中，依据隐私敏感程度的不同，对用户进行分类，并将区块链的应用程度进行量化，建立基于区块链应用程度的社会福利最大化模型。利用拉格朗日对偶理论和投影梯度法求出最优用电量、最优供电量和最优电价。数值仿真表明：区块链的去中心化性质、混币机制和链下加密技术，能有效地保护供需双方的隐私信息，降低供电成本和用电成本，提高供电商的利润和福利。

SaA08　　13 : 00 – 15 : 00
腾讯会议：129-704-258
系统思维及其应用

主持人：张兴永　　昆明理工大学
主持人：孟飞　　上海理工大学

➢ SaA08 - 1　　13 : 00 - 13 : 15

[646]Method of solving linear system $AXB = E$ based on semi-tensor product of matrices

樊学玲　　聊城大学
李莹　　聊城大学
刘志红　　聊城大学
赵建立　　聊城大学

In this paper, we study the existence of η-Hermitian solutions for quaternion and reduced biquaternion matrix equation $AXB = E$ based on semi-tensor product of matrices method. Because the operation rules of quaternion and reduced biquaternion are different, the results of semi-tensor product of matrices on quaternion and reduced biquaternion are different, and these results play a key role in the solution of matrix equation. In this paper, we mainly show the different results of semi-tensor product of matrices on quaternion and reduced biquaternion, and apply these results to solve the η-Hermitian solution of matrix equation. Furthermore, for some matrices with special structure, we use H-representation method to extract their independent elements, so as to reduce the complexity of computing process. And numerical examples are given to verify the effectiveness of the method.

➢ SaA08 - 2　　13 : 15 - 13 : 30

[640]目标检测模型鲁棒性评估：基于空间敏感度的梯度攻击方法

付凯　　江苏科技大学
王明正　　江苏科技大学
邵长斌　　江苏科技大学
高尚　　江苏科技大学

对抗性噪声已经成为威胁各类深度模型性能的最有力方式，其噪声的攻击性和不可察觉性是衡量攻击的两个主要指标。本文我们关注对目标检测模型的攻击。先前基于梯度符号的噪声生成很容易被我们视觉系统所感知。这主要源于符号法在输入空间上采用了全局的噪声附加策略。针对这一问题，我们分析了检测模型对于输入样本空间的敏感度，并提出了基于空间敏感度的梯度攻击方法。具体来说，我们核实了对检测和分类起关键作用的空间区域，并提出了基于关键梯度的噪声筛选策略来生成对抗样本。这不仅降低了对抗噪声的易察觉性，而且提供了更强力的攻击效果。以 YOLOv3 检测模型为例，我们在 VOC 数据集上进行了观测性验证和攻击性测试，试验结果证实了该方法的有效性。

➢ SaA08 - 3　　13 : 30 - 13 : 45

[131]Finite-time Event-triggered Adaptive network Tracking Control of output-constrained for Stochastic Nonlinear Systems

刘佳　　青岛大学
于金鹏　　青岛大学
刘加朋　　青岛大学

In the study of stochastic nonlinear systems, if the output signal exceeds the output bounded, the stability and performance of the system will be reduced. In order to realize effective control of stochastic nonlinear systems with output-constranted, the problem of adaptive neural network tracking control for stochastic nonlinear systems with finite-time under event triggering is studied in this paper. In the design of the controller, the unknown nonlinear function in the system are solved based on adaptive neural network technology. At the same time, combined with the backstepping technology, the controller is obtained by constructing the Barrier Lyapunov function with output-constrained in the closed-loop system to ensure that the output of the closed-loop system is bounded. But in the design of backstepping technology, there is the problem of "computational explosion". By introducing command filter technology, the problem of "computational explosion" can be avoided effectively. At the same time, in the construction of Lyapunov function to study the system stability, it is usually considered that the system

is stable in infinite-time. In order to ensure that the system reaches a stable state in a specified time, a finite time control method is introduced. By the backstepping method and adaptive neural network, the combination of the finite time and event triggering mechanism based on command filter designed a adaptive neural network controller, the designed controller can not only ensure all the signals in the limited time fast convergence, and reduce the transfer times between the controller and actuators, save the communication resources. Finally, the simulation results show that the proposed control method has faster response speed and smaller tracking error compared with existing control methods.

➢ SaA08 - 4 13 : 45 - 14 : 00

[734]Existence of solutions for a calss of poly-Laplacian coupled system on finite graphs

齐婉婷 昆明理工大学
张兴永 昆明理工大学
刘翠玲 昆明理工大学
谢俊平 昆明理工大学

In this paper, we investigate the existence of solutions for a class of coupled system involving poly-Laplacian and a parameter λ on finite graphs. By using mountain pass lemma together with cut-off technique, we obtain that system has at least a nontrivial weak solution (u_λ, v_λ) for every large parameter λ when the nonlinear term $F(x,u,v)$ satisfies superlinear growth conditions only in a neighborhood of $(u,v)=(0,0)$. We also obtain a concrete form for the lower bound of the parameter λ and the trend of (u_λ, v_λ) with the change of parameter λ.

➢ SaA08 - 5 14 : 00 - 14 : 15

[337] 舰船非接触水下爆炸系统的混合不确定度量化

杨伊伊 山东科技大学

舰船非接触水下爆炸不确定度量化(UQ)能提高建模与模拟的可靠性和预测能力。挑战在于舰船非接触水下爆炸模型中含有大量不确定的唯象参数和不确定度物理量。唯象参数没有物理意义，无法通过试验标定，取值来自于工程经验。利用专家意见对子区间进行基本概率分配，使用 Dempster-Shafer 理论融合不同专家意见，得到唯象参数实际取值可能性最大的子区间及其置信度。进而利用自适应基函数多项式混沌描述不确定度物理量，缓解“维数灾难”。将不确定的唯象参数作为外层，不确定的物理量作为内层，使用双层循环，执行舰船非接触水下爆炸不确定度量化(UQ)，得到冲击响应量的信度指派函数。研究结果能指导舰船防护。

➢ SaA08 - 6 14 : 15 - 14 : 30

[733]Existence of nontrivial solutions for a class of poly-Laplacian system with mixed nonlinearity on graphs

余小丽 昆明理工大学
张兴永 昆明理工大学
谢俊平 昆明理工大学
张雪琛 昆明理工大学

In this paper, we investigate the existence of nontrivial solutions for a class of poly-Laplacian nonlinear system with mixed nonlinearity term on a locally finite graph or a finite graph. By using the mountain pass theorem, we obtain some sufficient conditions about existence of a nontrivial solution. Our results are different from some known results even for the scalar equation on graph.

➢ SaA08 - 7 14 : 30 - 14 : 45

[93] 何谓系统思维

袁宏建 黄冈供电公司

本文从物质概念向系统概念演变讨论起始，讨论了系统概念与物质概念的同与不同，讨论了系统概念较之物质概念的那些新意，讨论了交换现象与系统概念的关系，讨论了交换六要素之精神要素的特殊性。并在此基础之上，对感觉、意识和精神三步曲的思维活动展开了一定程度的微观分析，提出了七层模型假说，认为系统概念较之物质概念的演化是一个维度的跃升。在系统概念层面，绝大多数系统都在且都会系统思维，系统思维其实是系统的一个常态。

➢ SaA08 - 8 14 : 45 - 15 : 00

[513] 武汉疫情的“蝴蝶效应”是如何形成的① ——兼谈普及系统学知识的必要性、紧迫性

袁宏建 黄冈供电公司

本文从武汉疫情的发生、发展乃至消除，全景式地展示了一个混沌集合如何通过“蝴蝶效应”而演变为一个病毒生态系统?这个系统如何危害人类?又如何逐步走向消亡的全过程。为了阐明这个过程，需要从系统概念的定义入手，借助链域思维空间，给出了熵强概念的定量分析，说明熵强在病毒生态系统的演化中中起着决定性作用。即使疫情结束后的常态化城市管理中，也要普及系统学知识，将熵强概念的认识提升到一个新的维度，并有效应用于城市管理，进而形成一种新型的城市文化。

SaA09　　13 : 00 – 15 : 00
腾讯会议：220-675-723
系统工程理论与方法

主持人：莫立坡　　北京工商大学
主持人：王瑜　　北京工商大学

➢ SaA09 -1　　13 : 00 - 13 : 15

[522]Robust Pose Graph Optimization against Outliers using Consistency Credibility Factor

蔡洁　　上海理工大学
魏国亮　　上海理工大学

In Simultaneous Localization and Mapping (SLAM) systems, the outliers (i.e., incorrect loop closure constraints) extensively exist the SLAM front-end system, and may lead to the degradation or even instability of the performance of SLAM back-end optimization. Therefore, the robustness of the back-end performance against outliers has become a major importance topic. In this paper, we first introduce a novel constrained SLAM cost function with the consideration of loop closures consistency, and can find an optimal solution. Motivated by the new cost function, an innovative consistency classification algorithm that starts with the credibility factor derivation model is proposed. Next, based on the credibility factor, the consistency test is designed to detect outliers. Finally, the results of several experiments conducted on multiple simulated datasets are provided to demonstrate the consistency and accuracy of the proposed algorithm, and it has shown our algorithm outperforms the several existing works in terms of Chi-square error.

➢ SaA09 - 2　　13 : 15 - 13 : 30

[605] 基于光纤 FBG 光栅的超声传感器性能研究

陈代勇　　广西师范大学
张萍　　广西师范大学
王力虎　　广西师范大学
梁维刚　　广西师范大学

在应变力作用下，光栅的反射谱中心波长会发生相应移动，将该性质用于超声波信号的检测时，光纤 FBG 光栅能支持较传统压电陶瓷换能器（PZT）更大的频率检测范围和更稳定的频率响应。基于这一点，本文构建了一套光纤光栅超声传感系统，通过边缘滤波解调算法对采集到的声波信号进行解调，并从幅值特性和频率响应两个方面对该系统的测量性能进行了实验探究。结果表明，该系统在 1.25MHz、2.5MHz、3MHz 三种不同频率的超声场下，其幅值特性与传统 PZT 传感器保持一致，且能够同时覆盖三种 PZT 传感器的总检测频域 0.6M-4.5MHz，由于没有共振问题，所以较 PZT 传感器表现出更为稳定的频率响应。该系统具有抗电磁干扰、抗腐蚀、易于复用等优点，有着良好的应用前景。

➢ SaA09 – 3　　13 : 30 - 13 : 45

[81]Distributed Heterogeneous Mult-Agent Optimization with or without Nonconvex Constraints

莫立坡　　北京工商大学
胡豪昆　　北京工商大学

This talk mainly discusses the distributed optimization of heterogeneous multi-agent systems, which are composed of some first-order agents and second-order agents. The global objective function is assumed to be the sum of some local objective functions, which are differentiable and convex. Firstly, when there isn't any constraints, a new distributed algorithm is designed for each agent based on the local objective function and the local neighbors' information that each agent can access. Secondly, when the velocities of all agents are constrained in some nonconvex sets, a distributed optimization algorithm is proposed for each agent based on the constraint operator. Thirdly, when unbounded position constraints and nonconvex velocity constraints coexist, an improved distributed algorithm is adopted. Three time-varying coordination transformations are introduced to change the closed-loop system into new systems. By the properties of the stochastic matrix and constraint operator, it is proved that all agents could collaboratively minimize the global objective function and the positions and velocities could always stay at the corresponding constraint sets if there exist corresponding constraints.

➢ SaA09 - 4　　13 : 45 - 14 : 00

[285]Design and Analysis of Elevator Guide Rail Detection System

牛超群　　青岛大学
赵东杰　　青岛大学
阿里纳玛提　　青岛大学
徐茂　　青岛大学
朱林　　青岛大学

Shuzhi Ge 新加坡国立大学

The current elevator guide rail deformation detection system has problems such as a low degree of automation, troublesome technical measurement methods, and low efficiency. To solve these problems, we designed a highly automated elevator guide rail quality inspection robot. The robot first adopts a symmetrical mechanical structure and utilizes dual traction units and dual clamping units to make the robot autonomously climb on the guide rails of the elevator. The robot then employs speed feedback control and differential control of the two traction motors to balance the robot climbing. At the same time, the robot can output the robot's posture during the climbing process of the robot in real-time. Finally, the robot uses an industrial CCD camera to collect laser point images that contain guide rail information， and calculates the corresponding elevator track parameters from these images. The actual experimental results show that the detection accuracy of our designed robot can reach 0.01mm, which exceeds the current existing elevator track deformation detection system.

➢ SaA09 - 5 14 : 00 - 14 : 15

[74]Temporal Stability of the Impact of Roadside Barriers on Injury-Severity of Mountainous Crashes: A Random Parameters Logit Approach with Heterogeneity in Means and Variances

宋栋栋 北京交通大学

The effectiveness of roadside barriers in improving safety has been demonstrated in several prior studies in traffic safety literature, especially in the accident-prone sections of mountainous regions. However, the effect of factors affecting the injury-severities resulting from crashes involving different types of roadside barriers may be different. This paper explores the factors affecting the driver injury-severity of crashes involving three different types of roadside barriers in mountainous regions: W-beam barriers, flexible barriers, and roadside trees. How these factors change over the years is leveraging through a random parameters logit modeling approach with heterogeneity in the means and variances (RPLHMV). Using injury-severity data from 2016 to 2019 for mountainous regions in Guiyang City, China, the potential influencing factors including drivers-, vehicle-, road-, and environment-specific characteristics are statistically analyzed. The magnitude of the effects of identified statistically significant factors on the driver injury-severity are evaluated by computing pseudo-elasticities. The results indicate that the vehicle impact with different types of roadside barriers results in different driver injury-severity outcome. For example, severe injury crashes are more likely when the vehicle impacts W-beam barriers. In addition, the effect of the variables that determine injury-severities of drivers change significantly over time. However, it is important to note that the pseudo-elasticites of many explanatory variables are observed to be temporally stable for crashes involving flexible or roadside barriers. In contrast, crashes involving W-beam barriers show that only the speeding indicator produces temporally stable pseudo-elasticities. The insights offered by this study could potentially be helpful to provide new guidelines for the design and selection of roadside barriers to reduce the injury-severity of crashes in mountainous regions.

➢ SaA09 - 6 14 : 15 – 14 : 30

[502] 基于超声回波重组相位分析的颗粒粒径测量方法

谭红 广西师范大学
王力虎 广西师范大学
梁维刚 广西师范大学

将超声波作用于沉降的颗粒时，由于颗粒的移动，超声回波会出现相位差异。本文通过对测量杯中某一确定深度处的回波信号进行相位分析和重组，发现重组后信号的频率可以计算出粒径；并分别对两种不同粒径分布的聚甲基丙烯酸甲酯 PMMA 微球悬浮液进行了超声波信号采样重组和去噪的实验，实验结果经小波时频方法分析后，证实了颗粒粒径分布与重组信号频率构成的确存在很高的相关性。

➢ SaA09 - 7 14 : 30 - 14 : 45

[94]A Data Augmentation Method for Fully Automatic Brain Tumor Segmentation

王瑜 北京工商大学
计亚荣 北京工商大学
肖洪兵 北京工商大学

Automatic segmentation of glioma and its subregions is of great significance for diagnosis, treatment and monitoring of disease. In this paper, an augmentation

method, called TensorMixup, was proposed and applied to the three dimensional U-Net architecture for brain tumor segmentation. The main ideas included that first, two image patches with size of 128×128×128 voxels were selected according to glioma information of ground truth labels from the magnetic resonance imaging data of any two patients with the same modality. Next, a tensor in which all elements were independently sampled from Beta distribution was used to mix the image patches. Then the tensor was mapped to a matrix which was used to mix the one-hot encoded labels of the above image patches. Therefore, a new image and its one-hot encoded label were synthesized. Finally, the new data was used to train the model which could be used to segment glioma. The experimental results show that the mean accuracy of Dice scores are 91.32%, 85.67%, and 82.20% respectively on the whole tumor, tumor core, and enhancing tumor segmentation, which proves that the proposed TensorMixup is feasible and effective for brain tumor segmentation.

➢ SaA09 - 8 14 : 45 - 15 : 00

225 考虑折返线的地铁系统提高运行可靠性研究

张朝阳 北京交通大学
高亮 北京交通大学

利用复杂网络方法评估地铁系统可靠性，不能忽视地铁系统本身的运营属性以及与其他网络不同的中断特征，事实上地铁系统的折返操作对系统运行可靠性具有重要影响。本文通过考虑地铁系统运营属性，研究地铁系统运行可靠性问题，并探讨可以提高地铁系统运行可靠性的折返线布设方法。本文定义了分布均匀度和趋近中心度两个指标，提出了一种折返线布设策略。以北京地铁系统为例，对比分析了不同折返线布设方案下的地铁系统运行可靠性。结果表明，不考虑折返操作与考虑折返操作的地铁系统可靠性存在较大差异，按本文所提策略优化折返线布设位置，在地铁系统网络拓扑结构不变的前提下，可有效提高地铁系统运行可靠性。

SaA10 13 : 00 – 15 : 00
腾讯会议：371-538-685
复杂网络

主持人：韩忠明 北京工商大学
主持人：霍良安 上海理工大学

➢ SaA10 - 1 13 : 00 - 13 : 15

92 基于网络嵌入方法的耦合网络节点表示学习

韩忠明 北京工商大学

网络节点表示学习是网络数据分析挖掘中的一个基础问题，通过学习网络节点表示向量，可以更加精准地对网络节点进行表征．近年来，随着深度学习的发展，嵌入方法在网络节点表示学习方面得到了广泛应用．同时，网络数据在规模、模态等特征方面也有了很大的变化，研究重点从单网络分析挖掘逐渐演变至耦合网络分析挖掘．本文首先分析了嵌入方法在单网络节点表示学习中的研究现状,对比了现有方法的优劣．然后借鉴单网络中嵌入方法的思想，针对耦合网络提出了耦合网络嵌入模型CWCNE．针对耦合网络的特性，改进了嵌入方法中的游走算法，提出了一种网络间带约束的随机游走策略；同时改进了模型的训练方法，使用网络间迭代训练的方式来学习模型参数．最后使用了社交耦合网络、学术耦合网络、影视耦合网络、诗词耦合网络、著作耦合网络等 5 组数据集验证了 CWCNE 的有效性．并在社团划分、实体识别、标签分类等任务上取得了良好的结果．

➢ SaA10 - 2 13 : 15 - 13 : 30

313 基于时态网络社会标记物的社会突发事件预警

李辉春 国防科技大学

真实世界中的各类复杂系统，从生态系统到金融市场，普遍存在临界转变现象。当这些复杂系统演化至临界点处时，其系统状态往往会出现规律性异变。社会系统作为一类特殊的复杂系统也不例外，即当临近重大社会事件爆发时，社会系统某些状态参数也可能产生有规律的异变。因此，基于复杂系统临界转变理论对社会突发事件进行预警研究，对社会系统安全管控、危机干预、舆论引导等领域具有重要的理论意义与应用价值。本研究借鉴动态生物标志物（DNB）方法思想，提出了时态网络社会标志物（TNS）方法。方法摆脱了传统动力学模型的束缚，利用系统观测数据的统计学特征和趋势，建立无模型方法对社会系统临界转变进行预测；运用时态网络对社会系统进行采样，从行为交互结构角度描述社会系统的演化过程；利用层次推断模型捕捉不同尺度下的社会群体，将研究对象从个体转移到群体，在一定程度上克服了社会系统中个体的主观行为造成的数据波动。与此同时，该方法支持回溯系统演化临界点处的敏感群体，具有较好的可解释性。本研究在安然电子邮件数据集和 John Jay & ARTIS 跨国恐怖主义数据集(JJATT)中进行了实验验证。在安然邮件数据集分析中，本方法捕捉到安然公司系统

演化的两个临界点，一是安然管理高层矛盾而产生危机，二是安然公司被正式调查而股价暴跌。在跨国恐怖主义数据集分析中，本方法在 6 个恐怖袭击事件发生之前捕捉到了恐怖分子关系网络系统演化的临界点，对应的时间大多为恐怖袭击事件爆发前半年至一年。上述案例实验表明本方法能够较好地捕捉社会系统临界转变的先兆信号，针对相应的社会突发事件表现出较准确的预测能力。

➢ SaA10 - 3 13 : 30 - 13 : 45

[438] A note on quantitative characterizations of symmetry in complex networks

马纪成 重庆文理学院

In this paper, quantitative characterization of global and local symmetry of complex network are given. Moreover, we compare these quantitative values to some existing examples in the literature, and it can be shown that although real-world networks are far from vertex symmetric ones, it admits rich local symmetry.

➢ SaA10 - 4 13 : 45 - 14 : 00

[31] Asymmetrical Synchronization of Extreme Rainfall Events in Southwest China

乔盼节 昆明理工大学
龚志强 中国气象局
刘文奇 昆明理工大学
张永文 昆明理工大学

Based on the complex network method, this study reveals the temporal and spatial characteristics of the synchronization of extreme rainfall events in Southwest China (SWC) during the main rainfall season (May to September). Our results show the significant synchronization pattern of extreme rainfall events in SWC, which is closely associated with the convergence of warm-wet air and cold-dry air and the corresponding occurrence of extreme rainfall in SWC. The network divergence indicates a dominated direction of the net influence of extreme rainfall from the Sichuan Basin to the Yunnan-Guizhou plateau, implying the extreme rainfall synchronization moving from north to south in SWC is more frequent than the opposite direction. The development of the low vortex and the north wind system usually shows a movement from north to south, resulting in the evolution of extreme rainfall events more tend to present a southward movement. The low-reinforced latitude cyclonic circulation leads to the strengthened transportation of water vapor from the tropical area to the north and converges with the anticyclonic circulation in the mid-latitudes to form the movement of heavy rainfall events from the Yunnan-Guizhou plateau to the Sichuan Basin. Therefore, the synchronization direction of extreme rainfall events in SWC has obvious asymmetry spatial feature due to the more frequent and stronger circulation system moving from north to south than the opposite.

➢ SaA10 - 5 14 : 00 - 14 : 15

[95] Optimal Deployment of Heterogeneous Nodes to Enhance Network Invulnerability

孙茜 北京工商大学
羊峰波 北京工商大学
王小艺 北京工商大学
王立 北京工商大学

Wireless sensor networks (WSN) can be used in many fields. In wireless sensor networks, sensor nodes transmit data in multi hop mode. The large number of hops required by data transmission will lead to uneven energy consumption and large data transmission delay of the whole network, which greatly affects the Invulnerability of the network. Therefore, we propose an optimal deployment of heterogeneous nodes (ODHN) algorithm to enhance the Invulnerability of the wireless sensor networks. The algorithm combines the advantages of DEEC (design of distributed energy efficient clustering) clustering algorithm and BAS (beetle antenna search) optimization algorithm to find the globally optimal deployment locations of heterogeneous nodes. Then, establish a shortcut to communicate with sink nodes through heterogeneous nodes, and construct heterogeneous sensor networks with small world characteristics. Besides, considering the practical deployment operation, we set the threshold of the mobile location of heterogeneous nodes, which greatly simplifies the deployment difficulty on the basis of meeting the network Invulnerability. Simulation results show that compared with traditional routing protocols, the proposed algorithm can make the network load more evenly, and effectively improve energy-utilization and the fault tolerance of the whole network, which can greatly improve the Invulnerability of the wireless sensor networks.

➢ SaA10 - 6 14 : 15 - 14 : 30

[96]Network Invulnerability Enhancement Algorithm Based on WSN Closeness Centrality

孙茜 北京工商大学
羊峰波 北京工商大学
王小艺 北京工商大学
王立 北京工商大学

Wireless Sensor Network (WSN) is an important part of the Internet of Things (IoT), which are used for information exchange and communication between smart objects. However, in practical applications, WSN often leads to premature failure of nodes due to uneven distribution of node centrality, excessive energy consumption, etc., which splits the originally connected network topology and even causes damage to the global network. In order to overcome the above-mentioned problems, this paper proposed a new WSN centrality measurement method based on the characteristics of WSN data transmission. On this basis, we constructed a heterogeneous wireless sensor network model with small-world characteristics to even out the centrality of the network and enhance the survivability of the network. At the same time, a new survivability measurement model was proposed as a specific quantitative index to measure the pros and cons of network survivability. Simulation analysis showed that the scheme proposed in this paper could effectively analyze the anti-destructive performance of the network. In addition, the life cycle and data transmission volume of the network can be improved with a lower network construction cost, the centrality of the network could be evened, and the invulnerability of the network could be effectively enhanced.

➢ SaA10 - 7 14 : 30 - 14 : 45

[185] Quantification of network structural dissimilarities based on graph embedding

王志鹏 杭州师范大学
詹秀秀 杭州师范大学
刘闯 杭州师范大学
张子柯 浙江大学

Identifying and quantifying structural dissimilarities between complex networks is a fundamental and challenging problem in network science. Previous network comparison methods are based on the structural features, such as the length of shortest path, degree and graphlet, which may only contain part of the topological information. Therefore, we propose an efficient network comparison method based on network embedding, i.e., DeepWalk, which considers the global structural information. In detail, we calculate the distance between nodes through the vector extracted by DeepWalk and quantify the network dissimilarity by spectral entropy based Jensen-Shannon divergences of the distribution of the node distances. Experiments on both synthetic and empirical data show that our method outperforms the baseline methods and can distinguish networks perfectly by only using the global embedding based distance distribution. In addition, we show that our method can capture network properties, e.g., average shortest path length and link density. Moreover, the experiments of modularity further implies the functionality of our method.

➢ SaA10 - 8 14 : 45 - 15 : 00

[193] Degree-based algorithms for influence maximization problem in hypergraphs

谢明 杭州师范大学
詹秀秀 杭州师范大学
刘闯 杭州师范大学
张子柯 浙江大学

Many complex systems, such as social networks, may contain interactions between more than two entities. The interactions in these systems can be modeled by hyperedges which can represent the relationship between more than two nodes in a hypergraph. In this paper, we study the influence maximization (IM) problem, i.e., maximizing the number of influenced nodes by selecting optimal seed nodes given a spreading process, in hypergraphs. We propose three degree-based heuristic algorithms to solve the IM problem and compare with state-of-the-art algorithms, i.e., the greedy algorithms and algorithms that are generalized from normal networks. We show that the degree-based heuristic algorithms perform better than the baselines in terms of both effectiveness and efficiency. Moreover, the experiments on synthetic hypergraphs indicate that the degree-based algorithms show high performance especially in hypergraphs with heterogeneous degree distribution.

SaA11　　13 : 00 – 15 : 00
腾讯会议：395-150-231
复杂网络与群体智能

主持人：樊瑛　　北京师范大学
主持人：暴琳　　江苏科技大学

➢ SaA11 - 1　　13 : 00 - 13 : 15

694 用户行为驱动的偏好代理模型辅助的交互式个性化进化搜索算法

暴琳　　江苏科技大学
吴杨　　江苏科技大学
齐亮　　江苏科技大学
宋英磊　　江苏科技大学
叶树霞　　江苏科技大学
张永韡　　江苏科技大学
孙雪莹　　江苏科技大学
李长江　　江苏科技大学
桂红　　江苏科技大学
吴战胜　　江苏科技大学

随着互联网中用户数量的快速增长，产生了大量用户生成内容，出现了信息过载现象。个性化搜索和推荐算法充分利用用户生成内容，建立用户兴趣模型，帮助用户从海量搜索空间中搜寻符合用户潜在需求和兴趣偏好的项目或内容，提升用户的使用体验和电子商务平台的商业利益。而面向用户生成内容的个性化搜索任务为一类复杂的动态定性指标优化问题，用户偏好或意图难以用精确的数学模型明确表达，且难以建立明确定义的目标函数进行描述，且搜索结果也因人而异。本文考虑用户生成内容，利用受限玻尔兹曼机(Restricted Boltzmann Machine, RBM) 模型强大的表示学习和特征提取能力，联合交互式进化计算的寻优能力，提出了用户行为驱动的偏好代理模型辅助的交互式个性化进化搜索算法。首先，利用用户交互行为、用户评分和项目类别信息，构建基于 RBM 的用户偏好模型，抽取用户偏好特征；然后，从进化优化的角度，利用用户偏好模型，设计基于用户偏好的代理模型及其进化策略，生成新的含用户偏好的项目个体，代替用户评价预测新进化个体的适应值，参与并引导进化优化过程；同时，根据新增用户生成内容，利用模型管理机制动态更新各模型，及时跟踪用户偏好，保障个性化进化搜索过程的有效推进。将所提算法应用于真实世界数据集，通过大量实验展示了所提算法的可行性及有效性，实现复杂应用场景中动态个性化搜索和推荐任务。

➢ SaA11 - 2　　13 : 15 - 13 : 30

457 基于动态演化的复杂作战体系抗毁性研究

陈文秀　　中山大学

抗毁性是作战体系在一定约束下保持其生存能力及作战能力的重要体现。目前基于复杂作战体系的抗毁性研究主要聚焦于单一测度指标静态的研究，也没有考虑网络演化过程中的时间与成本因素。本研究遵从抗毁性指标体系构建的完备原则，考虑时间成本与经济成本的同时从完整性、连通性以及冗余性三个角度对其生存能力进行综合评估。首先，将作战体系抽象成复杂网络，对网络特征及中心度进行验证，其次从三个角度出发计算遭受攻击下网络的生存能力，再结合作战过程对拓扑结构的动态演化影响，计算动态演化过程下的网络的生存性、时效性和经济性，最后综合各指标可得网络在不同演化情况下的抗毁性，为现实作战体系的兵力部署与抗毁能力提升提供理论参考。

➢ SaA11 - 3　　13: 30 - 13 : 45

516 基于模体的多层网络社团划分

刘亚芳　　北京师范大学
樊瑛　　北京师范大学

多层网络是一种重要的网络类型，由于层间边和层内边的异质性，使得对其的社团划分不同于单层网络。当前已有的多层网络社团划分研究主要针对多层复路（multiplex）网络进行。本文基于多层网络模体对于更一般的多层网络的社团划分进行了研究：首先对多层网络的社团以及多层网络中的模体进行了定义，特别关注了层间模体；随后设计了基于模体的多层网络模块度的计算方法，利用优化多层网络模块度进行了多层网络社团划分；在人工网络上进行该算法的检测，得到了较好的结果。

➢ SaA11 - 4　　13 : 45 - 14 : 00

771 树种算法改进及其实际约束优化问题求解

钱立泽　　吉林财经大学
姜建华　　吉林财经大学

应用群体智能优化算法求解实际生产中的约束优化问题一直是人工智能领域的研究热点之一。树种算法具备参数少、结构简单和迭优能力强等显著优点，但该算法仍存在易陷入局部最优和“局部强、全局弱”等不足。因此，本文提出了基于黄金分割比例的种子生成机制和树种演化机制，使得树与种子的位置以黄金分割法则规律进行更新，并利用 IEEE CEC 2014 测试集对新算法（gold_TSA）的性能进行测试，同时应用 gold_TSA 算法求解 IEEE CEC 2020 单目

标实际约束优化问题竞赛（RWCOP）的 57 个实际问题。将 gold_TSA 算法与树种算法（TSA）、粒子群优化算法（PSO）和差分进化（DE）算法等变体算法以及 RWCOP 竞赛前八名算法的性能进行比较，实验结果表明，gold_TSA 算法在世界级比赛中排名第七，是一种性能较好的算法。

➢ SaA11 - 5 14 : 00 - 14 : 15

[760]Social relationship adjustments within the same sex promote marital bliss

单旭 北京邮电大学

Parental care is essential for biological systems. Marital bliss is one of the ideal paradigms for parental care, in which male contributes in raising offsprings and female needs a courtship time. Yet marital bliss state is neither Nash equilibrium nor Pareto optimum based on the classic Battle of the Sexes game, which is widely adopted to depict the conflicts between male and female in raising the offspring. It thus leads to a gap between evolutionary theory and the marital bliss. Previous works concentrate on the pairwise interactions between two sexes to fill this gap, such as the courtship time and encounter rate. The social relationships within the same sex, however, receives much less attention. Here we investigate how the social relationships within the same sex change marital bliss by introducing the coevolution of strategy and social network. We find that marital bliss can be promoted when the male are rational and the female are irrational. Furthermore, the stable Coy-Coy social relationships not only promote marital bliss but also speed it up.

➢ SaA11 - 6 14 : 15 - 14 : 30

[824]Social relationship adjustments within the same sex promote marital bliss (同性社会关系的调整促进了婚姻的幸福)

单旭 北京邮电大学
武斌 北京邮电大学

Parental care is essential for biological systems. Marital bliss is one of the ideal paradigms for parental care, in which males contribute in raising offspring and females require a courtship time. Yet marital bliss state is neither Nash equilibrium nor Pareto optimum for the classic Battle of the Sexes. It thus leads to a gap between evolutionary theory and marital bliss. Previous works concentrate on the pairwise interactions between the two sexes to fill this gap, such as the courtship time and encounter rate. The social relationships within the same sex, however, receives much less attention. Here we investigate how social relationships within the same sex change marital bliss by introducing the coevolution of strategy and social network. Based on the time scale separation, it is found that a symmetric game is emergent via social adjustments within each sex, and the evolutionary outcome is determined by the interplay between the emergent symmetric game and the Battle of the Sexes. We find that marital bliss can be promoted when males are rational (strong selection limit) and females are irrational (weak selection limit); the stable Coy–Coy social relationships both stabilize and speed up marital bliss; the general criterion of stabilizing marital bliss for arbitrary imitation function are found, which are verified by simulations. Furthermore, the emergent symmetric games are insightful for determining whether the stable marital bliss is global stable. Our work provides an alternative avenue to facilitate marital bliss, which can be applied for general asymmetric games on dynamical networks.

➢ SaA11 - 7 14 : 30 - 14 : 45

[665]Synchronization of Complex Dynamical Networks Subject to DoS Attacks: An Improved Coding-Decoding Protocol

邢梦平 安徽工业大学
卢剑权 东南大学
邱建龙 临沂大学
沈浩 安徽工业大学

This article investigates the synchronization of communication-constrained complex dynamic networks subject to malicious attacks. An observer-based controller is designed by virtue of the bounded encode sequence derived from an improved coding decoding communication protocol. Moreover, taking the security of data transmission into consideration, the denial-ofservice attacks with the frequency and duration characterized by the average dwell-time constraint are introduced into data communication, and their influence on the coder string is analyzed explicitly. Thereafter, by imposing reasonable restrictions on the transmission protocol and the occurrence of attacks, the boundedness of coding intervals can be obtained. Since the precision

of data is generally limited, it may lead to the situation that the signal to be encoded overflows the coding interval such that it results in the unavailability of the developed coding scheme. To cope with this problem, a dynamic variable is introduced to the design of the protocol. Subsequently, based on the Lyapunov stability theory, sufficient conditions for ensuring the input-tostate stability of the synchronization error systems under the communication-constrained condition and malicious attacks are presented. The validity of the developed method is finally verified by a simulation example of chaotic networks.

➢ SaA11 - 8 14 : 45 - 15 : 00

[389] 复杂网络中的系综不等价

张齐 江苏科技大学

系综等价是指在热力学极限下使用不同统计系综所描述的热力学系统其宏观特性是一致的。然而近年的研究也发现系综不等价会出现在由系统中的非叠加性引起的发生在长程相互作用系统在相变临界点上。本工作发现在对节点度或权约束的复杂网络中系综不等价也广泛的存在，且这种系综不等价不依赖相变的产生，是由网络中随节点数增加而增加的局域约束所引起的。所以当描述那些具有时空关联的复杂系统时，使用不同的系综可能会得到不同的宏观特性。这意味着统计物理中采用不同的统计系综对网络状复杂系统进行描述从而理解其在宏观状态下的演化规律的研究方法可能是有误差的，且这种由系综不等价导致的误差与网络状复杂系统各子单元之间的关联程度有联系。

SaB01 15 : 15 – 17 : 30

腾讯会议：638-488-140

复杂系统动力学

主持人：曾春华 昆明理工大学

主持人：杨金 重庆交通大学

➢ SaB01 - 1 15 : 15 - 15 : 30

[390]Threshold dynamics of a stochastic model of intermittent androgen deprivation therapy for prostate cancer

陈林 重庆交通大学

杨金 重庆交通大学

Intermittent androgen deprivation therapy is often used to treat prostate cancer, but there are few mathematical modelling studies of it. To explore the mechanisms of such therapy, we describe intermittent therapy with impulsive differential equations, then we propose a novel mathematical model of intermittent androgen deprivation therapy with white noise. We first studied the model's basic properties including the existence and uniqueness of the solution. By using the theory of stochastic differential equations, we investigated the thresholds for the extinction and persistence of prostate cancer cells, which are markedly affected by the antigenicity of tumours and noise parameters. Moreover, sufficient conditions for the stationary distribution and ergodicity of the system are provided. The results show that reducing the period of pulsed interventions or increasing the dosages (or frequencies) of the therapy will be helpful for curing prostate cancer.

➢ SaB01 - 2 15 : 30 - 15 : 45

[207]Seasonal prediction of ozone pollution in China using the SST memory effect

陈源 昆明理工大学

Ozone pollution gradually emerges as a big obstacle to improve air quality in China, which has caused severe harm to human health and the natural environment. However, the future trend of ozone pollution over China remains poorly understood. In this study, we find that the first eigen microstate (EM1) of surface ozone in China can explain its changing trend appropriately. On this basis, we develop a statistical model to predict the EM1 evolution series(V1) on a long-term scale. In summer, the June-July-August(JJA) daily maximum 8-h average(MDA8) ozone anomaly is regulated mainly by the El Nino Southern Oscillation (ENSO), the western Pacific subtropical high (WPSH), and the South Pacific subtropical dipole sea surface temperature (SST) anomaly; In winter, the climate patterns related to the December-January-February(DJF) MDA8 ozone anomaly are not only affected by ENSO but also by the Northeast Pacific, the Western Pacific Warm Pool, and the tropical Atlantic SST anomalies. Moreover, the ocean areas capturing the teleconnections can identify the model as having an important impact on the MDA8 ozone anomaly in China. The prediction results of the developed model are highly consistent with reality. The correlation coefficient between JJA MDA8 ozone forecasting more than 100 days in advance and the real

data reached 0.64; the correlation coefficient between DJF MDA8 ozone forecasting more than 100 days in advance and the real data reached 0.65. Our statistical model shows great seasonal predictability of summertime and wintertime ozone pollution in China, which can better serve the ozone pollution control.

➢ SaB01 - 3 15 : 45 - 16 : 00

[845] 网络结构对传播动力学爆发式相变的影响

王胜烽 北京邮电大学

理解网络结构对于传播动力学的影响，对于预测和调控传播过程具有重要意义。标准的简单传播模型中传播过程呈现连续相变。但实际的传播过程往往呈现不连续相变，也称为爆发式相变。最近，爆发式相变的传播机制问题得到了广泛关注和研究，发现了传播中的强化效应，传播的相互促进等多种机制，导致传播过程偏离了标准的简单传播假设。本文关注网络结构与传播动力学爆发式相变的关系，为此构建了一个反馈传播模型。网络中节点传播状态能够反馈到传播参数上，不同的反馈函数形式以及反馈强度可以让传播过程经历连续相变到不连续相变的转变。通过对网络反馈传播动力学方程的重整约化，我们发现在相变点附近爆发式相变的出现直接由网络本征向量的分布决定。基于此，我们通过调整人造网络以及实际网络的结构对于传播过程进行调控，促进传播阈值附近爆发式相变的出现。

➢ SaB01 - 4 16 : 00 - 16 : 15

[15]Irregular spots on body surfaces of vertebrates induced by supercritical pitchfork bifurcations

王欣 安庆师范大学
高见 安庆师范大学

The classical Turing mechanism containing a long-range inhibition and a short-range self-enhancement provides a type of explanation for the formation of patterns on body surfaces of some vertebrates, e.g., zebras, giraffes and cheetahs. For other type of patterns (irregular spots) on body surfaces of some vertebrates, e.g., loaches, finless eels and dalmatian dogs, the classical Turing mechanism no longer applies. Here, we propose a mechanism, i.e., the supercritical pitchfork bifurcation, which may explain the formation of this type of irregular spots, and present a method to quantify the similarity of such patterns. We assume that, under certain conditions, the only stable state of 'morphogen' loses its stability and transitions to two newly generated stable states with the influence of external noise, thus producing such ruleless piebald patterns in space. The difference between the competitiveness of these two states may affect the resulting pattern. Moreover, we propose a mathematical model based on this conjecture, and obtain this type of irregular patterns by numerical simulation. Furthermore, we also study the influence of parameters in the model on pattern structures, and obtain the corresponding pattern structures of some vertebrates in nature, which verifies our conjecture.

➢ SaB01 - 5 16 : 15 - 16 : 30

[341]Darboux transformation, soliton solutions of the variable coefficient nonlocal modified Korteweg-de Vries equation

辛祥鹏 聊城大学

In this paper, the nonlocal modified Korteweg-de Vries (mKdV) equation is extended to the variable coefficient form based on the AKNS system. The Darboux transformation of the nonlocal mKdV equation with variable coefficient is constructed. Some exact solutions are obtained based on the Darboux transformation using zero seed solution and nonzero seed solution, including single soliton solution, kink solution, breather waves solution and rouge wave solution. The results show that we are able to obtain some solutions which are more general than its constant coefficient form.

➢ SaB01 - 6 16 : 30 - 16 : 45

[168]Modelling effects of a chemotherapeutic dose response on a stochastic model for prostate cancer with androgen deprivation therapy

杨金 重庆交通大学

Continuous androgen deprivation is one of the endocrine therapies for advanced prostate cancer. Studies have shown that the combination of chemotherapy and immunotherapy has a good therapeutic effect on cancer. However, there are few mathematical models to treat prostate cancer by combining continuous androgen deprivation therapy, immunotherapy and chemotherapy. To explore these mechanisms of treatment, we establish a pulsed stochastic tumour-immune dynamical model considering tumour antigenicity and density dependent mortality. Firstly, by using theorems of the impulsive stochastic differential equations, the tumour-free

solution and the global positive solution of the system are investigated. We show that the solutions of proposed system are stochastically ultimately bounded. Then threshold conditions for extinction, non-persistence in the mean, weakly persistence in the mean and stochastic persistence of prostate cancer cells are provided. Moreover, sufficient conditions for the existence of stationary distribution and ergodicity of the system are established. The results show that comprehensive treatment is more effective than single therapy, and the treatment of prostate cancer is related to the progression of the disease, so it is necessary to develop a specific treatment plan for the patients.

➢ SaB01 - 7 16 : 45- 17 : 00

[7]Long-term memory of air pollution and its spatial patterns in China

于平 昆明理工大学

Fine particulate matter (PM2.5 and PM10) and ozone (O3) pollutants have been the two major air pollutions in China in recent years. The fluctuations of PM2.5, PM10 and O3 unusually strongly depend on the weather processes and anthropogenic emission. These processes could lead to the existence of long-term memory behaviors in air pollutions. Hence, here we investigate the long-term memory behavior of air pollutants (PM2.5, PM10 and O3) in summer and winter for different cities in China based on the detrended fluctuation analysis (DFA). Our results suggest that PM2.5, PM10 and O3 have strong long-term memory characteristics both in summer and winter. Furthermore, the memory is stronger in winter than summer for most cities. Meanwhile, the memory measures are smaller for northern cities than those of southern cities in China. We also find that within the time scale of one year, the memory of O3 is weaker relative to PM2.5 and PM10 for most cities in China. However, when the time scale is longer (above one year), the memory of O3 is enhanced and stronger than that of PM2.5 and PM10. Our results suggest that the memory behaviors of air pollutions are different between short-term (within one year) and long-term (above one year) scales.

➢ SaB01 - 8 17 : 00 - 17 : 15

[437]Effect of individual and enterprise behaviors on the interplay between product-attributes information propagation and word-of-mouth communication in multiplex networks

袁伟 上海理工大学
霍良安 上海理工大学

In the course of individual consumption decision making, the interaction between online product-attributes information propagation and face-to-face word-of-mouth (WOM) communication is an important influencing factor, and due to the heterogeneity of individuals and the involvement of enterprise, the interaction becomes more complicated. In this paper, we establish a multi-layer network model to explore the effect of individual and enterprise behaviors on the interaction between product-attributes information propagation and WOM communication, and derive mean-field equations to describe the dynamics process on complex social networks. We use analytical and numerical solutions of these equations to examine the threshold for the product-attributes information propagation and the WOM communication (both positive WOM and negative WOM). It also finds that individual behavior promotes both product-attributes information propagation and WOM communication, but the marginal utility of such promotion is diminishing; enterprise behavior promotes the communication of positive WOM and suppresses the communication of negative WOM.

➢ SaB01 - 9 17 : 15 - 17 : 30

[29]Spatial early warning signals of critical transitions in complex systems

曾春华 昆明理工大学

Gene transcription regulation is a noisy process that can lead to regime shifts and these shifts are difficult to predict. In this Letter, we consider spatiotemporal fluctuations in gene transcription regulation, and employ a spatially extended gene transcription regulation system by using theoretical analysis and numerical simulation. We find that the system produces a regime shift from a low (high) to a high (low) protein concentration state (i.e., the transform of the switch of gene transcription regulation), and we apply spatial early warning signals (e.g., rising spatial variance, spatial skewness, spatial kurtosis, and lag-1 autocorrelation) to study the regime shifts of protein

concentration. The results show that the spatial early warning signals can be used as a robust indicator of predicting gene transcription regulation switch. Once the signal is detected, we will take measures to intervene. Our results may have a positive effect on improving early treatment interventions for complex human diseases.

SaB02　　15 : 15 – 17 : 15
腾讯会议：431-379-675
复杂系统动力学

主持人：卢剑权　　东南大学
主持人：张琴　　重庆交通大学

➢ SaB02 - 1　　15 : 15 - 15 : 30

619 基于储备池算法的耦合映象格子时空混沌系统的学习与预测

高健　　北京邮电大学
兰岳恒　　北京邮电大学
Jinghua Xiao　　北京邮电大学

相对于低维的动力系统，时空系统的学习和预测更具有挑战性。本文以耦合映象格子系统为例，采用储备池算法，对于包括时空混沌在内的多种不同的时空状态进行学习和预测。基于时空系统的空间对称性，本文采用并行学习的方法，将大系统的学习任务约化为并行的多个小系统之和，从而大幅度降低学习成本。研究发现了时空系统中存在多尺度、不均匀的学习和预测现象。在短期的定量预测基础上，发现了随机冻化状态中扭结位置、缺陷扩散状态中的扩散速率、时空混沌状态中的时空谱等性质的长期预测现象。通过结合动力学重构方法，基于稳定性理论对于多尺度的预测现象给出了合理的解释。本文的研究对于从数据出发的复杂系统研究有重要意义。

➢ SaB02 - 2　　15 : 30 - 15 : 45

755 基于因果关系发现的突发事件网络舆情传播建模方法研究

Jun Zhang　　山东理工大学

在数据驱动下开展群体行为计算，设计舆情传播建模方法，为网络舆情管理创新提供支持。结合群体行为理论和收敛交叉映射算法，提出一种基于数据驱动的突发事件网络舆情传播建模方法。首先从群体结构、群体规范和群体过程视角提取舆情系统特征，之后根据最邻近方法和时间序列收敛判断法识别特征之间的因果关系，构建舆情传播模型。该方法将突发事件网络舆情中的社会强化机制计算化，通过系统特征因果关系强弱和差异分析，揭示了网络舆情事件的演化机理。基于新浪微博平台中“双黄连事件”、“白银越野赛事件”、“十堰爆炸事件”和“青海地震事件”等 4 组舆情数据的实证结果发现，各事件中的群体交互持续能力和聚集度都维持在较高的水平，即突发事件网络舆情是典型的群体事件。此外，不同类型的舆情事件系统特征间因果关系强弱程度不同，因果关系越弱舆情演化不确定性越大。

➢ SaB02 - 3　　15 : 45 - 16 : 00

519Multistability analysis of state-dependent switched Hopfield neural networks with the Gaussian-wavelet-type activation function

刘洋　　山东科技大学
王震　　山东科技大学

In multistability analysis, the Gaussian-wavelet-type activation function is shown to have better properties by comparison with sigmoidal functions, saturated functions and Mexican-hat-type functions. State-dependent switched Hopfield neural network(SSHNN) is expected to display even richer dynamical behaviors in contrast with conventional Hopfield neural networks(HNNs). Considering these two reasons, this paper studies the multistability of SSHNNs with the Gaussian-wavelet-type activation function. Some sufficient conditions for the coexistence as well as the stability of multiple equilibria of SSHNNs are derived. It is obtained that SSHNNs with the Gaussian-wavelet-type activation function can have at least 7^n or 6^n equilibria, of which 4^n or 5^n are locally stable (LS). We find that, compared with conventional HNNs with the Gaussian-wavelet-type activation function or SSHNNs with other kinds of activation functions, SSHNNs with the Gaussian-wavelet-type activation functions can have more LS equilibria. It implies that SSHNNs with the Gaussian-wavelet-type activation functions have even larger storage capacity and have overwhelming superiority in associative memory applications. Lastly, some simulation results are given to verify the correctness of the theoretical results.

➢ SaB02 - 4　　16 : 00 - 16 : 15

392Zero inertial limit of incompressible Qian–Sheng model

马扬军　　重庆交通大学

The Qian–Sheng model is a system describing the hydrodynamics of nematic liquid crystals in the Q-tensor framework. When the inertial effect is included, it is a hyperbolic-type system involving a second-order material derivative coupling with forced incompressible Navier–Stokes equations. If formally letting the inertial constant ε go to zero, the resulting system is the corresponding parabolic model. We provide the result on the rigorous justification of this limit in R3 with small initial data, which validates mathematically the parabolic Qian–Sheng model. To achieve this, an initial layer is introduced to not only overcome the disparity of the initial conditions between the hyperbolic and parabolic models, but also make the convergence rate optimal. Moreover, a novel ε-dependent energy norm is carefully designed, which is non-negative only when ε is small enough, and handles the difficulty brought by the second-order material derivative.

➢ SaB02 - 5 16 : 15 - 16 : 30

637Finite-time synchronization of quaternion-valued neural networks with delays: A switching control method without decomposition

彭涛 东南大学
卢剑权 东南大学

For a class of quaternion-valued neural networks (QVNNs) with discrete and distributed time delays, its finite-time synchronization (FTSYN) is addressed in this paper. Instead of decomposition, a direct analytical method named two-step analysis is proposed. That method can always be used to study FTSYN, under either 1-norm or 2-norm of quaternion. Compared with the decomposing method, the two-step method is also suitable for models that are not easily decomposed. Furthermore, a switching controller based on the two-step method is proposed. In addition, two criteria are given to realize the FTSYN of QVNNs. At last, three numerical examples illustrate the feasibility, effectiveness and practicability of our method.

➢ SaB02 - 6 16 : 30 - 16 : 45

620 混沌扭摆实验的自动建模

谢桂今 北京邮电大学
高健 北京邮电大学
兰岳恒 北京邮电大学
Jinghua Xiao 北京邮电大学

如何根据实验数据自动建模并重构实验系统动力学是复杂实验系统研究的一个重要问题。本文通过混沌扭摆实验，研究了受驱动的实验系统的动力学重构问题。在不同的驱动频率下，混沌扭摆会产生包括周期、混沌在内的丰富的动力学行为。本文采用了基于局部动力学的全局近似方法近似出混沌扭摆实验方程的轨道。同时，通过延迟坐标的方法，有效处理了缺失数据时实验轨道的近似问题。通过回归分析，完成了对于非自治实验系统的重构，基于观测数据得到不同状态对应的试验系统参数。通过仿真的模拟实验数据，系统研究了近似方法、噪声、缺失数据等对于重构结果的影响。基于仿真实验的探索为实验数据的分析奠定了基础，也在实验数据的分析中得到了验证。

➢ SaB02 - 7 16 : 45 - 17 : 00

411Existence and uniqueness of axially symmetric compressible subsonic jet impinging on an infinite wall

张琴 重庆交通大学

This paper is concerned with the well-posedness theory of the impact of a subsonic axially symmetric jet emerging from a semi-infinitely long nozzle, onto a rigid wall. The fluid motion is described by the steady isentropic Euler system. We showed that there exists a critical value M_cr > 0, if the given mass flux is less than M_cr , there exists a unique smooth subsonic axially symmetric jet issuing from the given semi-infinitely long nozzle and hitting a given uneven wall. The surface of the axially symmetric impinging jet is a free boundary, which detaches from the edge of the nozzle smoothly. It is showed that a unique suitable choice of the pressure difference between the chamber and the atmosphere guarantees the continuous fit condition of the free boundary. Moreover, the asymptotic behaviors and the decay properties of the impinging jet and the free surface in downstream were also obtained. The main results in this paper solved the open problem on the well-posedness of the compressible axially symmetric impinging jet, which has proposed by A. Friedman in Chapter 16 in [26]. The key ingredient of our proof is based on the variational method to the quasilinear elliptic equation with the Bernoulli's type free boundaries.

➢ SaB02 - 8 17 : 00 - 17 : 15

430 两类自由半群作用的系统的原像分枝熵

张文达 重庆交通大学

我们将讨论自由半群作用的两类系统的原像分枝熵：(a)由闭 Riemann 流形上的一个扩张映射经充分小的 C1-扰动生成的系统；(b)有限图上的等度连续系统。我们证明了这两类自由半群作用的系统的原像分枝熵均为零。

SaB03 15 : 15 – 17 : 15
腾讯会议：111-707-071
稳定性与鲁棒性理论

主持人：林崇 青岛大学
主持人：杨绪君 重庆交通大学

➢ SaB03 - 1 15 : 15 - 15 : 30

239 矩形时滞广义系统的稳定性与状态导数反馈镇定

耿文韬 青岛大学
林崇 青岛大学
陈兵 青岛大学

本文研究了矩形时滞广义系统的稳定性及状态导数反馈镇定问题。首先，给出了基于秩判据的矩形时滞广义系统有唯一解且无脉冲的充分必要条件。值得注意，由于$m < n$情形下系统没有唯一解，本文仅针对$m > n$情形的矩形时滞广义系统进行研究。其次，通过矩形广义系统的状态等价形式得到了矩形时滞广义系统稳定的充分条件，扩展了方形时滞广义系统的稳定性结果到矩形系统中。然后，基于线性矩阵不等式(LMI)的稳定性条件，获得矩形时滞广义系统状态导数反馈镇定的控制器设计方法。最后，通过两个数值例子说明本文方法的有效性。

➢ SaB03 - 2 15 : 30 - 15 : 45

361 Output-Feedback Control for Multiple Uncertain Euler-Lagrange Systems Based on Extended State Observer

郭鑫晨 上海理工大学
魏国亮 上海理工大学

This paper addresses the leader-following consensus problem (LFCP) for multiple Euler-Lagrange (EL) systems subject to model uncertain parameters, external disturbance, and unmeasured velocity via output-feedback control under a directed graph. The purpose of this paper is to design a local extended state observer (ESO) and a distributed finite-time observer (FTO), as well as a distributed output-feedback controller. Firstly, a local ESO is put forward to estimate both the compound disturbance and unmeasured velocity for each EL system itself. Under standard assumptions, the uniform ultimate boundedness of the observer error can be guaranteed. Next, due to the fact that only parts of the followers can receive the leader's information, a distributed FTO is designed to observe the leader's position and velocity for each EL system. By introducing such an observer, the consensus problem is transformed into a local tracking problem. Further, on the basis of the ESO and FTO designed, a distributed output-feedback controller is proposed using the back-stepping method to solve the LFCP for multiple EL systems, such that the tracking error is semi-globally uniformly ultimately bounded (SGUUB). Finally, the effectiveness of the proposed observers and control protocol is further verified by a numerical simulation.

➢ SaB03 - 3 15 : 45 - 16 : 00

787 针对高机动目标的攻击角度约束有限时间收敛制导律

李俊贤 北京信息科技大学
范军芳 北京信息科技大学
陈仕伟 北京信息科技大学
豆登辉 北京信息科技大学

针对机动目标的拦截末制导问题，设计了一种基于有限时间收敛的终端落角约束的滑模制导律。首先建立导弹拦击目标的制导模型，将目标的机动看作未知的有界扰动；其次，通过具有有限时间收敛特性的扰动观测器对由目标机动引起的外部扰动进行快速估计，并基于固定时间扰动观测器设计终端落角约束制导律，通过理论分析证明了制导系统可以在有限时间收敛的特性。最后，为了验证所提制导律的有效性，分别在二维平面与三维平面进行数值仿真，验证了所提制导律可以使得制导系统在有限时间范围内收敛至期望状态。

➢ SaB03 - 4 16 : 00 - 16 : 15

115 Optimized Control Strategy Based on EPCH and DBMP Algorithms for a Class MIMO Nonlinear System

孟祥祥 青岛大学
于海生 青岛大学
张洁 青岛大学
颜克甲 青岛大学
杨庆 青岛大学

According to the actual production requirements in process control, this paper proposes an optimized control strategy for a class multiple-input-multiple-output (MIMO) nonlinear system. Firstly, the state error

port controlled Hamiltonian (EPCH) controller is designed by Hamiltonian system model construction which utilize the Hamiltonian principle, and a disturbance observer (DOB) is chosen to compensate disturbances impact. Seconded, a deadbeat model predictive (DBMP) control algorithm with discrete-time disturbance observer (DTDOB) is proposed. Thirdly, in order to establish an optimized control strategy, an optimized function is proposed, which can give full play to the advantages of DBMP-OB algorithm with fast dynamic response and EPCH-OB algorithm with good steady-state performance. Finally, by quadruple-tank liquid level system (QTLLS) as an example, using the Bernoulli's law and mass conservation principle, the dynamic mathematical model of QTLLS is established and linearized. A wealth of results from simulation and experimental fully confirm the superiority of the proposed control strategies compare with proportional–integral–derivative (PID) control and sliding mode control (SMC). Moreover, the proposed optimized control strategy has been realized position control, tracking control and disturbance compensation control in this paper. It meets the needs of production and has great industrial application prospects.

➢ SaB03 - 5 16 : 15 - 16 : 30

[71]Exponential stabilization of chaotic systems based on fuzzy time-triggered intermittent control

彭硕 青岛大学
王庆芝 青岛大学
傅保增 青岛大学

The exponential stabilization of chaotic systems is studied via fuzzy time-triggered intermittent control\r\n(FTIC). For the Takagi-Sugeno (T-S) fuzzy model representing a chaotic system, the mathematical description of FTIC is presented initially. Compared with fuzzy intermittent control (FIC), FTIC just needs the information at sampling instants on control time intervals. Compared with fuzzy sampled-data control (FSC), FTIC only transmits partial sampling data. Then, for the deduced FTIC system, a novel mixed Lyapunov functional is constructed to establish an exponential stabilization theorem. Based on it, FTIC can be designed. Further, the amount of transmitted data and the cost function are taken into consideration as two performance indexes. Finally, the effectiveness and the superiority of FTIC are shown in an example.

➢ SaB03 - 6 16 : 30 - 16 : 45

[407]On radius of robust feasibility for convex conic programs with data uncertainty

王梅 重庆交通大学

The radius of robust feasibility is the maximal size of uncertain set in which the robust feasible set for an uncertain program is nonempty. In this paper, we employ robust optimization technique to study a class of uncertain convex conic program, and give its formulas for radius of robust feasibility under several data uncertain sets. First, with aid of the distance from the origin to the so-called epigraphcal set, we provide computable upper and lower bounds of the radius of robust feasibility for convex conic program in face of ball uncertainty. Second, a formula is presented for the radius of robust feasibility for robust convex optimization problem with SOS-convex polynomial constraints under ball uncertain sets. Finally, some exact formulas of radius of robust feasibility are given for convex conic program with piecewise linear function constraints under boxes or polytopes uncertain sets.

➢ SaB03 - 7 16 : 45 - 17 : 00

[408]Stability of nabla discrete distributed-order dynamical systems

杨绪君 重庆交通大学

This paper studies the stability of nabla discrete distributed-order systems. Firstly, according to the definition of nabla discrete fractional-order sum/difference, we could analogically define the nabla discrete distribution-order sum/difference. Then, some lemmas of nabla discrete fractional-order systems are exteded to nabla discrete distributed-order systems.

➢ SaB03 - 8 17 : 00 - 17 : 15

[75] 具有输出延迟和欺诈攻击的 CPS 基于观测器的镇定

张满 青岛大学
耿文韬 青岛大学
林崇 青岛大学
陈兵 青岛大学

信息物理系统(CPS)深度融合了计算、通信和物理过程，容易遭受传输时延和攻击的影响。本文首次考虑了一类具有时变输出延迟和遭受欺诈网络攻

击的 CPS，其中欺诈网络攻击的建模包括乘法和加法攻击两类，加法攻击又包含状态依赖和状态独立攻击，大大增加了研究的难度。首先通过状态重构将 CPS 状态模型转化为广义系统模型，进而设计安全状态观测器和控制器，通过 Lyapunov 方法得到了受控 CPS 指数稳定的充分条件，在该充分条件求解时会同时得到所需的观测器增益与控制器增益。最后，通过仿真实例验证了所设计的 CPS 基于观测器的镇定方法的实用性和有效性。

SaB04　　15 : 15 – 17 : 15
腾讯会议：513-690-513
稳定性与鲁棒性理论

主持人：费晨　　上海理工大学
主持人：宋乾坤　　重庆交通大学

➢ SaB04 - 1　　15 : 15 - 15 : 30

[418]Global asymptotic stability of fractional-order complex-valued neural networks with probabilistic time-varying delays

陈思邯　　重庆交通大学
宋乾坤　　重庆交通大学
赵振江　　湖州师范学院
刘玉荣　　扬州大学

The stability of fractional-order complex-valued neural networks (FOCVNNs) with probabilistic time-varying delays is investigated in this paper. By constructing suitable Lyapunov–Krasovskii functional and utilizing inequality technique, a complex-valued linear matrix inequality (LMI) criterion guaranteeing the global asymptotic stability of the proposed FOCVNNs is deduced. A numerical example with simulations is provided to demonstrate the feasibility and availability of the obtained theoretical result.

➢ SaB04 - 2　　15 : 30 - 15 : 45

[420]Global Mittag-Leffler stability for fractional-order quaternion-valued neural networks with piecewise constant arguments and impulses

陈彦希　　重庆交通大学
宋乾坤　　重庆交通大学
赵振江　　湖州师范学院
刘玉荣　　扬州大学

This paper is devoted to analysing the global Mittag-Leffler stability of fractional-order quaternion-valued neural networks with piecewise constant arguments and impulses. The quaternion direct method is adopted to address the considered model avoiding any decomposition. By utilising the matrix inequality technique and Lyapunov direct method, some sufficient conditions to guarantee the global Mittag-Leffler stability of equilibrium point for the considered model are obtained in the form of quaternion-valued linear matrix inequalities(LMIs). To certify the validity of the derived result, a numerical example is presented.

➢ SaB04 - 3　　15 : 45 - 16 : 00

[419]Robust stability for a class of fractional-order complex-valued projective neural networks with neutral-type delays and uncertain parameters

黄为琴　　重庆交通大学
宋乾坤　　重庆交通大学
赵振江　　湖州师范学院
刘玉荣　　扬州大学

This paper is devoted to researching the robust stability of fractional-order complex-valued projective neural networks (FOCVPNNs) with neutral-type delays and uncertain parameters. Without dividing the FOCVPNNs into two real-valued systems, based on Lyapunov method, matrix inequality technique and homeomorphism principle, several delay-independent and delay-dependent criteria are established to make sure that the equilibrium point of the addressed FOCVPNNs is existent, unique and globally robustly stable. Finally, three examples with simulations are given to verify the availability of the main results.

➢ SaB04 - 4　　16 : 00 - 16 : 15

[854]Stabilisation of highly nonlinear neutral stochastic systems by delay feedback control

沈明轩　　安徽工程大学
费晨　　上海理工大学

This paper is devoted to deal with the exponential stabilisation of highly nonlinear hybrid neutral stochastic differential equation by delay feedback control. There are so far some results on the stabilization of delay stochastic systems on the current state, however, there are few results on the stabilisation of neutral stochastic systems by delay feedback control. Finally, an example is provided to verify our theoretical results.

➢ SaB04 - 5　　16 : 15 - 16 : 30

[417]Stabilization of T-S fuzzy fractional rectangular

descriptor time-delay system

吴倩 重庆交通大学
宋乾坤 重庆交通大学
赵振江 湖州师范学院
刘玉荣 扬州大学

This paper focuses on the stabilization of the T-S fuzzy fractional rectangular descriptor time-delay system.Toconvertthefuzzyrectangulartime-delaysystemintothefuzzysquaretime-delaysystem, a suitable dynamic compensator of proportional and derivative type is constructed, and the admissibility of the resultant square closed-loop system is enough to guarantee the stabilization of the nonlinear rectangular descriptor time-delay system. A sufficient condition is derived to ensure the stabilization for the considered system and the dynamic compensator parameters can be computed by solving the corresponding linear matrix inequalities (LMIs). A numerical example is provided to manifest the theoretical result.

➢ SaB04 - 6 16 : 30 - 16 : 45

[485]Coderivatives and Aubin properties of solution mappings for parametric vector variational inequality problems

薛小维 重庆文理学院

This paper deals with sensitivity analysis for a parametric vector variational inequality problem in finite dimensional spaces by using advanced tools in modern variational analysis and generalized differentiation. We mainly pay attention to computing the coderivatives of the solution mapping in the parametric vector variational inequality problem and then apply them to establish verifiable conditions for the Aubin property of the solution mapping.

➢ SaB04 - 7 16 : 45 - 17 : 00

[531] 基于站点线路数的城市公交网络鲁棒性研究

谢怡燃 昆明理工大学
李国华 昆明理工大学
杨波 昆明理工大学

该文以成都，重庆，昆明，贵阳和拉萨的公交站点网络为例，研究了节点依据站点线路数（途经某车站的公交线路总数）失效后网络的鲁棒性，并将所得结果与广泛研究的随机失效，度值选择性失效和介数值选择性失效进行了比较。具体包含以下三方面的内容：首先分析了网络的拓扑特性；然后研究了不同节点失效方式下网络的静态鲁棒性；最后基于负载-容量级联失效模型，研究了网络的动态鲁棒性。结果显示：(1)各城市累积度分布和累积站点线路数分布近似服从指数分布；(2)公交站点网络的静态鲁棒性与网络的拓扑结构密切相关，累积度分布的指数越大，度值选择性失效下的网络越脆弱；(3)与静态鲁棒性的结果相反，在考虑级联失效时，动态度值选择性失效对网络的破坏性弱于静态度值选择性失效。

➢ SaB04 - 8 17 : 00 - 17 : 15

[442]Optimality conditions for robust weakly efficient solutions in uncertain optimization

翟玉雯 重庆交通大学

In this paper, we provide two methods to find the vector-based robust weakly efficient solution and the flimsily robust weakly efficient solution for the uncertain vector optimization problem by means of the weighted sum scalarization method and strictly robust counterpart, respectively. In addition, we introduce a new epiderivative, which is called the higher-order weak upper inner Studniarski epiderivative. Moreover, we obtain two properties of the new notion under the star-shaped set assumption. Finally, by applying the higher-order weak upper inner Studniarski epiderivative, we obtain the optimality conditions of the vector-based robust weakly efficient solution for a uncertain vector optimization problem under higher-order strictly generalized cone convex condition.

SaB05 15 : 15 – 17 : 15
腾讯会议：718-578-046
系统演化及其稳定性分析

主持人：董高高 江苏大学
主持人：房庆祥 中国计量大学

➢ SaB05 - 1 15 : 15 - 15 : 30

[598]Wielding Intermittency with Cycle Expansions

曹环宇 北京邮电大学
兰岳恒 北京邮电大学

As periodic orbit theory works badly on computing the observable averages of dynamical systems with intermittency, we propose a scheme to cooperate with cycle expansion and perturbation theory so that we can deal with intermittent systems and compute the averages more precisely. Periodic orbit theory assumes that the shortest unstable periodic orbits build the

framework of the system and provides cycles expansion to compute dynamical quantities based on them, while the perturbation theory can locally analyze the structure of dynamical systems. The dynamical averages may be obtained more precisely by combining the two techniques together. Based on the integrability near the marginal orbits and the hyperbolicity in the part away from the singularities in intermittent systems, the chief idea of this paper is to revise intermittent maps and maintain the natural measure produced by the original maps. We get the natural measure near the singularity through the Taylor expansions and periodic orbit theory captures the natural measure in the other parts of the phase space. We try this method on 1-dimensional intermittent maps with single singularity, and more precise results are achieved.

➢ SaB05 - 2 15 : 30 - 15 : 45

643 宏观与中微观尺度下的复杂网络鲁棒性分析

董高高 江苏大学

复杂网络中的鲁棒性具有广泛的应用，如评估实际系统的健壮性、弹性、病毒传播等行为。实际网络系统彼此耦合、共存，规模巨大。本报告分别从网络宏观尺度下的最大连通集团、中微观尺度的有限大小连通集团系统地探讨网络的鲁棒性、相变行为及临界现象，特别是对于规模巨大的网络系统，中微观情形下的有限大小连通集团仍占有很大的比例，而不能被忽视。在这里，我们关注在随机攻击、局部攻击、目标攻击和有限信息目标攻击等不同失效场景下，大小为 s＝1, 2, 3, … 的连通集团 π_s 的渗流行为。我们从理论和数值模拟发现，对于包括正则随机、随机与无标度网络随机构型网络，有限大小连通集团的分布都显示出与最大连通集团不同的峰形。特别是，我们在 1/s 和 1/ p_max 之间找到了一类新型的一般化标度关系，这里 p_max 表示网络中 π_s 的峰值点对应的 p（剩余节点比例）值。此外，我们还关注了属于不小于 s 的有限连通集团的相变行为，并发现了不同尺度下连通集团的分布和 s 之间存在一类新型的标度关联。进而，将理论框架应用到实际网络中，并预测了实际网络中有限连通集团的相变行为。这一发现为确定临界阈值提供了一类潜在有效的理论方法，同时从宏观与中微观的角度对网络的鲁棒性进行了系统的探讨和分析。

➢ SaB05 - 3 15 : 45 - 16 : 00

777 Attractivity and stability of solutions of hereditary integral equations

房庆祥 中国计量大学

In this paper, the problem of attractivity and stability of solutions for functional hereditary integral equations is initiated. By utilizing the properties of convolution and the fixed point theorem, several sufficient conditions were derived for the existence of attractive solutions. Existence of asymptotically stable solutions was investigated according to the method of measure of noncompactness and Gronwall-Bellman-Pachpatte inequality. A limit condition of the convolution of two functions is introduced to ensure the asymptotical stability of hereditary integral equations. The conclusions presented extend some published results.

➢ SaB05 - 4 16 : 00 - 16 : 15

439 考虑媒体覆盖的随机谣言传播模型研究

霍良安 上海理工大学
董雅芳 上海理工大学

在信息全球化时代，谣言传播的速度更快，影响范围更广，严重时甚至危害社会稳定，因此研究谣言传播机理至关重要。考虑到确定性模型不能描述环境噪声干扰因素，本文在经典确定性模型的基础上构建了包含媒体覆盖和随机过程的谣言传播模型，其中随机过程包括维纳过程和莱维过程。首先证明了系统全局正解的唯一性，求得基本再生数 R0。其次研究了该模型解在平衡点附近的动态行为。当 R0 <1 时，谣言最终趋于消失；当 R0 >1 时，谣言将持续传播，随机系统解将在平衡点附近随机振荡，振荡幅度与系统所受到的扰动有关。然后通过引入科普教育和媒体覆盖两种控制策略，建立了模型近最优控制的充分必要条件。最后通过数值模拟验证了上述理论结果。

➢ SaB05 - 5 16 : 15 - 16 : 30

869 G-布朗运动驱动的随机神经网络指数稳定性

梁勇 安徽工程大学
费为银 安徽工程大学

本文研究了一类 G-布朗运动驱动的随机神经网络指数稳定性，在局部 Lipschitz 条件和线性增长条件下，利用了 G-Itô 公式、容度 V 下指数鞅不等式、Borel-Cantelli 引理等，给出了此类随机神经网络是拟必然指数稳定和不稳定的判据，并研究了线性随机扰动的镇定性和反镇定性条件。

➢ SaB05 - 6 16 : 30 - 16 : 45

860 Exponential stability of infinite delay stochastic

systems with Markovian switching

梅春晖 安徽工程大学
沈明轩 安徽工程大学
费为银 安徽工程大学

When the coefficients of stochastic systems (SSs in short) are superlinear growth, how to ensure the exponential stability of its solution? There have been abundant literature for hybrid stochastic systems with finite memory. But there is no corresponding result in the hybrid stochastic systems with infinite memory (hybrid IMSSs in short). After choosing the appropriate phase space, using the relevant theory of fading memory space, this letter gives the criteria of exponential stability for a class of hybrid IMSSs. Finally, an example is given to illustrate the effectiveness of our results.

➢ SaB05 - 7 16 : 45 - 17 : 00

647 网络形式背景的概念稳定性分析

闫梦宇 昆明理工大学
李金海 昆明理工大学

形式概念分析是处理对象-属性数据集的有效工具，且每个形式概念均可以看作一个分类，而类的稳定性是一个值得讨论的问题。现有的概念外延稳定性仅能够计算概念外延依赖内涵的程度，无法判断概念外延的结构稳定性。注意到数据中对象的结构信息可以用网络的形式表示，且网络结构熵是对网络结构均匀程度的一种描述，因此本文将网络结构熵引入到已有的概念外延稳定性公式中，提出了新概念外延稳定性公式，这样既能判断外延依赖内涵的程度，又能判断对象之间的结构稳定性，也更符合数据中既有对象-属性信息又有对象结构信息的情况；进一步分析了其相关性质；最后，通过实验证实了本文提出的新概念外延稳定性公式的优势，同时也表明了相关性质的有效性。

➢ SaB05 - 8 17 : 00 - 17 : 15

633 数据丢包下非线性系统的事件触发脉冲控制

朱海涛 东南大学
卢剑权 东南大学

在工程实际中，受信道堵塞、执行器故障等因素影响，数据丢包现象时有发生，此时相应的控制输入便无法生成，这使得系统原有的受控性能遭受极大破坏。本文充分考虑了非线性系统中可能存在的数据丢包和外部扰动现象，借助脉冲控制方法研究了其输入-状态稳定性。为了进一步降低数据传输和控制器更新的成本消耗，设计了一类混杂事件触发机制。特别地，该事件触发机制仅要求事件参数为正数便可排除可能的 Zeno 现象，极大释放了以往对事件触发机制本身的限制。紧接着，通过建立脉冲丢包率，系统参数和外部扰动信息间的动态约束关系，基于 LMI 技术得到了保证系统输入-状态稳定性的充分性准则。最后，应用矩阵理论解决了事件触发脉冲控制策略的设计问题，并提出一个数值例子展示了所得结论的有效性。

SaB06 15 : 15 – 17 : 15

腾讯会议：149-554-469

系统建模

主持人：刘翠玲 北京工商大学
主持人：潘峰 贵州民族大学

➢ SaB06 - 1 15 : 15 - 15 : 30

750 Handoff calls' joining behavior and incentive mechanism in wireless cellular networks with retrial orbit

曹建 北京邮电大学

In wireless cellular networks, handoff is a key element in providing quality of service and supporting mobility for users. There is an interaction between wireless cellular networks and handoff calls which strategically act to achieve their own objectives. In order to reasonably control the access of handoff calls and achieve the optimization of social network resources, we present a game-theoretic queueing model to investigate the strategic behavior of handoff calls in wireless cellular networks. The noncooperative joining behavior of handoff calls that maximizes their expected net benefit selfishly is considered. Moreover, the socially optimal joining behavior of handoff calls that maximizes their social total welfare is analyzed. The equilibrium and socially optimal strategies of handoff calls are obtained. Counterintuitively, we find that the socially optimal joining probability is larger than the equilibrium joining probability. In order to eliminate the difference of joining probabilities, an appropriate incentive-payment is proposed to attract handoff calls to join the system actively. In doing so, it is feasible to induce individuals to behave in a socially best way.

➢ SaB06 - 2 15 : 30 - 15 : 45

259 基于离散化建模的对交通便利性的评估方法

郭子乐 北京交通大学

王行健 北京交通大学

路网拥挤，效率低下成为城市发展中亟需解决的问题之一。本文通过对北京城市路网系统离散化建模，利用百度地图 API 接口提供的实时数据，探究了北京市区内出行速度，时间等指标的空间与时间分布情况，评价了特定地区的交通便利性，并利用 QGIS 等工具对数据进行可视化。针对路网，评价了各地点的通达度，发现了通达度有待提升的区域与不同时间段北京市内较易产生拥堵的节点。此外，本文对比了各地区公共交通与自驾车之间的里程与速度差异，评价了各时段各地区公共交通线网的便利程度。本文研究思路与成果可为交通管理与控制提供了数据基础，对新线路的规划具有重要参考价值。

➢ SaB06 - 3 15 : 45 - 16 : 00

[83]Multi-view Multi-objective Optimization for Location of Electric Vehicle Charging Stations

郝媛媛 北京交通大学
四兵锋 北京交通大学
赵春亮 中山大学

Electric vehicles play an important role in achieving carbon neutrality. The charging station is a non-negligible factor restricting the development of electric vehicles, such as charging anxiety. So far, the layout of the charging station lacks a systematic plan. In other words, only the single-perspective multi-objective optimization problem is considered, i.e., many objectives of the corporation. Nevertheless, the layout of charging stations from the real-world scenario often requires multi-perspective consideration. To this end, the optimal location of charging station as a multi-view multi-objective optimization problem that contains all goals of multiple stakeholders is modeled. Moreover, we propose a bi-layer decomposition-based evolutionary algorithm to solve the problem. The algorithm is able to find a set of scenario-based well-distributed and well-converged solutions for decision-makers. The obtained solutions are posterior, which describe the effect of each objective of each view. Moreover, an integration preference policy is designed for determining the final solution before the project implementation. Experimental results show the modeled problem and the proposed algorithm are effective, which achieve the compromise under the multi-view environment. Hence, a comprehensive plan can be developed based on the found solutions.

➢ SaB06 - 4 16 : 00 - 16 : 15

[212] 基于 TrAdaBoost 算法的近红外光谱模型传递研究

刘翠玲 北京工商大学
徐金阳 北京工商大学
孙晓荣 北京工商大学
张善哲 北京工商大学
昝佳睿 北京工商大学

随着近红外光谱检测仪种类的增多，不同仪器间的校正模型无法共享问题，可利用模型传递解决。以食用油为研究对象，在主机上建立其酸值的极限学习机校正模型，利用迁移学习中的 TrAdaBoost 算法把主机模型传递到从机上，探讨标准化样品数量对模型传递效果的影响，并与直接标准化算法、缺损数据重构算法和极限学习机自编码器的模型传递算法进行对比。结果表明：主机模型经 TrAdaBoost 算法模型传递后，从机预测集的决定系数 R2 从 0.489 上升到 0.922，预测均方根误差(root mean square error of prediction，RMSEP)从 4.824 mg/g 下降到 0.198mg/g，且模型效果几乎不受标准化样品数量的影响。说明 TrAdaBoost 算法可以有效应用于模型传递领域，实现了不同光谱仪器之间的共享，可对模型传递算法提供了研究思路。

➢ SaB06 - 5 16 : 15 - 16 : 30

[757] 系统科学视域认知演化计算及其 OOP 建模方法

潘峰 贵州民族大学
谢雨寒 贵州民族大学
苏浩翀 贵州民族大学

针对遗传算法为典型代表的演化算法在教学中学生学习比较困难的实际情况，我们分析了当前对遗传算法教与学中存在的两个方面的不足：一是认知上的混乱，缺乏一种科学的系统观；二是系统实践的建模工具选择不当，往往是基于面向过程的方式，而不是利用面向对象的方法构建计算系统。基于以上问题，本工作应用系统科学的观点分析遗传算法构成的要素和时空结构，结合面向对象程序设计的方法自下而上解决问题的特点，提出应用面向对象程序设计的系列方法构建遗传算法计算系统，从而增加对遗传算法系统的认知，达到有效地降低学习难度的目的。在我们的实际教学过程中学生反应良好，表明该方法是有效的，具有推广到研学其他演化算法中的指导意义。

➢ SaB06 - 6 16 : 30 - 16 : 45

338 基于遥感图像 3D-CNN 的蓝藻水华预测方法

王立 北京工商大学
李文浩 北京工商大学
吴羽溪 北京工商大学
王小艺 北京工商大学
刘载文 北京工商大学

现有的蓝藻水华预测方法大多基于水质和气象的现场监测点数据，缺乏对整体水域的全面分析，同时，遥感图像虽能够反映整体水域变化，但传统分析方法难以有效处理海量的遥感数据。本研究以富营养化状态和叶绿素浓度作为蓝藻水华的表征指标，以遥感图像及其反演图为主要研究数据，提出了一种基于 3D-CNN 的蓝藻水华预测新方法。首先，基于 3D-CNN 对遥感图像进行特征提取，并采用细菌觅食算法优化网络结构，预测水体富营养化等级。其次，综合采样点的测量值、机理模型计算值和 3D-CNN 提取的特征信息作为输入数据建立 Elman 神经网络模型，预测精确的叶绿素浓度。仿真结果表明，基于 3D-CNN 的模型在富营养化状态和叶绿素 a 浓度预测方面均取得良好效果，预测精度达到 71.43%和 93.97%.

➢ SaB06 - 7 16 : 45 - 17 : 00

226 高效城市路网实时可达性算法研究——以北京为例

王行健 北京交通大学
高亮 北京交通大学

实时路网可达性求解对于实时道路交通管理与控制、出行者路径规划与导航等，具有重要意义。并且，由于实时数据量较大且存在明显传输时延、计算量大且时效性要求高，因此，急需找出高效的实时可达性算法。本文以路网为研究对象，研究高效路网实时可达性算法。本文通过对路网整体进行栅格化建模的方式，通过研究特征 OD 对，建立可达性评估指标。其次用多目标规划模型解释了可达性最优化问题，提出基于机器学习的算法，利用实时路网数据推算对整体可达性进行优化的理论最优方案。最后本文利用上述方法，借助实时路网数据，对北京市五环范围公园绿地的可达性进行分析；证明本文提出的算法相对于已有算法计算效率得到提高。

➢ SaB06 - 8 17 : 00 - 17 : 15

817Lasso 回归对人均 GDP 影响因素分析——以重庆市为例

张恩丹 重庆交通大学

随着新冠疫情的发生，人均 GDP 或多或少地受到影响，研究重庆市人均 GDP 背后的主要影响因素是十分有必要的。本文通过分析选取了 9 个可能影响人均 GDP 的影响因素，即年末总人口（万人）、城镇登记失业人数（万人）、政策性生育率（%）、房屋施工面积（万平方米）、能源消费弹性系数、人均个人储蓄存款余额（元）、降水量（毫米）、普通高等学校（含研究生）、第三产业。并将以上各因素在 1990-2020 年 31 年间的资料进行了实证分析，采用一般最小二乘法、逐步回归法、Lasso 回归方法，对重庆市人均 GDP 的主要影响因素及其拟合效果进行了分析，并提出相应的结论与建议。

SaB07 15 : 15 – 17 : 30
腾讯会议：639-713-958
信息系统与信号处理

主持人：缪旻 北京信息科技大学
主持人：龙飞 贵州民族大学

➢ SaB07 - 1 15 : 15 - 15 : 30

232 深度学习相位解缠

韩焱森 国防科技大学

二维相位解缠是 InSAR 获取高程的关键步骤，也是解缠过程中必不可少的步骤，但传统解缠方法无法实现强噪条件下保证精度的相位恢复。为解决强噪条件下的相位恢复问题，本文利用提出了一种使用卷积神经网络进行强噪条件下的相位解缠的方法。首先利用实地的 DEM 数据对卫星的相位数据进行模拟并添加大小不同的噪声。而后利用模拟数据进行神经网络的训练，该方法利用可形变卷积层高效的提取不同地形条件中的相位信息，并使用二元交叉熵函数来进行约束限制。同时为确保神经网络的有效性本文还使用了另外一种神经网络方法平行进行训练对比。最后使用另一实地的 DEM 数据来进行方法的验证并与几种传统方法进行比较。实验结果表明，在强噪条件下神经网络方法可以获得更好的解缠效果。

➢ SaB07 - 2 15 : 30 - 15 : 45

673 基于二维超材料结构实现电磁波高效非对称传输的研究

龙飞 贵州民族大学

我们通过二维超材料提出一种实现电磁波高效非对称传输的宽带线性极化转换器。所提出的转换器的单元结构由两个相同的介电层和三个金属层构成，其尺寸为 $0.33\lambda_0\times0.33\lambda_0\times0.1\lambda_0$（其中 λ_0 是工作带宽中心频率处的自由空间波长），其工作频率范围在 6.5GHz 到 13.5GHz，极化转换率保持近 100%。对

表面电流和电场的分布进行了数值模拟，以阐明极化转换的物理机制，本结构可应用于无线通信和卫星通信等领域。重要的是，我们建立类法布里-珀罗腔模型以揭示极化转换比的提高。推导出包括理想模型和近似模型在内的清晰表达式，为亚波长二维超材料结构中的类法布里-珀罗腔模型提供了很好的解释。

➢ SaB07 - 3 15 : 45 - 16 : 00

800 三维集成微纳系统集成用 TSV 关键技术研究新进展

缪旻 北京信息科技大学
李振松 北京信息科技大学
孙亮 北京信息科技大学

三维集成电路（Three-Dimensional Integrated Circuit, 3D-IC）技术已成为微纳米尺度系统集成和摩尔定律持续发展的关键技术。作为 3D-IC 的关键技术，硅通孔（Through Silicon Via, TSV）技术对三维集成系统信号传输带宽、总体功耗优化、集成密度提升方面具有重要意义。本文从微纳米尺度的系统集成、调控与系统架构优化的角度出发，介绍了三维集成系统中 TSV 技术相关的结构建模、信号/电源完整性（Signal Integrity/Power Integrity, SI/PI）分析、链路级传输技术等三个方面研究进展。提出了碳纳米管（Carbon Nanotube, CN）-铜-硅通孔（CN-C-TSV）阵列结构，硅基转接板中带 TSV 接地共面波导（Ground Co-Planar Waveguide, GCPW）结构的 GCPW-TSV-GCPW 结构等结构模型，深入研究了模型中物理特性对传输性能的影响，并通过制作样品实测等方法验证了模型的有效性。提出了基于芯粒（chiplet）的域特定架构（Domain Specific Architecture, DSA）可扩展卷积加速架构及其应用场景下的高速互连传输链路 SI/PI 分析框架、协同仿真分析方法。提出了基于 Turbo 乘积码（Turbo Product Code, TPC）并行编码传输方案和适用于高速互连设计的低密度奇偶校验编码（Low Density Parity Check Code, LDPC）优化传输方案，实现了片上互连传输链路的高保真信息传输。通过上述研究工作，形成了基于 TSV 技术的三维集成系统高速信号通路的结构建模、SI/PI 分析，以及链路级传输技术的物理特性、技术原理、设计分析方法、性能评估等研究路线和特色，推动基于 TSV 的三维基础封装技术不断向前发展，服务于三维集成系统的优化与应用。

➢ SaB07 - 4 16 : 00 - 16 : 15

719 基于表面肌电信号的假肢手控制技术的研究

潘福东 广西师范大学
郁凡 广西师范大学
赵书华 广西师范大学

肌电假肢手是由肢体残疾者的大脑神经残肢肌肉运动产生的电信号，通过将肌电信号放大后用来控制微型电机，带动传动系统，来驱动假肢按人的意志的一种体外力源上肢假肢。由于肌电假手的运动接受大脑指挥，它除了具有电动假手的长处外，还具有直感性强、控制灵活和使用方便等优点，是目前现代假肢的发展方向。本文从肌电假肢手、单手指控制及手指弯曲度、力度等方面进行了研究。主要工作如下：首先，通过对自然人手的生理结构及运动特点进行分析，发现自然人手的结构是复杂的，人手的运动特点是简单的，因此只需要对人手几个抽象动作进行表面肌信号的提取及识别，就可以完成对智能仿人型假肢手的控制，其处理环节包含信号预处理、特征提取与动作别。通过对假肢手各个手指布局、手指自由度以及动作组合的研究，设计出肌电假肢手。其次，基于已设计出的肌电假肢手，进行简单手指动作控制实验，以确保假肢手能灵活运动。信号选取并采集的是受试者前臂四块肌肉表面肌电信号，通过对手臂肌群的分析，选取与五根手指弯曲动作最为相关的尺侧腕屈肌、掌长肌、桡侧腕屈肌以及指浅屈肌这四块肌肉。完成采集离散表面肌电信号后，利用蓝牙传输进行信号。通过小波及小波包变换对表面肌电信号进行时频域特征提取，使用 BP 分类器对其进行行动作模式分类，成功分类识别了单手指动作及张合动作，其平均识别率达到 80%~96%之间。识别结果传送到肌电假肢手控制环节，实现假肢手动作控制。最后，对假肢手复杂动作的拆解进行了研究。对构成日常生活常需要的抓握、拿取等动作的关键元素：动作持续时间、手指的张合程度以及力度三方面进行研究。发现从时域观察动作持续时间，可区分性相当高；手指张合程度及力度可得出两条拟合曲线，均呈现出递增关系，说明以上特征具备明显可识别性。

➢ SaB07 - 5 16 : 15 - 16 : 30

779Chip-scale optical communication and signal processing

秦军 北京信息科技大学

At the intermediate nodes of optical communication network, when the optical signals need to be processed or transformed, handling the signals directly in the optical domain, to avoid the power consuming optical

electrical optical (O-E-O) conversion process, has been concerned as an important capability by researchers. The development of silicon photonics (SiPh) makes it possible to realize integrated, small size and low-power consumption on-chip all-optical signal processing technique. Compared with other material platforms, the biggest advantage of SiPh is that it is compatible with the CMOS (complementary metal oxide semiconductor) process that commonly used in the existing microelectronic chips, which is of great helpful for the future construction of optoelectronic monolithic integrated optical communication system. In this paper, based on SiPh platform, we focus on the research of chip scale all-optical signal processing technology that could be deployed in optical communication system. The research of optical signal processing for analog signal (radio over fiber signal) and digital signal are simultaneously carried out. The main work includes: 1) hybrid receiver based linearity compensation method for silicon Mach Zehnder modulator, 2) the design and fabrication of III-V material (AlGaAs) based devices with high nonlinearity, 3) the technique of multichannel wavelength multicasting employing AlGaAs devices for short-range PAM (pulse amplitude modulation) signals that widely used in data center, 4) the technique of dark-pulse Kerr combs generation from a high-Q microresonator with normal dispersion, 5) new flexible nonlinear material (indium tin oxide (ITO) thin film) investigation for optical signal processing. The details and main innovation points of the work are given as follows: I): An MRC-RX (maximum ratio combined receiver) was proposed to compensate the system performance degradation that caused by the low linearity Si modulator when deployed in PON (passive optical network) system. By employing MRC-RX, at bit error rate (BER) of 1×10^{-4}, 3.5 dB and 6.7 dB receiver sensitivity improvement is achieved compared to lite-coherent detection receiver (lite CO-RX) and direct detection receiver (DD-RX), respectively. By setting the frequency interval properly, 28.5% error vector magnitude (EVM) improvement is achieved. Through a comparison analysis with a system employing a commercial lithium niobite (LiNbO3) modulator, for the MRC-RX in silicon modulator system, 1.1dB and 5.6dB receiver sensitivity improvement is obtained compared to the lite CO-RX and DD-RX in LiNbO3 modulator system, respectively. The system performance degradation caused by the low linearity of silicon modulator than LiNbO3 modulator can be effectively reduced by employing MRC-RX. The proposed MRC-RX is an algorithm based post-fabrication performance optimization method for silicon modulator, which has never been reported before. Meanwhile the cost and complexity of the proposed MRC-RX doesn't increase significantly except digital signal processing (DSP) circuits. Using optical devices fabricated in the silicon platform in the access will make the optical access network with smaller size and cost. II): Based on wafer bonding technology, an AlGaAsOI waveguide device was fabricated. Based on the device, highly efficient wavelength multicasting for PAM3/PAM4 signal was realized based on the nonlinear four-wave mixing (FWM) process inside the device. The low loss, high nonlinearity and small mode area of the waveguide make it possible to generate the high efficient FWM process. By virtue of the transparency of the FWM process to the modulation format, the multicasting function can be realized. In the experiment, an average conversion efficiency of -11.2dB was achieved in the whole C-band. Under the BER threshold of KP4-FEC, the power penalty of the multicasting channels of PAM3/PAM4 signal were all less than 2.1dB. The proposed scheme is of great significance for the construction of nonlinear OSP systems based on high efficiency III-V materials in the near future. III): Mode-locked dark-pulse Kerr combs based on an AlGaAsOI high-Q microresonator was demonstrated. With a relative low pumping power of 5 mW, a 90 GHz spacing low-noise comb is achieved. which is the first time, to the best of our knowledge, a coherent Kerr comb source generated at room temperature in this III-V platform, which further exploit the huge potential of this efficient integrated nonlinear photonics platform. IV): The nonlinear optical properties of new flexible nonlinear material indium tin oxide (ITO) thin film was investigated. ITO is a useful plasmonic optical material because of its widely tunable optical permittivity and low loss in the near-infrared (NIR) and mid-wave

infrared (MWIR) spectral ranges, the nonlinear refractive index of ITO is $6 \times 10^{-12} cm^2/W$, which is much higher than III-V material. The employing of ITO devices will further improve the performance of optical signal processing system.

➢ SaB07 - 6 16 : 30 - 16 : 45

642 基于变阶分数阶各向异性扩散的图像去噪方法

舒小虎 国防科技大学
韩佳玲 国防科技大学
王泽龙 国防科技大学

分数阶偏微分方程是图像去噪的重要方法之一，能够保留图像中较多的精细纹理结构，然而传统方法的分数阶微分阶数采用固定常数，难以去除自然图像中的多尺度纹理结构的噪声。本文提出了一种基于变阶分数阶各向异性扩散的图像去噪方法。该方法通过局部方差自适应地将图像划分为均匀区域和非均匀区域。在均匀区域采用相对较小的分数阶微分阶数来提高去噪效果，避免阶梯效应；在非均匀区域（包含边缘和纹理），采用相对较大的分数阶微分阶数来提升结构保持能力。实验结果表明，该方法与固定分数阶偏微分方法相比具有更好的去噪效果和结构保持能力。

➢ SaB07 - 7 16 : 45 - 17 : 00

798 短距离 53GBaud_s PAM4 光信号信号并行均衡算法研究

孙剑 北京信息科技大学

针对大吞吐量实时均衡器更新抽头系数占用大量硬件资源的问题，提出了一种基于 LMS（最小均方误差）算法的共享抽头系数并行 FFE 结构，与串行 FFE 的均衡效果进行了对比，结果表明提出的并行结构具有相近的均衡效果，同时大幅减小了更新抽头系数所需的计算量。面向某基于单片集成硅基发射机的 400Gb/s PAM4 实验光传输系统，采用离线方式分析了抽头数、并行度、带宽受限程度及输入/输出信号位宽下共享抽头系数并行 FFE 结构的均衡效果，当并行度小于 700 时，均衡后信号的误码率均小于 3.8×10^{-3}.

➢ SaB07 - 8 17 : 00 - 17 : 15

488Total variation with modified group sparsity for CT reconstruction under low SNR

张伶俐 重庆文理学院

Background and objective: Since the stair artifacts may affect non-destructive testing (NDT) and diagnosis in the later stage, an applicable model is desperately needed, which can deal with the stair artifacts and preserve the edges. However, the classical total variation (TV) algorithm only considers the sparsity of the gradient transformed image. The objective of this study is to introduce and test a new method based on group sparsity to address the low signal-to-noise ratio (SNR) problem. Methods: This study proposes a weighted total variation with overlapping group sparsity model. This model combines the Gaussian kernel and overlapping group sparsity into TV model denoted as GOGS-TV, which considers the structure sparsity of the image to be reconstructed to deal with the stair artifacts. On one hand, TV is the accepted commercial algorithm, and it can work well in many situations. On the other hand, the Gaussian kernel can associate the points around each pixel. Quantitative assessments are implemented to verify this merit. Results: Numerical simulations are performed to validate the presented method, compared with the classical simultaneous algebraic reconstruction technique (SART) and the state-of-the-art TV algorithm. It confirms the significantly improved SNR of the reconstruction images both in suppressing the noise and preserving the edges using new GOGS-TV model. Conclusions: The proposed GOGS-TV model demonstrates its advantages to reduce stair artifacts especially in low SNR reconstruction because this new model considers both the sparsity of the gradient image and the structured sparsity. Meanwhile, the Gaussian kernel is utilized as a weighted factor that can be adapted to the global distribution.

➢ SaB07 - 9 17 : 15 - 17 : 30

658 Advances in Particle Filtering

张庆铭 贵州民族大学

Particle filtering is an important scheme to solve problems in non-linear filters, but the phenomenon of sample degeneracy impairs performance of particle filtering. We review recent advances in methods for suppressing sample degeneracy, summarizing three pivotal problems worth to focus: the estimation on performance of particle filtering, adaptive filtering under the framework of multiple importance sampling, and improving schemes in importance sampling.

SaB08　　15 : 15 – 17 : 15
945-693-627
滤波、估计与预测

主持人：高尚　　江苏科技大学
主持人：李兵　　重庆交通大学

➢ SaB08 - 1　　15 : 15 - 15 : 30

[528] 基于支持向量机分类的个人信用评价

高尚　　江苏科技大学

信用评价可以较精确地估计消费信贷的风险，给贷款人提供了一个可靠的技术手段，避免不良贷款，控制债务拖欠和清偿。对当前传统个人信用评价中的种种问题，提出了一种利用支持向量机分类模型的个人信用评价的方法。该方法利用 SPSS Clementine 数据挖掘工具，使用支持向量机方法进行分类。对于支持向量机的不同核函数及参数情况下，作了详细分析。

➢ SaB08 - 2　　15 : 30 - 15 : 45

[56]PFVAE: A Planar Flow-Based Variational Auto-Encoder

金学波　　北京工商大学
宫文涛　　北京工商大学
孔建磊　　北京工商大学
白玉廷　　北京工商大学
苏婷立　　北京工商大学

Prediction based on time series has a wide range of applications. Due to the complex nonlinear and random distribution of time series data, the performance of learning prediction models can be reduced by the modeling bias or overfitting. This paper proposes a novel planar flow-based variational auto-encoder prediction model (PFVAE), which uses the long- and short-term memory network (LSTM) as the auto-encoder and designs the variational auto-encoder (VAE) as a time series data predictor to overcome the noise effects. In addition, the internal structure of VAE is transformed using planar flow, which enables it to learn and fit the nonlinearity of time series da-ta and improve the dynamic adaptability of the network. The prediction experiments verify that the proposed model is superior to other models regarding prediction accuracy and proves it is effective for predicting time series data.

➢ SaB08 - 3　　15 : 45 - 16 : 00

[254] 基于高光谱技术的乌龙茶儿茶素及其酯类衍生物含量的快速判别

刘翠玲　　北京工商大学
秦冬　　人工智能学院
凌彩金　　广东省农业科学院茶叶研究所
孙晓荣　　北京工商大学
郜礼阳　　广东省农业科学院茶叶研究所
周巧仪　　广东省农业科学院茶叶研究所
吴静珠　　北京工商大学
昝佳睿　　北京工商大学

茶多酚是茶叶的重要成分之一，是酚类物质总称，占干物质的 20%-30%，酚类里面儿茶素及其酯类衍生物含量最多，占茶多酚 70%-80%，具有医疗和保健的功效，且是茶汤苦涩味的主要来源，准确估测儿茶素及其酯类衍生物的含量对茶叶的品质鉴定和定量分析具有重要的意义。通过高光谱成像仪采集乌龙茶茶汤的光谱信息，按照国标法测得茶叶样本的 8 种儿茶素及其酯类衍生物的含量浓度，结合化学计量学方法建立光谱与儿茶素及其酯类衍生物的回归预测反演模型。首先对光谱信息进行不同方法的预处理，消除噪声和人为误差；运用 KS 法按照约 4：1 比例划分校正集和预测集样本;然后采用连续投影法(SPA)进行特征波长筛选,建立偏最小二乘模型(PLS)，结果发现部分化学值的预测效果达不到预期。为了进一步提高模型的预测能力，在特征波长筛选基础上，引入粒子群算法(PSO)优化前馈神经网络(BP)算法，通过建模对比，结果可以使得 GCG、CG、EGC、总儿茶素四种化学值的预测集r^2达到 0.9 以上，表示模型有很好的预测效果；EC、EGCG、简单儿茶素、酯型儿茶素四种的预测集r^2介于 0.8-0.9 之间，表示模型有较好的预测效果。可以看出基于机器学习的优化算法能够明显提高模型预测精度，预测集的均方根误差有明显的降低。对于乌龙茶的定量预测有一定的实用价值,能够对感官评审提供一定的客观评价。

➢ SaB08 - 4　　16 : 00 - 16 : 15

[434]The Optimal Distributed Kalman Filtering Fusion with Linear Equality Constraint

李华　　重庆交通大学

In this paper, the optimal distributed Kalman filtering fusion with linear equality constraint (LEC) is proposed. When the Kalman filter subject to LEC is applied in state estimation of distributed linear dynamic system, all local error covariance matrices are singular, which is a challenge for most of the existing distributed fusion algorithms. However, the new fusion algorithm is

rigorously derived with matrix analysis technique on the Moore-Penrose inverse. Updating state estimate and error covariance matrix, the new fusion algorithm only uses local estimates and their corresponding error covariances. We have proved theoretically that the distributed Kalman filtering with LEC (DKF-LEC) just using all local measurements is equivalent to the centralized Kalman filtering with LEC (CKF-LEC), which means it is optimal. Furthermore, we also prove the optimality of the proposed fusion formula for Kalman filtering with LEC and feedback. In addition, the simulation results show that the proposed fusion formula for Kalman filtering with LEC have the same performance of the centralized Kalman filtering with LEC whether considering feedback or not. It is consistent with the theoretical result that the DKF-LEC is equivalent to CKF-LEC as the estimate of CKF-LEC is disassembled into local estimates in distributed system. And the performance of the new fusion formula for Kalman filtering with LEC and feedback is obviously better than those without feedback.

➢ SaB08 - 5 16 : 15 - 16 : 30

[148] 基于自适应随机共振的信号估计方法

潘燕 山东科技大学

在信号估计中，由于最优估计量的封闭形式不容易得到，或者结构过于复杂不易实施，因此，实际的信号估计任务中，通常选择易于实现的次优估计器。本文设计了一种通用的噪声增强估计器，并采用自适应随机共振方法探索噪声的有益性及估计器参数的学习能力。为了更有效的提高估计性能，我们采用核函数方法寻求加入的最优噪声概率密度的近似解。在最大化估计性能的优化过程中，噪声概率密度及估计量参数构建了一个有限维非凸优化空间，通过序列二次规划算法自适应搜索最优解。本文讨论了从低分辨率数据中估计随机参数以及在厚尾噪声环境中估计确定性参数两个具有代表性的估计问题，结果表明自适应随机共振方法可以提高次优估计器的性能并使其非常接近最优估计器性能。

➢ SaB08 - 6 16 : 30 - 16 : 45

[400] Event-Triggered State Estimation for Fractional-Order Neural Networks

许冰睿 重庆交通大学
李兵 重庆交通大学

This paper is concerned with the problem of event-triggered state estimation for a class of fractional-order neural networks. An event-triggering strategy is proposed to reduce the transmission frequency of the output measurement signals with guaranteed state estimation performance requirements. Based on the Lyapunov method and properties of fractional-order calculus, a sufficient criterion is established for deriving the Mittag–Leffler stability of the estimation error system. By making full use of the properties of Caputo operator and Mittag–Leffler function, the evolution dynamics of measured error is analyzed so as to exclude the unexpected Zeno phenomenon in the event-triggering strategy. Finally, two numerical examples and simulations are provided to show the effectiveness of the theoretical results.

➢ SaB08 - 7 16 : 45 - 17 : 00

[320] Short-term Social Conflict Prediction for pedestrian

于继宇 青岛大学
赵东杰 青岛大学
冉鹏飞 青岛大学
徐茂 青岛大学
牛超群 青岛大学
Shuzhi Ge 新加坡国立大学

We propose a method (PSTSC) for predicting short-term social conflicts between pedestrian trajectories that can help pedestrians plan their paths in advance and avoid social problems caused by trajectory conflicts. PSTSC utilizes YOLOV3 to compute pedestrian trajectories from video and utilizes Kalman filter to filter pedestrian trajectories. PSTSC then estimates future pedestrian trajectories via linear regression and utilizes the designed judgment model to predict potential conflict judgments. Experimental results show that PSTSC could accurately predict the upcoming conflicts of pedestrians, and give accurate judgments on various states. In addition to this, PSTSC is 5 times faster in computation time than current methods.

➢ SaB08 - 8 17 : 00 - 17 : 15

[399] H_∞ state estimation for Round-Robin protocol-based Markovian jumping neural networks with mixed time delays

邹聪 重庆交通大学

This paper discusses the H_∞ state estimation issue in regard to Markovian jumping neural networks (MJNNs)

under the scheduling of the Round-Robin protocol (RRP). The model takes into account mixed time-delays, sensor nonlinearities and exogenous disturbances, making it relatively general and comprehensive. The transmission of MJNNs signals invoked a communication scheme in which the RRP is used for the data transmissions in order to avoid undesirable data collisions. Protocol-dependent state estimator modeling of a hybrid switching system with mixed time delays and disturbances is designed for the first time to achieve asymptotic tracing for the neuron state. Using the Lyapunov stability theory and several asymptotic methods, sufficient conditions for guaranteeing the asymptotic stability of the state estimation are established under the constraint of H_∞ performance. By employing a combination of matrix analysis techniques, the estimator gain matrices are calculated by the feasible solutions to the linear matrix inequalities (LMIs). Finally, a numerical example and related simulations demonstrate the validity of the proposed model.

SaB09　　15 : 15 – 17 : 15

腾讯会议：882-155-755

模式识别

主持人：段法兵　　青岛大学

主持人：孙晓荣　　北京工商大学

➢ SaB09 - 1　　15 : 15 - 15 : 30

[67] 基于阈值网络的自适应随机共振极限学习机

陈泽嘉　　青岛大学
段法兵　　青岛大学
白赛娅　　青岛大学
李伟进　　青岛大学

由于硬件实现的简易性和设计的低复杂度，阈值型神经网络一直是一类具有实际应用价值的神经网络。然而，由于阈值型激活函数存在不可微和零导数值，所以基于梯度的后向传播学习算法不能直接用于训练此类网络。为了克服这一局限性，本文提出了一种阈值神经网络的混合训练算法，该算法有两个优点：一是通过改进神经网络的结构，使得网络通过自适应随机共振机制增强了在线学习能力；二是利用极限学习机算法使阈值网络获得了较好的泛化性能。函数拟合、回归分析和数据集分类的实验结果证明了本文所提出的混合训练算法的高效性和可实现性，也进一步证实了人工噪声注入在阈值神经网络中的有益作用。

➢ SaB09 - 2　　15 : 30 - 15 : 45

[101] 基于便携式近红外光谱仪的花生冻伤品质无损检测研究

高翔　　北京工商大学
吴静珠　　北京工商大学

花生是我国重要的食、油两用经济作物和传统的大宗出口农产品。目前我国已成为世界上最大的花生生产国和消费国，在全球花生进出口贸易中占据着重要地位。花生的冻伤会导致花生出油率明显下降，严重影响花生品质。本文采用近红外光谱技术，结合便携式近红外光谱仪对脱壳样品进行无损检测，实现对花生冻伤程度的探测。使用 DLP 光谱模块搭配遮光附件对花生的吸光度数据进行采集，形成 900-1700nm 波段内吸光度数据集。分别使用归一化、标准化、中心化、MSC、SNV、一阶导数的预处理手法对数据进行预处理，并对处理后的数据基于 SVM 算法进行模型的建立。研究结果表明，经过 MSC 预处理后的数据所建立的模型预测准确率最高，具有更好的预测能力。同时，实验所用的近红外光谱仪依靠其小巧、便携、对环境要求低的优点，为农业生产环节实现无损、快速检测奠定了基础。

➢ SaB09 - 3　　15 : 45 - 16 : 00

[68] 基于随机共振的阈值网络超参数在线学习

李伟进　　青岛大学
段法兵　　青岛大学
白赛娅　　青岛大学
陈泽嘉　　青岛大学

针对由不可微激活函数组成的前馈阈值神经网络的训练，噪声注入方法形成了一个基于随机共振的阈值网络，该网络可由各种基于梯度的优化器进行优化。注入噪声的引入将噪声水平扩展了所设计的阈值网络的参数空间，但这样导致损失函数的高度非凸优化。因此，分别考虑网络权值和噪声水平的超参数在线学习过程成为一项具有挑战性的任务。结果表明，Adam 优化器作为随机梯度下降的自适应变量，有效地训练了基于随机共振的阈值网络，显示了其优越的学习能力。实验结果表明，由 Adam 优化器训练的阈值网络在函数逼近和图像分类方面的性能有显著提高。

➢ SaB09 - 4　　16 : 00 - 16 : 15

[111] Study on cottonseed plumpness based on terahertz time-domain transmission imaging technology

李阳　　北京工商大学

吴静珠 北京工商大学

Cottonseed plumpness (the degree to which the cotton kernel fills the space in the seed coat) has a significant impact on the emergence, vigor, maturity and yield of cotton. In this paper, terahertz time-domain transmission imaging technology, combined with a variety of image reconstruction methods and image processing algorithms, is used for non-destructive testing of shelled samples to realize the exploration of cottonseed fullness. Use the TeraPulse4000 and transmission imaging accessories to scan the terahertz spectrum image of a whole cotton seed with a resolution of 0.2mm, and compare time slice/frequency domain slice imaging, time slice/frequency domain differential imaging, maximum/minimum flight The state of grain imaging under multiple reconstruction methods such as time imaging and peak-to-peak imaging, found that time slice/frequency domain slice imaging, time slice/frequency domain differential imaging, peak-to-peak imaging of intact kernels with shells The imaging shows the outline of the sample, and peak-to-peak imaging and frequency domain slice imaging within 0.5~0.8THz can show the external outline of the sample and the internal state of the grain. Using the peak-to-peak reconstruction method, the terahertz image can be used to preliminarily determine the shape and size of the cotton husk and cotton kernel. The terahertz image of the cotton seed is filtered by the morphological filtering algorithm, and the diamond-shaped structural element with a side length of 3 is used as the check image Perform an expansion, and then calculate the external gradient of the image to complete the filtering; use the Otsu method and K-means clustering algorithm to segment the filtered image, and calculate the number of pixels between the cotton kernel and the cotton husk to obtain the cotton seed Fullness. The research results show that the terahertz time-domain transmission imaging technology highlights the different information of the grain under different image reconstruction methods, laying the foundation for the subsequent establishment of the non-destructive inspection model of the inner quality of the cottonseed with the shell. At the same time, the terahertz imaging technology also helps the shell seeds. Quality provides a new evaluation program.

➢ SaB09 - 5 16 : 15 - 16 : 30

[35] 一种多视角的通过异质图嵌入的科研论文分类方法

吕怡琴 国防科技大学
谢正 国防科技大学

学术论文的持续增长使科研人员难以在短时间内精准定位相关论文，因此对论文进行准确分类有利于提高搜索效率。以往的科研论文分类方法通常只基于论文内容或引文文献，仅考虑单个方面使得分类准确率难以得到大幅提升。本文同时考虑二者，提出了一种多视角的通过异质图嵌入的科研论文分类方法，将论文作为节点，将论文之间的语义相似性和引用关系作为边，由此构建由两种类型的边组成的异质图；然后利用对比学习的方法将异质图中的节点嵌入到向量空间；最后将论文节点对应的向量输入到分类器。本文在三个科研论文数据集上进行实验，结果表明，我们的方法较只考虑单视角的方法，分类准确率提高至少 5%以上，验证了我们方法的有效性。

➢ SaB09 - 6 16 : 30 - 16 : 45

[57] Transformer and CNN Fusion Classification Method for Building Structural Health Monitoring

苏婷立 北京工商大学
李健 北京工商大学
金学波 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学

As one of the best methods of big data processing and analysis at present, deep learning can use the structural response data captured by distributed sensors deployed in buildings to learn independently and analyze the changes of material parameters and geometric characteristics of internal structures, to evaluate the safety and stability of building structural facilities. Effective structural health monitoring can provide a reliable basis for decision-making, which plays a vital role in ensuring building structural safety. In this paper, a 20-story steel structure building simulation model is established, and the dataset of earthquake response of each floor structure of the building is generated. Aiming at the limitation of existing deep learning models in data feature mining, which leads to unsatisfactory classification accuracy, we propose a dual-model fusion

framework based on Transformer and convolutional neural network, which extracts damage-sensitive features from data from time dimension and space dimension respectively, and these features play an important role in improving the accuracy of structural health monitoring. Finally, the improved linear weighted fusion method is used to fuse the two models, and the weight of the single model is dynamically adjusted to obtain the best evaluation result. Ten other deep learning models are compared through experiments using the generated dataset. The results show that the evaluation accuracy of this model is better than that of other models, and the accuracy of damage state identification can reach 94.93%. It provides an effective way to use the deep learning method to solve the problem of structural health monitoring.

➢ SaB09 - 7 16 : 45 - 17 : 00

[98] 拉曼光谱技术快速检测专用煎炸油极性组分

孙晓荣 北京工商大学
田密 北京工商大学
刘翠玲 北京工商大学
吴静珠 北京工商大学

为能够快速、无损检测专用煎炸油的极性组分含量，采集不同煎炸时间下煎炸油样本的拉曼光谱图。为建立稳定性高、误差小、精度高的模型，研究不同预处理方法对模型效果的影响，建立相应的偏最小二乘回归模型以选择最优的光谱预处理方法。结果表明：标准正态变换处理后的偏最小二乘模型最优，预测均方根误差（root meansquare error of prediction，RMSEP）为 1.18，决定系数 R2 为 0.9404。其次，将标准正态变换处理后的光谱数据分别建立误差反向传播（error back propagation，BP）算法和径向基函数算法神经网络模型，通过比较稳定性以及误差大小，得出采集到的拉曼光谱经过标准正态变换处理后采用 BP 神经网络建立的模型效果最好，RMSEP 为 0.0326，R2 为 0.972。该方法可以用作专用煎炸油极性组分的快速分析。

➢ SaB09 - 8 17 : 00 - 17 : 15

[52] SAR image despeckling based on variance constrained convolutional neural network

郑彤 北京工商大学
陈嘉仑 北京工商大学
李聪 北京工商大学

Despeckling is always used to mitigate the inherent speckle noise in synthetic aperture radar (SAR) images. It could benefit SAR image classification and other applications. Recently, with fast development of deep learning, the despeckling method based on convolutional neural network (CNN) has been proposed. One of significant distinctions between speckle noise and ground truth is their statistical characteristics. Therefore, this paper brings attention to the improvement of loss function in the CNN based SAR despeckling processing. The new loss function in the proposed method is composed of the squared -norm and the total variance of estimated noise. The first term of overall loss function is the per-pixel Euclidean loss term as usual, which reflects difference between estimated noise and label. Introduced second term represents the total variance of estimated noise. In order to decrease variance of estimated noise, it is set as reciprocal of variance and drives the learning of network to produce the result with more dispersion. In experiments, four X-band SAR images are used to verify the effectiveness of proposed method. Synthetically speckled images are then obtained by using original SAR images and Gamma distributed noise model. Based on three typical assessment metrics of SAR image quality, i.e., mean squared error (MSE), signal-to-noise ratio (SNR) and peak signal-to-noise ratio (PSNR), despeckling performance of the proposed method is compared with that of the same network architecture but with only Euclidean loss term based loss function. It indicates that the proposed method is not only independent of background image in training, but also outperforms classical SAR despeckling CNN by using the variance constraint. For example, after despeckling by these two networks to synthetically speckled images under trees background, there are MSE reductions of 0.0381 and 0.0565, SNR promotions of 9.6335dB and 19.7895dB, and PSNR advances of 4.2455dB and 11.1567dB, respectively.

SaB10 15 : 15 – 17 : 15
腾讯会议：159-721-751
模式识别

主持人：李阳 北京工商大学
主持人：邢素霞 北京工商大学

➢ SaB10 - 1 15 : 15 - 15 : 30

[125] 基于 Tikhonov 正则化和随机共振的阈值网络泛化性能研究

白赛娅 青岛大学
段法兵 青岛大学
李伟进 青岛大学
陈泽嘉 青岛大学

在前馈阈值神经网络中注入人工噪声，使得前馈阈值神经网络具有可训练性，还将损失扩展为噪声水平和网络权值的多维函数。这结构构成一个基于自适应随机共振的阈值网络，其中噪声水平可以自适应收敛到非零的最优值，从而可以在整体参数空间中找到一个“好”的最小损失。我们从理论上证明了注入噪声对阈值网络训练具有广义 Tikhonov 正则化的作用。回归和分类问题的实验表明，引入训练良好的噪声可以提高阈值网络的泛化能力。在阈值网络中注入噪声的可行性表明了自适应随机共振在机器学习中的重要应用。

➢ SaB10 - 2 15 : 30 - 15 : 45

[118] 基于卷积神经网络和高光谱成像的花生冻伤无损鉴别

崔程 北京工商大学
吴静珠 北京工商大学

花生是我国重要的食、油两用经济作物。2020-2021 年，我国花生产量达 1707 万吨，占世界花生年产量近 1/3。目前我国已成为世界上最大的花生生产国和消费国，在全球花生进出口贸易中占据着重要地位。但是花生在收获、运输、储藏和加工过程中极易受环境温湿度变化出现冻伤现象。冻伤会导致花生出油率明显下降。本文提出了一种一维卷积神经网络(CNN)，对花生进行冻伤鉴别，讨论了不同预处理、不同 CNN 参数对鉴别准确率的影响，并对使用 CNN 方法建模与 K-近邻法(KNN)、支持向量机(SVM)建模进行对比。结果表明，均值中心化、标准化、标准正态变量变换、SG 一阶导-MSC 后的分类准确率有较大的提高，经把 SG 一阶导-MSC 处理的光谱数据在大多数情况下取得最佳分类结果；具有较大尺寸的卷积核在光谱上滑动卷积的跨度较大，能有效提取光谱曲线的模式特征，以及使用 3 层卷积的结构能有效提升花生冻伤的鉴别准确率；对于分类模型来说，CNN 的性能明显优于两种机器学习方法，可以提供更优秀的分类效果，训练集分类准确率达到了 85.88%，测试集准确率达到了 82.00%。综上所述，CNN 结合高光谱技术有望实现单粒花生冻伤的高通量、无损鉴别，可为花生油及其他花生制品的食用安全提供保障。

➢ SaB10 - 3 15 : 45 - 16 : 00

[251] Fine-grained pests & diseases recognition via Spatial Fea-ture-enhanced attention architecture with high-order pooling representation for Precision Agriculture Practice

孔建磊 北京工商大学
王宏兴 北京工商大学
杨成才 北京工商大学
Xuebo Jin 北京工商大学
苏婷立 北京工商大学
白玉廷 北京工商大学

With the development of advanced information and intelligence technologies, precision agricul-ture has become an effective solution to monitor and prevent crop pests & diseases. However, pest & disease recognition in precision agriculture applications is the fine-grained image classification task essentially, which aims to learn effective discriminative features that can identify the subtle differences among similar visual samples. It is still challenging to be solved for existing standard models troubled by oversized parameters and low accuracy performance. Therefore, this paper proposes a feature-enhanced attention neural network (Fe-Net) to handle the fine-grained image recognition of crop pests & diseases in innovative agronomy practices. This model is established on the basis of an improved CSP-stage backbone network, which offers massive channel-shuffled features in various dimensions and sizes. Then, a spatial feature-enhanced attention module is added to exploit the spatial interrelationship between different semantic regions. Finally, the proposed Fe-Net employs a higher-order pooling module to mine more high-representative features by computing the square root of the covariance matrix of elements. The whole architecture is efficiently trained in an end-to-end way without additional manipulation. With comparative experiments on CropDP-181 Dataset, proposed Fe-Net achieves the Top-1 Accuracy up to 85.29% with the average recognition time of only 71ms, outperforming other existing methods. More experimental evidence demonstrates that our approach obtains a good balance between model’s performance and parameters, which is more suitable for the practical deployment in precision

agriculture art applications.

➢ SaB10 - 4 16 : 00 - 16 : 15

[250]Deep-stacking network approach by multisource data mining for hazardous risk identification in IoT-based intelligent food management systems

孔建磊 北京工商大学
杨成才 北京工商大学
Xuebo Jin 北京工商大学
苏婷立 北京工商大学
白玉廷 北京工商大学

Risk identification and traceability system (RITS) is not only vital for maintaining the safety and sustainable of high-quality food supply, but also provides important support to help increase consumer satisfaction and thereby promote the efficiency and income of related food enterprises with reducing call losses and unnecessary waste in China. With the rapid development of innovative industrial information technologies, numerous studies have focused on applying Internet of Things (IoT), artificial intelligence and cloud analysis to promote the efficiency and sustainability of RITS for preferable food safety guarantee in supply chains. This paper presents a new approach for hazardous risk identification in food safety management by utilizing deep-stacking network method and data mining technology, which rely on Internet of Things to timely monitor massive multi-source bio-signals of the whole food supply chain. The aim of proposed method is to help managers and operators in food enterprises to find accurately risk levels of food security in advance, and provides and to provide regulatory authorities and consumers with potential rules for better decision making, thereby maintaining the safety and sustainability of food products supply. The case analysis of collected food bio-signal data is implemented to illustrate that the proposed deep-stacking network outperforms state-of-the-art methods in terms of accuracy and stability, providing an effective approach for risk level identification and offering real-time visibility of traceability rules in the food supply chains, which can help in enhancing the RITS performance for assuring food supply chain security and attaining effective multiple cooperation between regulators, enterprises and consumers.

➢ SaB10 - 5 16 : 15 - 16 : 30

[112] Study on rapid nondestructive identification of rice varieties based on THz-ATR Technology

李阳 北京工商大学
吴静珠 北京工商大学

The quality and yield of rice are closely related to its own varieties, so rice variety identification is a key link in the process of agricultural breeding. Currently, the commonly used rice variety identification techniques, such as morphological identification, (deoxyribonucleic acid) DNA fingerprinting and (Simple Sequence Repeats) SSR molecular marker identification, are time-consuming and inefficient. In this study, Terahertz attenuated total reflection technique (THz-ATR) was used to collect the 0~359.97 cm-1 spectra of 8 varieties of rice seeds, and the refractive index spectra and absorption spectra of the sample set were calculated by optical parameters. After 3-point moving window mean optimization, breed recognition models based on support vector machine (SVM) algorithm were established respectively. The results show that the prediction accuracy of SVM model based on absorption coefficient is 98.5 %, and that of SVM model based on refractive index spectrum is 89 %. This study also demonstrated the preliminary feasibility of applying terahertz attenuated total reflection spectroscopy to rice variety identification, and compared the modeling results of different optical constants to seek an efficient and nondestructive rice variety identification method, which is expected to provide a reference for rapid rice variety identification.

➢ SaB10 - 6 16 : 30 - 16 : 45

[138] 基于太赫兹时域光谱的花生冻伤无损鉴别

吕钟鸣 北京工商大学
吴静珠 北京工商大学

在我国东北地区,花生收获期如收获不及时或遇初霜期提前,很容易发生冻害,降低花生品质,导致花生种子发芽率大幅降低或丧失,造成留种困难花生。同样，花生在收获、运输、储藏和加工过程中也极易受环境温湿度变化出现冻伤、霉变等现象。花生作为油料作物，冻伤会导致花生出油率明显下降。但是，我国现行标准花生冻伤检测标准和方法，采用湿化学方法，大都存在试样破坏性、操作复杂、检测周期长等弊端。针对目前冻伤花生在无损检测方面存在

定性难 的问题，提出一种基于衰减全反射(ATR)式太赫兹时域光谱(THZ-TDS)技术的冻伤花生快速、无损鉴别分析方法。首先采集不同实验样本的的太赫兹时域光谱图，选取有效信号波段提取到光学常数,经预处理算法校正后的光学常数,结合多种化学计量学方法建立定量分析模型,实现快速、无损冻伤花生检测。采用 Teraview 公司生产配有 ATR 检测模块采集 THZ-TDS 样本信号，根据 THZ-TDS 谱图信号特征筛选有效波段用于建模分析。通过快速傅里叶变换得到频域信号并从中提取所需光学常数。采用 S-G 卷积平滑对数据进行预处理，去除干扰信号。运用 K-S 算法划分样本的训练集和测试集，结合 SVM 算法建立分析模型，对花生冻伤进行识别。实验结果表明,SVM 算法的分类准确率可达 99.5%。由此可知，基于太赫兹时域光谱的花生冻伤无损检测是完全可行的，可以有效解决受到低温影响的花生品质问题

➢ SaB10 - 7 16 : 45 - 17 : 00

[175] ViT 预训练模型的胸腔 X 线影像多标签分类

邢素霞 北京工商大学
鞠子涵 北京工商大学
刘子骄 北京工商大学
王瑜 北京工商大学
范福强 北京工商大学

目的 因公开医学影像数据较少，基于计算机的胸腔 X 线影像疾病辅助诊断误诊率高，准确率低。拟在视觉 Transformer（Vision Transformer，ViT）预训练模型的基础上，通过迁移学习方法，实现胸腔 X 线影像辅助诊断和疾病多标签分类，提高诊断准确率和效率。方法 选用带有卷积神经网络（Convolutional Neural Network，CNN）的 ViT 模型，其在超大规模自然图像数据集中进行了预训练；通过微调模型结构，使用预训练的 ViT 模型参数初始化主干网络，并迁移至胸腔 X 线影像数据集 IU X-Ray 中再次训练，实现疾病多标签分类。结果 对预训练的 CNN 模型与 ViT 模型，以及 ViT 迁移学习前、后模型平均 AUC 得分进行对比分析实验，结果表明，预训练 ViT 模型平均 AUC 得分为 0.774，与 CNN 模型相比提升 0.035 至 0.189；不使用迁移学习的 ViT 模型精度和训练效率大幅下降，平均 AUC 得分仅为 0.566，比迁移学习后降低 0.208。结论 与 CNN 模型性比，ViT 模型胸腔 X 线影像的多标签分类性能更强，且迁移学习可以提升 ViT 模型在小型数据集中的分类性能和模型泛化性，并大幅降低训练成本。消融实验证明，包含 CNN 结构的 ViT 模型能重点关注有意义的区域，高效地从胸腔 X 线影像中获取视觉特征，提升多标签分类准确率。

➢ SaB10 - 8 17 : 00 - 17 : 15

[182] 基于高光谱技术的花生种子内部霉变检测方法研究

张倩 北京工商大学
吴静珠 北京工商大学

花生是一种重要的粮食作物，具有非常高的经济和营养价值。由于花生富含大量水分、脂肪和蛋白质等营养成份，在贮藏，销售以及加工等过程中极易受温度和湿度等因素的影响而发生霉变，误食霉变花生会对人体造成极大危害。目前，绝大多数花生加工企业，主要依靠人工观测判断花生是否发生霉变，该检测方法易受主观因素影响，且由于内部霉变花生表面颜色与正常粒几乎没有差别，肉眼难以鉴别。此外由于花生样本数量巨大，因此通常采用抽样法进行整体质量评估，以至于无法做到对每个样本都进行检测分析。因此寻找一种能够客观、便捷、无损的检测花生种子霉变的方法具有重要意义。高光谱成像技术具有“图谱合一”的优点，不仅具有图像信息，还具有光谱信息。可以综合被检测样本的图像和光谱信息，从而从样本的外观特性和内部品质两个方面进行综合分析，因此在农产品检测领域，该技术较计算机视觉技术和近红外光谱技术更加具有优势。花生易受环境影响发生霉变，内部霉变花生表面颜色与正常花生几乎没有差别，肉眼很难鉴别，为了能够快速、无损地检测花生种子霉变，本文研究了一种基于高光谱技术和模式识别方法相结合的霉变花生识别方法。采用近红外高光谱成像系统采集花生图像及光谱信息(波段 968nm-2340nm)。利用主成分分析（Principal Component Analysis，PCA）方法，对高光谱数据进行降维，在前两个主成分的二维得分图中背景像素点和花生种子像素点呈现不同聚类，基于此，可将背景像素点直接剔除；利用单波段阈值分割和掩膜运算，切割得到单粒花生种子高光谱图像，提取该图像内所有像素点的平均光谱作为此样本的光谱数据；首先利用矢量归一化、移动窗口平滑法、SG 卷积平滑和二阶导数差分等算法对提取的全波段光谱数据进行预处理，以消除噪声干扰；在预处理的基础上利用蒙特卡洛算法（Monte-Carlo, MC）结合无信息变量消除算法（Uninformative Variable Elimination, UVE）对光谱进行特征提取，降低数据维度，提高运行速度；最后建立支持向量机

（Support Vector Machine，SVM）识别模型。实验结果表明，采用全波段光谱信息建立的霉变花生识别模型的平均准确率可达到 96%，分析结果可知，利用近红外高光谱成像技术的全波段光谱信息识别霉变花生是可行的。尽管全波段光谱信息取得了较好的结果，但高光谱成像设备较为昂贵、光谱信息数据量较大、模型计算速度较慢无法满足现场检测的要求，因此，采用 MC-UVE 算法对全波段光谱数据进行特征波段的选择，可使波段数量由 246 维降低到 10 维，从而提高系统的可行性和运算速度。实验结果表明,采用 10 个特征波段建立的判别模型的平均识别率为 93%，分析结果可知，尽管采用 10 个特征波段准确度略有下降，但维度降低了 24 倍，大大提高了系统实时性，降低了成本。以上实验结果表明，基于近红外高光谱成像技术的内部霉变花生检测在提高运算速度的同时也保证了识别准确率，为后期霉变花生快速检测设备的开发提供了有效的依据。

SaB11　　15 : 15 – 17 : 15

腾讯会议：680-545-508

模式识别与经济系统分析

主持人：徐一鸣　　南通大学

主持人：张云丰　　安徽工程大学

➢ SaB11 - 1　　15 : 15 - 15 : 30

[825]Temperature Prediction of Battery Energy Storage Plant Based on EGA - BiLSTM

蒋凌　　南通大学

顾菊平　　苏州科技大学

张新松　　南通大学

Battery energy storage plants (BESPs) are more and more important in the future power systems. The industry desires a credible temperature prediction method to deliver a safe temperature range of the BESPs. This paper develops a bespoke methodology that combines the elitist preservation genetic algorithm (EGA) and bidirectional long-short term memory network (BiLSTM) to deliver accurate battery temperature predictions. First, this paper applies the EGA to obtain the optimal segmentation strategy of time-series data. Second, the BiLSTM is used to predict both the highest and the lowest temperature of the battery pack within the energy storage power plant. In this step, an improved loss function is proposed to improve the prediction accuracy of the BiLSTM. This paper applies the real operation data, from January to February 2020, of one certain BESP to justify the developed an EGA-BiLSTM method. Case studies reveal that compared to the LSTM and the Light GBM, the developed method significantly reduces the prediction error by 12% and 26%, respectively. Lastly, we also conduct ablation experiments to prove that the EGA-BiLSTM method also accommodates short-term scenarios, where the R2_score of short-term temperature prediction for BESP could achieve up to 0.86. All these can provide an effective method of temperature prediction, ensuring safe operation of the BESPs.

➢ SaB11 - 2　　15 : 30 - 15 : 45

[780]基于先验张量近似的高光谱异常目标检测

李禄　　北京信息科技大学自动化学院

高光谱异常检测一直以来是高光谱图像重要的应用方向和热点研究问题。高光谱图像作为图谱合一立方体数据，本质上可以表示为三阶张量，其具有一些光谱和空间的先验信息。 利用这些先验信息，本文提出了基于先验张量近似的高光谱异常检测方法，该方法首先将原始数据分解为背景张量和异常张量。在背景张量中，利用低秩先验对光谱维度进行约束，采用截断核范数中进行正则化，并进一步采用分段平滑先验对其空间维度上的进行约束和正则化。另一方面，对于异常张量，沿谱维展开采用空间组稀疏先验进行约束和正则化。实验结果在几个公开数据集上进行了实验和验证，实验表明所提出的算法在精度上优于当前主流的高光谱异常检测算法。

➢ SaB11 - 3　　15 : 45 - 16 : 00

[318]基于随机动态优化自编码器的数据降维

任昱昊　　青岛大学

许丽艳　　青岛大学

段法兵　　青岛大学

自编码器在数据降维等无监督学习任务中有广泛应用。经典的自编码器存在权重初值敏感、易发生梯度弥散等稳健性问题。我们受阵列自适应随机共振方法的启发，提出了随机动态优化激活函数。对于神经网络中的每个目标节点，随机动态优化激活函数中存在二个可学习参数，在神经网络的训练过程中可自适应调整参数取值。该激活函数可视为经典硬限幅激活函数的光滑化推广，具有更稳健的梯度传导特性。我们利用受限玻尔兹曼机对自编码器的初始权重进行了求解，在此基础上使用随机动态优

化神经网络模型对目标数据进行降维编码和升维解码。结果显示在 mnist 和 olivetti 等数据集上，随机动态优化自编码器的损失函数更低，图像解码性能更优，并具有更高的稳健性。

➢ SaB11 - 4 16 : 00 - 16 : 15

524 数字时代下平台经济的反垄断规制研究

魏继媛 四川省社会科学院

当前中国平台企业存在寡头竞争、跨界经营等特征，平台经济中存在的垄断问题不断威胁平台企业的创新发展和平台用户的合法权益，因此探究平台经济的反垄断规制刻不容缓。通过分析中国平台经济的发展现状和相关政策文件，本文可分为两部分来探讨平台经济的反垄断规制，第一，基于系统演化论的观点，对比传统市场的垄断定义，结合数字时代背景下，系统分析中国平台经济的垄断形成机制；第二，基于系统调控论的观点，旨在通过监管部门与平台企业的合作博弈、平台用户与平台企业的反馈调控、平台企业之间的适应协同和监管部门之间的运筹优化，结合包容审慎的监管原则，使中国平台经济实现可持续健康发展，从而提升中国在全球平台经济领域的竞争力。

➢ SaB11 - 5 16 : 15 - 16 : 30

664 能见度对地下建筑个体及小群体疏散速度影响的研究

王一 上海理工大学
房志明 上海理工大学

近年来，随着城市轨道交通的建设和发展，越来越多的行人选择城市轨道交通作为城市内出行的主要交通工具。城市轨道交通车站作为乘客集散的重要场所，其运营过程中遇到火灾等紧急情况下人员的安全疏散尤为重要。楼梯在城市轨道交通车站发生火灾等紧急情况时发挥着重要作用，火灾和由此产生的烟雾导致能见度低，这可能会影响居住者的移动速度。本文旨在研究在正常和视力受损条件下，个体和小群体的楼梯疏散性能。在四种能见度条件下进行楼梯个体及小群体向上疏散实验，共有 96 名受试者。分别对楼梯梯段及平台上实验人员的疏散速度、疏散行为和小群体特性进行了分析讨论。研究发现，楼梯梯段上的疏散速度整体高于平台，正常能见度条件下差异较大，低能见度情况下差异较小。随着能见度的降低，个体的下降速度急剧下降，小群体的下降速度呈现相对较小的下降趋势。在正常能见度下，群体行为对疏散性能有负面影响，群体速度收敛到群体中最慢的成员的速度。在低能见度情况下，小群体的运动速度比个体更快。

➢ SaB11 - 6 16 : 30 - 16 : 45

832 Research on Driver Status Recognition System of Intelligent Vehicle Terminal Based on Deep Learning

徐一鸣 南通大学
彭玮 南通大学
王栗 南通大学

Automobile safety driving technology is a hot topic in today's society, which is very significant to the social transportation system. Vehicle driving behavior monitoring is the foundation and core of safe driving techniques. The research on existing vehicle safety technology can not only improve the understanding of current safe driving research progress, but also provide reference for future researchers. This paper proposes a state recognition system based on a three-dimensional convolutional neural network, which can identify several improper states frequently encountered by drivers during driving, including drinking, making phone calls, and smoking, and can also issue alarm interventions. The system takes the collected continuous video frame information as the input of the three-dimensional convolutional network, carries out multi-level feature extraction and spatio-temporal information fusion, and identifies the driver state according to the extracted spatio-temporal features. The state is judged by the facial feature points of the video stream, and the design of the video surveillance driver state recognition system is completed. Then, the driver status recognition is improved and optimized, and finally, the actual deployment of the driver status recognition system on the mobile terminal is completed. A large number of experimental results show that the driver status recognition system proposed in this paper has achieved upper identification accuracy.

➢ SaB11 - 7 16 : 45 - 17 : 00

529 Research on Eddy Current Image Denoising of Titanium Plate based on Sparse Representation K-SVD

张艺丹 昆明理工大学

Eddy current testing of titanium plates is often affected by environmental noise, and the imaging quality of detection images containing noise is not good. Therefore, the quality of denoising of detection images often directly affects the effectiveness and reliability of

subsequent image processing. To solve the above problems, this paper focuses on the application of dictionary learning in images and proposes research on eddy current image denoising of titanium plate based on sparse representation k-SVD. The detection image containing noise is obtained through K-SVD learning dictionary to training algorithm, and the dictionary corresponding to each image block is obtained. Iteration is repeated until the sparsest over-complete dictionary is achieved. In this way, the sharpness of the image and details such as geometric edge texture are well preserved. Experimental results show that the proposed method can effectively filter Gaussian white noise in images with different SNR and the denoised image can highlight the edge and details of the image better.

➢ SaB11 - 8 17 : 00 - 17 : 15

[858] 考虑政府双重补贴与消费者双重偏好的双渠道供应链决策研究

张云丰 安徽工程大学

在单一制造商和单一零售商组成的双渠道供应链中，考虑消费者存在双重消费偏好，基于制造商领导的 Stackelberg 博弈，建立政府无补贴、政府减排补贴、政府消费补贴及政府双重补贴 4 个决策模型，分别得到其均衡状态下的产品定价、碳减排、系统利润及社会福利并进行比较，讨论政府的补贴政策和消费者的偏好类型对供应链决策变量的影响。结果表明，无论政府采用减排补贴还是消费补贴，都能够有效激励制造商提高碳减排水平，提高供应链整体绩效；政府双重补贴政策下的社会福利并不总是优于单一补贴政策，且存在低于政府无补贴下的社会福利的情形；若政府只实施单一补贴政策，则政府消费补贴政策的效果往往优于政府减排补贴。

SaB12 15 : 15 – 17 : 15

腾讯会议：233-866-778

数据挖掘与大数据

主持人：陈谊 北京工商大学

主持人：金学波 北京工商大学

➢ SaB12 - 1 15 : 15 - 15 : 30

[102] A survey on visualization approaches for exploring association relationships in graph data

陈谊 北京工商大学

张清慧 北京工商大学

Exploring relationships in complex datasets is one of the challenges in today's big data era. The graph-based visualization approach, which integrates the advantages of graph analysis theory and visualization technologies and combines machine and human intelligence, has become an effective means for analyzing various relationships in complex datasets. In this paper, we first introduce a graph-based visual analytics model for associated data. Then, we summarize seven typical visualization methods for associated data according to their layout features, including node-link diagram, adjacency matrix, hypergraph, flow diagram, graphs with geospatial information, multi-attribute graph, and space-filling diagram and discuss their advantages and disadvantages. We describe current graph simplification and interaction techniques, including graph filtering, node clustering, edge bundling, graph data dimension reduction, and topology-based graph transformation. Finally, we give some application examples. We also discuss the potential challenges and developmental trends of the research direction.

➢ SaB12 - 2 15 : 30 - 15 : 45

[324] Fuzzy information decomposition incorporated and weighted Relief-F feature selection: When imbalanced data meets incompletion

窦军 上海理工大学

宋燕 上海理工大学

魏国亮 上海理工大学

张亚萌 上海理工大学

Data classification is an important computer task in data analysis, which suffers seriously unknown features, imbalanced class, and incomplete data. However, despite their vital yet practical significance, few results have been made on such three distinct issues. To address this problem, we propose a novel feature selection method for the data subject to incomplete data and imbalanced class, namely, improved fuzzy information decomposition (IFID) incorporated and weighted Relief-F (WRelief-F) feature selection. The main idea of the proposed feature selection method is threefold. (1) The proposed IFID algorithm can deal with the imbalanced class and incomplete data at the same time. (2) In IFID, a new membership function is provided to reflect the influence of the observed data on the missing values appropriately. Based on this establishment, a more delicate information decomposition is adopted to

make a better recovery than the traditional FID. (3) After using IFID, WRelief-F is put forward to take the relationship of the target instance to inter-class instances and the intra-class instances into consideration in a proper manner. Finally, experiments on the seven public data sets are utilized to show the effectiveness and universal applicability of the proposed feature selection algorithm.

➢ SaB12 - 3 15 : 45 - 16 : 00

[55]A Variational Bayesian Deep Network with Data Self-Screening Layer for Massive Time-Series Data Forecasting

金学波 北京工商大学
宫文涛 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学
苏婷立 北京工商大学

Compared with mechanism-based modeling methods, data-driven modeling based on big data has become a popular research field in recent years because of its applicability. However, it is not always better to have more data when building a forecasting model in practical areas. Due to the noise and conflict, redundancy, and inconsistency of big time-series data, the forecasting accuracy may reduce on the contrary. This paper proposes a deep network by selecting and understanding data to improve performance. Firstly, a data self-screening layer (DSSL) with a maximal information distance coefficient (MIDC) is designed to filter input data with high correlation and low redundancy; then, a variational Bayesian gated recurrent unit (VBGRU) is used to improve the anti-noise ability and robustness of the model. Beijing's air quality and meteorological data are conducted in a verification experiment of 24 h PM2.5 concentration forecasting, proving that the proposed model is superior to other models in accuracy.

➢ SaB12 - 4 16 : 00 - 16 : 15

[104] 聚类算法在电动出租车充电站选址中的应用

李雪 山东科技大学
李勍 山东科技大学
孙秋霞 山东科技大学

合理的充电站布局是提高电动汽车市场渗透率的重要举措。本文基于多重、多类型聚类算法的思想，提出了一种广泛适用的电动出租车充电站选址方法。利用海量 GPS 轨迹数据提取电动出租车的停留信息和充电需求，结合研究区域的合理网格化结果，对地域网格分别进行多重聚类和多重多类型聚类，得到充电站的选址结果并进行比较分析。实证分析表明多重多类型聚类算法比多重聚类算法的选址结果更加合理，可以有效延长电动出租车的出行距离，节约驾驶员的时间成本。

➢ SaB12 - 5 16 : 15 - 16 : 30

[64]Broad Echo State Network with Reservoir Pruning for Nonstationary Time Series Prediction

刘文杰 北京工商大学
白玉廷 北京工商大学
金学波 北京工商大学
王小艺 北京工商大学
苏婷立 北京工商大学
孔建磊 北京工商大学

Abstract: The nonstationary time series generates in various natural and man-made systems, of which the prediction is vital for advanced control and management. The neural networks have been explored in the time series prediction, but the problem remains in modeling the data's nonstationary and nonlinear features. Referring to the time series feature and network property, a novel network is designed with dynamic optimization of the model structure. Firstly, the echo state network (ESN) is introduced into the broad learning system (BLS). The broad echo state network (BESN) can increase the training efficiency with the incremental learning algorithm by removing the error backpropagation. Secondly, an optimization algorithm is proposed to reduce the redundant information in the training process of BESN units. The number of neurons in BESN with fixed step size is pruned according to the contribution degree. Finally, the improved network is applied in the different datasets. The tests in the time series of natural and man-made systems prove that the proposed network performs better on the nonstationary time series prediction than the typical methods, including the ESN, BLS, and recurrent neural network.

➢ SaB12 - 6 16 : 30 - 16 : 45

[255] 基于全球视角的“一带一路”沿线国家人口迁移特征及演化趋势

马佳骏 北京师范大学

李小萌 北京师范大学
陈清华 北京师范大学

“一带一路”沿线国家的人口规模和迁移量均超过世界总数的一半，其人口迁移不仅对区域内部，也对世界经济、政治等方面产生深远影响。现有文献往往只关注某个相关国家或若干国家间的人口迁移特征，而没有将研究置于全球人口迁移的大背景之中。本文使用 1960-2020 年 200 个国家的人口迁移数据，基于复杂网络分析方法，发现“一带一路”子网络具有小世界特性和链接的负相关性。此外，通过分析人口迁移骨干网的社团划分结果和社团变化路径，发现该区域的国家普遍具有“抱团性”和“聚集性”。通过网络影响力分析，发现“一带一路”国家在世界人口迁移网络中的影响力相对欧盟较弱，其需要进一步发挥迁移“凝聚力”的优势。

➢ SaB12 - 7 16 : 45 - 17 : 00

[58]Self-supervised Learning for Human Activity Recognition using Sensor Data

苏婷立 北京工商大学
李健 北京工商大学
金学波 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学

Human activity recognition (HAR) involves identifying specific movements of others based on sensor data, which is a challenging time series classification task. However, the accuracy of the current recognition technology is not high due to the deficiency in the ability of mining data features. in addition, the difficulty of labeling sensor data limits the volume of the data set. in this paper, a high-precision human activity recognition method is proposed. This method is based on the self-supervised learning and training method to train the model, uses a new workflow to solve the HAR problem, and evaluates it on the UCI HAR dataset. Our proposed model first generates two views through different degrees of data enhancement and inputs them into the dual-stream fusion encoder for full feature extraction of time and space dimensions. Secondly, the model is optimized by mapping the multi-layer perceptron to the loss space. Finally, the results show that, compared with the traditional method, we use data sets with fewer tags, but achieve better accuracy and performance.

➢ SaB12 - 8 17 : 00 - 17 : 15

[848] 基于手机定位大数据和遥感数据的居民区人口在室率计算

张小咏 北京信息科技大学

人员在室率是地震灾害最终人员伤亡计算的关键要素，也是传统地震人员伤亡评估的难点。手机数据虽然具有非常高的时间分辨率，但其定位精度不能直接判断人员是否在室内。本研究基于对手机定位大数据人员活动规律分析，以张家口市区为例，分析手机定位人群在城市空间上的分布特征和手机定位人群一天 24 h 的活动规律，获得张家口居民区人口变化；利用 Pleiades 卫星遥感数据获张家口城区建筑高度、基准面积等建筑物属性信息，即融合遥感数据在人活动场景环境的属性信息，构建居民区在室率模型，获得居民区人员在室率。结果表明，同一研究区每小时在室率日变化趋势基本一致，在室内率最高值出现在早上 7 点、18 点和 21 点到次日早上 7 点。最低值出现在上午 13 点。

2022 年 11 月 13 日（周日）

SuA01　　13 : 00 – 15 : 00
腾讯会议：660-135-676
数据挖掘与大数据

主持人：邬吉波　　重庆交通大学
主持人：孙秋霞　　山东科技大学

➢ SuA01 - 1　　13 : 00 - 13 : 15

235 基于高阶网络模型的时态社交网络事件检测方法

李翔　　国防科技大学
张雪　　国防科技大学
黄彭奇子　　国防科技大学
赵城利　　国防科技大学
段晓君　　国防科技大学

事件检测是复杂网络研究中最重要的领域之一，旨在识别与社会事件相对应的异常时间点。基于一阶网络模型的传统事件检测方法在描述复杂系统中组件的多变量顺序交互和准确识别时态社交网络中的异常方面很差。在本文中，我们提出了两种基于高阶网络模型的有效方法，即恢复高阶网络算法和创新高阶网络算法，以帮助进行时态社交网络中的事件检测。给定二元序列数据，首先我们利用时间顺序恢复多元序列数据。同时，我们使用逻辑序列开发新的多元序列数据。通过使用高阶网络模型对多元序列数据进行高效建模，得到一些常见的多元交互模式，用于判断社会事件的异常程度。时态社交网络中的实验最终证明了我们方法的显着性能。

➢ SuA01- 2　　13 :15 - 13: 30

329 基于机器学习方法的翼型气动性能分类

林锦星　　中山大学

对翼型库中的翼型按气动性能进行分类，再提取几何特征的正交基，能减少气动优化中几何参数化的变量数，进而提高优化效率。但是，传统方法通过计算翼型库中所有翼型的气动力来实现分类，计算花费较大。本文提出了一种基于机器学习的方法，这种方法只需要计算一部分翼型的气动力，另一部分翼型的气动力使用机器学习方法求出。首先对翼型库进行抽样，计算抽样翼型的气动力，同时将翼型数据使用 CST 方法提取出设计变量，把设计变量作为机器学习模型的输入，气动性能作为标签，经过训练后得到一个能对翼型气动性能分类的机器学习模型，使用该机器学习模型对剩余翼型进行分类，根据预定的气动性能指标，筛选出“优秀”的翼型。实验表明，这种基于机器学习的方法相比于传统方法能大大降低翼型分类的时间，具有一定的应用价值。

➢ SuA01 - 3　　13: 30- 13 : 45

261 基于 K-Means 聚类和路网时空关联性分析的交通速度短时预测

孙秋霞　　山东科技大学
贾秀燕　　山东科技大学
李勍　　山东科技大学

准确的交通速度预测有助于解决交通拥堵问题，为出行者的出行提供指导性的建议。考虑城市路网中相邻路段交通流之间的时空关联性，引入衡量目标道路与相邻道路间短期相关性的时空相关矩阵，并计算时空相关矩阵之间的相似性。利用 K-Means 聚类将历史数据集划分为若干簇，在簇内进行时空关联性分析，分别单独训练不同的预测模型。然后，根据输入数据与不同簇集的相似性，选择相应模型进行预测，结合真实交通数据集评估本文提出的预测方法。实验结果表明，与 ARIMA 模型、PLS 模型和 LSTM 模型相比，该方法在交通速度的短时预测中具有更好的性能。

➢ SuA01 - 4　　13 : 45- 14 : 00

260 基于对比度和共识日的交通速度预测

孙秋霞　　山东科技大学
孙砚琦　　山东科技大学
李勍　　山东科技大学

交通速度预测是智能交通系统中热点研究内容之一，准确预测有助于出行者做出可靠的出行决策。考虑到路网中交通速度变化的时空关联性和规律性，本文提出一种基于对比度和共识日的交通速度预测模型。首先，为捕捉短时内速度的变化趋势，构建对比度模型并根据其值更新历史数据集的速度等级；其次，采用 K-means 方法对更新后的数据集进行聚类，通过 Rand 指数识别出每簇的最佳共识日，并根据其信息预测交通速度；最后，借助 RMSE、MAE 和 ACC 等指标对预测模型进行有效性分析。结果表明：（1）模型预测结果准确率达 93.8%，说明其对交通速度预测问题的具有适用性；（2）与 ARIMA、灰色预测模型、SVR、共识日预测等模型相比，该模型具有更

高的预测准确度。

➢ SuA01 - 5 14 : 00 - 14 : 15

[455]The way to Invest: Trading Strategies Based on ARIMA and Investor Personality

汤骁宇 江苏科技大学
朱琎 江苏科技大学
刘子涵 江苏科技大学
徐思佳 江苏科技大学

In the field of financial investment, accurate prediction of financial market values can increase investor profits. Nowadays, machine learning algorithms are widely used in the field of financial investment. The purpose of this paper is to study the problem of optimal matching of financial investment by using machine learning algorithms combined with finance. And based on the model results, we study the effects of different investor personalities on factors such as expected investment returns and number of transactions. Based on the time-series characteristics of price data, through multi-model comparison, we select ARIMA model combined with particle swarm algorithm to determine the optimal prediction model and introduce the concepts of mean-variance model, Sharpe ratio, and efficient frontier, so as to find the balance point of risk and return. In this study, we use gold and bitcoin price data from 2016-2021 to develop optimal investment strategies and study the impact of investor behavior on trading strategies.

➢ SuA01- 6 14 : 15 - 14 : 30

[493]A generalized difference-based mixed two-parameter estimator in partially linear model

邬吉波 重庆交通大学

In this paper a generalized difference-based mixed two-parameter estimator in partially linear model is presented, when stochastic linear restrictions are assumed to hold. We also discussed the properties of the new estimator and a method to select the biasing parameters is discussed. Finally a simulation study is given to show the performances of the estimators.

➢ SuA01 - 7 14 : 30 - 14 :45

[256] 基于投资者情绪和多重注意力机制的神经网络股票价格预测

张建鑫 山东科技大学
王向荣 山东科技大学

股票价格预测是多元时间序列分析的一个重要研究领域。传统的股票预测通常基于历史市场数据分析,如股票价格、成交额或日收益率等。然而,作为股票市场的主体，投资者的投资情绪也是驱动股票市场多变的重要信息。传统构建情绪指数的方法没有区分不同投资者主体，难以涵盖不同类型的投资者情绪。本文提出一种结合投资者情绪的神经网络模型对股票进行预测。首先从散户、券商和基金公司三个角度构建三类投资者情绪指数，然后提出一种多重注意力机制来构建不同投资者情绪与股票预测相关变量和时间序列之间的关系，并使用长短时记忆网络进行股票预测。实验结果表明，与其他基准预测模型相比，该模型取得了最佳预测精度并对股票预测具有较好的解释力。

➢ SuA01 - 8 14 : 45 - 15 : 00

[334]A weighted fuzzy candlestick model for stock market price prediction

张亚萌 上海理工大学
宋燕 上海理工大学
魏国亮 上海理工大学

Stock markets usually suffer from enormous challenges due probably to their nonlinearity, uncertainty, complexity, and so on. Recently, a fuzzy candlestick model has been proposed, which combines the fuzzy logic and Japanese candlestick theory into a representation to realize the price forecasting for the stock market. However, such a prediction model is conservative to some extent, since it only takes the most similar historical data (i.e., the nearest neighbor information) into account and makes the prediction exclusively by the selected historical data without considering its difference with the current trading day. To address this issue, a novel fuzzy forecasting model, namely weighted fuzzy candlestick model, is put forward in this paper to reflect the influence of historical data on the predicted result in an adequate and proper manner. Firstly, a fuzzy system is established to transfer the raw data of the stock market to the fuzzy candlestick patterns: Rsize and Rpos. Secondly, one nearest neighbor (1NN) algorithm is adopted to find the most similar historical information. Thirdly, the KNN algorithm is utilized to find k nearest neighbors to the current trading day, thereby generating the weighted fuzzy forecasting model for the price prediction. Finally, experimental results demonstrate that the proposed

fuzzy model outperforms the other tested fuzzy models at the prediction accuracy.

SuA02　　13 : 00 – 15 : 00
腾讯会议：243-166-912
大数据与机器学习

主持人：于化龙　　江苏科技大学
主持人：王琦　　江苏科技大学

➢ SuA02 - 1　　13 : 00 - 13 : 15

506 基于收入与消费维度的精准扶贫政策的效应评估

范聪　　重庆交通大学

40 余年的改革开放在为中国带来了举世瞩目的经济增长奇迹的同时也创造了史无前例的减贫成就。本文基于中国家庭金融调查（CHFS 2015、CHFS 2017）资料，运用断点回归的方法，基于收入与消费维度深入探讨了精准扶贫政策的实施效应。相较于其他居民，贫困家庭的收入、消费、资产累积在 2015-2017 两年内分别平均增加了 18343 元、728 元、83676 元，恩格尔系数平均下降 2.7%，结果表明该政策能切实有效地帮助贫困居民提高生活质量、摆脱贫困。

➢ SuA02 - 2　　13 : 15 - 13 : 30

535PLVI-CE：一种复合不确定性和多样性度量准则的多标记主动学习算法

顾妍　　江苏科技大学
于化龙　　江苏科技大学
高尚　　江苏科技大学

在多标记学习中，每个样本可能同时与多个类标相关联，对其进行标注需要付出高昂的代价。主动学习可以通过查询少量样本学习一个鲁棒的分类模型，进而达成降低标注成本的目的。多标记主动学习的主要挑战是如何设计一个有效的查询策略，从而衡量未标注样本在所有标签上的统一信息。本研究结合不确定性和多样性测度共同构建了一个名为 PLVI-CE 的查询策略，其中不确定性由未标注样本在两种预测标签向量上的不一致性度量，多样性则由未标注与已标注集样本之间的概率估计的平均差异来进行度量。采用 LW-ELM 作为基分类器，能够在主动学习的训练模块中有效解决类别不平衡问题。通过大量实验结果，表明了所提出的 PLVI-CE 算法的有效性，可行性与优越性。

➢ SuA02 - 3　　13 :30- 13 : 45

601 基于单类三角全局对齐核极限学习机的无人机状态数据异常检测

胡飞沙　　江苏科技大学
王琦　　江苏科技大学
于化龙　　江苏科技大学
高尚　　江苏科技大学

无人机应用广泛，满足了军事和民用方面的众多需求。随着应用场景的不断丰富和广泛拓展，无人机自身的安全性也不断受到挑战。 为了应对这一挑战，我们提出了旨在检测无人机自身异常数据的算法，以提高无人机的安全性。我们使用了单类核极限学习机（OCKELM）来检测无人机数据的异常情况。默认情况下，OCKELM 使用径向基（RBF）核函数作为模型的核函数。为了提高 OCKELM 的性能，我们选择了三角全局对齐核函数（TGAK）来代替 RBF 核函数，此外引入了快速独立分量分析（FastICA）算法来对无人机数据进行重构。基于上述改进，我们提出了新的异常检测方法 FastICA-TGAK-OCELM。该方法最终通过 UCI 数据集进行了验证，并对航空实验室故障与异常（ALFA）数据集进行检测。实验结果表明，该方法与其他方法相比精度提升了 30%以上并有效地检测出点异常。

➢ SuA02 - 4　　13 : 45 - 14 : 00

534PDE-SMOTE：一种基于概率密度估计的 SMOTE 过采样算法

还章军　　江苏科技大学
于化龙　　江苏科技大学
高尚　　江苏科技大学

类别不平衡学习是机器学习领域的研究热点之一，在诸多现实的应用领域中均发挥着重要的作用。SMOTE 过采样是最为常用的一种类别不平衡学习技术，可有效缓解随机过采样方法所带来的过拟合问题，但其同时也会导致噪声样本传播，且仍然存在一定过拟合的缺点。针对上述问题，提出了一种基于概率密度估计的噪声样本清除策略及一种新颖的样本生成策略，进而开发了一种名为 Probability density estimate-based SMOTE (PDE-SMOTE) 的 SMOTE 改进算法。该算法采用 K 近邻概率密度估计(KNN-PDE)法评价每个样本在同类和异类中的标准化概率密度，根据二者之间的关系定位并清除噪声，并根据近邻少数类样本的概率密度值确定新样本位置。通过大量比较实验验证了本文算法的有效性，鲁棒性与优越性。

➢ SuA02 - 5　　14 : 00 - 14 :15

539 基于聚类技术的类别不平衡分段决策阈值策略研究

卢梦珂　　江苏科技大学
于化龙　　江苏科技大学

高尚 江苏科技大学

决策阈值策略是用于解决类别不平衡学习问题的主要技术之一。近年来，已出现多种决策阈值算法，且在不平衡数据分类问题上取得了较好的效果，但其均存在一个共同的缺点，即对所有样本，均赋予同一个阈值，而没有考虑样本空间分布的影响。针对上述问题，提出了一种更为鲁棒和普适的改进算法：CDTA 算法。该算法首先采用 DBSCAN 聚类算法对样本空间分布进行了探索和分区，然后在每个区域内，计算该区域样本的最优决策阈值，并以此来指导分类超平面的移动。该算法可以自适应数据中的密度变化，对于存在类内子聚集的数据也有很好的效果。通过与几种流行的决策阈值算法进行实验比较，结果表明了所提算法的有效性与优越性。

➢ SuA02 - 6 14 :15 - 14 : 30

536 基于异构集成的类别不平衡学习算法研究

孟祥宇 江苏科技大学
高尚 江苏科技大学
于化龙 江苏科技大学
葛云飞 江苏科技大学

传统分类器在解决不平衡数据问题时，对少数类的分类存在较大误差，效果往往不尽人意，为了提高少数类和整体的分类性能，提出一种基于异构集成思想的不平衡数据分类模型。该模型基于时下较为流行的九种采样方法和九种分类方法，根据数据分布自适应地选择 AUC 最高的基分类器，然后整合所有基分类器得到预测。最后，通过使用 2 个综合性能评判指标和 14 个数据集，发现所提出的模型在处理不平衡数据时有较好的改进，能够改善分类器对少数类分类性能。

➢ SuA02 - 7 14 : 30- 14 : 45

597 基于双因变量序列 Probit 模型的事故责任双方驾驶员受伤严重程度研究

宋栋栋 北京交通大学

交通事故责任双方驾驶员受伤严重程度间可能存在相关关系，以往研究仅考虑负主要责任方或受伤最严重驾驶员，易导致参数估计及研究推论出现偏差。本文基于 2017-2020 年贵州省的道路交通事故数据，综合考虑驾驶员、车辆、道路、事故特征等潜在影响因素，构建双方驾驶员受伤严重程度的双因变量序列 probit 模型，并利用平均边际效应量化各显著变量对事故责任双方驾驶员受伤严重程度的影响。结果表明，同一起事故中责任双方驾驶员受伤严重程度间显著相关。具体表现为交通事故中负责任的女性和老年驾驶员均增加了不负责任驾驶员发生严重伤亡的概率；负责任驾驶员逆行、违法会车、无证驾驶等违法行为增加了不负责任驾驶员发生严重伤亡的概率；无交通信号控制、路侧无防护、路侧行道树、低能见度、夜间无路灯照明等增加了事故责任双方驾驶员发生严重伤亡的概率，且相同条件下不负责任的驾驶员往往会经历更严重的伤亡程度。

➢ SuA02 - 8 14: 45 - 15 : 00

538CycleAE：一种基于特征空间插值的过采样生成方法

吴仕祺 江苏科技大学
邵长斌 江苏科技大学
于化龙 江苏科技大学

用于图像识别的数据往往存在不平衡分布，其这一特性会对深度学习的性能产生一定的负面影响。传统的样本采样技术在高维的图像数据上往往不适用。因此，在此类数据上，训练生成对抗网络(GAN)或变分自编码器(VAE)可能是有效的解决方案。现有的小样本生成模型通常采用类条件驱动生成过程使其朝向目标类，但是存在生成样本多样性不足和准确性较低的缺点。本研究提出了循环自编码器(CycleAE)，作为增强工具，进而解决上述问题。CycleAE 是一种新的网络框架，能够更紧密地关联原始空间与特征空间，搭配提出的训练方法，通过特征空间的插值实现原始空间样本的平滑过渡，进而实现过采样。与 VAE 和最先进的 GAN 模型相对比，表明 CycleAE 在不平衡分布的图像识别任务上具有更优的性能。

SuA03 13 : 00 – 15 : 00

腾讯会议：791-412-733

滤波、估计与预测的数据挖掘方法

主持人：何理 武汉科技大学

主持人：刘洋 山东科技大学

➢ SuA03 - 1 13 : 00 - 13 : 15

628 基于分层聚类的不平衡多标记学习方法研究

段继聪 江苏科技大学
于化龙 江苏科技大学
高尚 江苏科技大学

多标记学习是机器学习领域的研究热点之一，在诸多现实场景中均有着广泛的应用。与传统的单标记机器学习相比，多标记学习主要存在以下两个难点：一是每个标记的分布往往都是极为不平衡的；二是标记之间通常存在错综复杂的联系。针对上述问题，本文提出了一种基于分层聚类的多标记数据分类方法。该方法首先采用分层聚类挖掘标记之间的联系，

将强关联类标成组提取，进而采用编码转换的方式将每个子多标记问题转化为多类问题，利用成熟的多类不平衡学习方法进行建模，最后再通过集成的方式得到样本的整体标记。在 12 个多标记数据集上验证了该算法的有效性与可行性。结果表明：该算法不但在性能上要优于现有的主流不平衡多标记学习方法，而且在时间复杂度上也有一定优势。

➢ SuA03- 2 13 : 15 - 13 :30

630DME：一种基于分布相似度的自适应在线加权集成学习方法

冯宝全 江苏科技大学
于化龙 江苏科技大学
高尚 江苏科技大学

在线学习是机器学习领域的研究热点之一，其难点在于如何及时地跟踪并适应数据流中所出现的概念漂移。加权集成学习是用于解决概念漂移的一类重要方法，但是现有的此类方法往往依赖的都是已标注样本的经验，而并未利用到新接受的未标注样本信息，因而对概念漂移的适应均存在一定的滞后性。针对上述问题，本文提出了一种名为 Distribution Matching Ensemble（DME）的新算法，该算法利用混合高斯分布来提取每个数据块的分布信息，以 KL 散度计算块与块之间的分布相似度，进而采用多个已标注块与新接收的未标注块之间的分布相似度来自适应地为对应的自分类器分配权重，最后通过加权集成形成决策。大量实验结果指明了该方法的有效性与可行性。

➢ SuA03 - 3 13: 30- 13 : 45

330 微差爆破振动能量分析及延期时间识别研究

何理 武汉科技大学
刘易和 武汉科技大学
李琳娜 武汉科技大学

为实现微差爆破实际段间延期时间精确识别，从能量角度研究信号时频特征，力求更好地控制爆破地震效应。结合现场精确延期台阶爆破试验，利用 MATLAB 编制小波包分析程序，研究爆破振动信号能量分布特征随爆心距的演变规律，并运用基于小波变换的时-能密度法对微差爆破实际段间延期时间进行识别。结果表明，爆破振动能量主要集中于 0～200 Hz 频带范围内，在此范围内又可划分为多个子频带；随传播距离的增加，爆破振动信号高频能量衰减较低频能量快，能量分布最终向低频带集中；爆破振动能量不仅仅是峰值振动速度的表征，还取决于爆破振动持续时间与振动频率。基于小波变换的时-能密度法可有效识别微差爆破实际段间延期时间，段间延期时间识别结果分别为 26. 1ms、24. 1ms，多因素影响下的识别误差最大仅为 4. 4%。研究成果可为微差爆破参数优化设计提供理论依据。

➢ SuA03 - 4 13 : 45 - 14 : 00

156 基于 Kruskal-Wallis 检验的多分类基因特征选择算法

刘洋 山东科技大学
周长银 山东科技大学

针对基因表达数据的高维度、小样本、高噪声等问题，提出了基于 Kruskal-Wallis 检验的多分类特征选择算法。该算法首先使用 Kruskal-Wallis 检验，保留类别之间差异大的基因，在此基础上，分别利用 Relief-F 和 Laplacian 得分算法计算特征得分，据此对特征基因做二次筛选，进一步减少特征基因表达数据维度。最后，在五组基因表达数据上对该算法的有效性进行了验证，将得到的特征基因数据分别在支持向量机、决策树和 近邻三个分类器上进行测试，实验表明，本文提出的算法既降低了特征数量，又提高了分类效果。

➢ SuA03 - 5 14 : 00- 14 : 15

617 基于余弦-高斯核函数模型的随机渐进式概念认知

刘之茗 昆明理工大学
李金海 昆明理工大学

概念是知识表示的基本认知单元，它由对象集和属性集两部分组成，分别称为外延和内涵。概念认知是将属于这一概念的特征属性筛选出来，同时把不属于这一概念的特征属性排除，即给定任意一个对象集，找出其全部特征属性的过程。概念的渐进式认知理论首次提出了不完全认知算子，即将时间因素与认知算子结合来反映认知是一个循序渐进的过程，但由于初次认知后对线索集的更新，使得该理论在认知过程中会丢失部分属性，同时当改变认知顺序时会导致认知结果发生改变。为了改进上述不足，本文在现有理论的基础上提出了基于余弦-高斯核函数模型的随机渐进式概念认知算法，利用部分已知概念作为先验知识训练余弦-高斯核函数模型，并计算所有属性与线索集的概率，从而依概率随机选择认知属性。同时考虑到属性间的依赖性，本文提出了属性的后验概率和互信息的概念用来衡量已认知完成属性对后续的剩余属性影响，即在完成第一次属性认知后依据后验概率再进行剩余属性的随机认知。最后实验分析表明，本文的方法使得概念

认知精度大大提高，同时时间复杂度也优于原有的认知理论，由此证明了本文方法的有效性。

➢ SuA03 - 6 14 : 15 - 14 : 30

[844]Construction of implicit social network based on ISM-RMR algorithm and recommendation between users and items

余鑫怡 武汉科技大学
涂俐兰 武汉科技大学
柴浪 武汉科技大学
陈娟 武汉科技大学

Most research on social recommendation systems is currently based on datasets containing explicit trust relationships between users. However, with the increasing importance users place on protecting their privacy, explicit trust relationships between users will become more difficult to capture. Once explicit trust relationships are not available, most research methods on social recommendation system may face breakdown or even collapse. Therefore, this paper considers mining the implicit "social relationships" between users and even between items without the explicit trust relationship dataset, and incorporating such social relationships into recommendation tasks to avoid the collapse of social recommendation systems due to privacy protection. This paper argues that, on the one hand, similar to user social networks, there are also "item social networks" among items. Therefore, in this paper, both the user social network and the "item social network" are included in the mining of implicit social relationships. On the other hand, since the rating matrix in a real recommendation system is relatively sparse, the common purchase relationship between users on items is also relatively sparse. Accordingly, this paper considers relaxing the restriction on common relationships. Specifically, in mining the implicit social relationships between users or between items, this paper proposes the ISM-RSimRank algorithm. Firstly, this paper calculates the attribute similarity between users or items based on the attribute information of users or items. Secondly, based on the attribute similarity and the user-item rating sub-network, this paper uses the improved SimRank metric to calculate the transfer similarity between users or items. Finally, a convex combination of attribute similarity and transfer similarity is used to construct a subnetwork of social relationships between user pairs or item pairs. Further, in reconstructing the recommendation relationships between users and items, the RMR-RNMF algorithm is proposed in this paper. Based on the social relationships in the previously constructed subnets of user-pair or item-pair social relationships, the NMF model is improved in this paper so as to obtain the rating matrix between users and items. Combining the ISM-RSimRank algorithm and the RMR-RNMF algorithm, the ISM-RMR algorithm is proposed in this paper to build a recommendation list between users and items. To illustrate the feasibility and effectiveness of the ISM-RSimRank algorithm and the RMR-RNMF algorithm, especially the ISM-RMR algorithm, numerical experiments are conducted using the Movielens dataset in this paper. The results of the numerical experiments show that: (1) the ISM-RSimRank algorithm can more comprehensively explore the implied social relationships between user-item pairs and item pairs in the face of sparse user-item rating relationships. (2) The RMR-RNMF algorithm is convergent. (3) In completing the recommendation task, the ISM-RMR algorithm has a relatively high sensitivity to changes in the parameters. At this time, finding the optimal combination of parameters will help improve the performance of the ISM-RMR algorithm and the accuracy of recommendations; (4) Compared with other traditional NMF-based algorithms, the ISM-RMR algorithm has higher prediction accuracy and is more effective in alleviating the cold start problem; (5) The ISM-RMR algorithm has good scalability.

➢ SuA03 - 7 14 : 30 – 14:45

[831]Double-Vector-Based Model-Free Predictive Current Control for Three-Level Inverter-Fed PMSM

周陈辉 南通大学
於锋 南通大学
程勋慧 南通大学

A double vector model-free predictive current control is proposed to overcome the weak parameter robustness and large current ripples of conventional predictive current control, and implemented in a three-level inverter driving permanent-magnet synchronous motor system. Initially, by virtue of the full-current-variation

update technique, the future current can be predicted to choose the first applied vector, getting rid of the influence on parameter mismatch. Then, the optimal duration is decided via the dead-beat principle and the actual current variations corresponding to feature vector is amended to ensure the accuracy of current variations application. Following this, the second active vector is selected by the improved cost function, which always considers the pre-selection of voltage vectors and the neutral point voltage constraint. At last, the experimental results have demonstrated the superiority of the proposed strategy in current ripples suppression as well as the strong robustness against parameter mismatch simultaneously.

➢ SuA03 - 8 14 : 45 - 15 : 00

629 基于间接样本先验分布信息提取的代价敏感学习方法研究

周杉林 江苏科技大学
于化龙 江苏科技大学
高尚 江苏科技大学

代价敏感学习是用于解决类别不平衡问题的主要方法之一。传统的代价敏感学习要么不考虑样本的具体分布，而直接为每类样本分配一个统一的经验值，要么采用直接的探索方式来量化样本分布，从而实现个性化代价分配。已有的个性化代价分配方法可能会受到诸多因素的影响，从而并不准确。本研究提出了一种间接的样本先验分布信息提取策略，用于解决上述问题。该策略利用降采样集成来间接地评估每个样本的位置信息，从而达到去除噪声，强化边界的目的。通过大量实验证明了该方法的鲁棒性，普适性与优越性

SuA04 13 : 00 – 15 : 00
腾讯会议：854-566-428
系统模拟及仿真

主持人：曹俊英 贵州民族大学
主持人：杜绍洪 重庆交通大学

➢ SuA04 - 1 13 : 00 - 13 : 15

677 分数阶微分方程最优控制问题高阶数值格式的收敛性分析

曹俊英 贵州民族大学

本报告利用先优化后离散的方法构造了 Caputo 分数阶偏微分方程的最优控制问题的高阶数值格式。首先建立了 Caputo 分数阶偏微分方程的最优控制问题一阶最优性条件；其次利用修正的 Block-by-Block 方法针对最优性条件建立数值格式；最后利用梯度投影算法和线性搜索算法 Caputo 分数阶偏微分方程的最优控制问题高阶数值格式，并建立了其局部截断误差进行严格分析，数值结果表明算法是高效的、与理论分析是吻合的。

➢ SuA04 - 2 13 : 15 - 13:30

172High order CDG-FE methods for the Green-Naghdi model with the enhanced dispersive property

程用平 重庆交通大学

In this paper, we present a family of high order numerical methods for numerical simulation of strongly nonlinear and dispersive waves by the fully nonlinear Green-Naghdi model with improved frequency dispersive properties. The governing equations contain mixed spatial and temporal derivatives of the unknowns and also have still-water stationary solutions. So a reliable numerical scheme for these equations should preserve still-water stationary solutions and maintain non-negativity of the water depth. In our numerical approach, we first reformulate the Green-Naghdi equations into balance laws coupled with an elliptic equation. We then propose a coupled method which discretizes the balance laws with positivity-preserving well-balanced central discontinuous Galerkin methods and the elliptic part with continuous finite element method. Numerical tests are performed to verify the well-balanced property, positivity-preserving property, high order accuracy as well as the capability of the Green-Naghdi model to describe the propagation of strongly nonlinear and dispersive waves.

➢ SuA04 - 3 13: 30 - 13 : 45

791考虑弹体动力学的时间协同和角度控制三维制导律研究

豆登辉 北京信息科技大学
范军芳 北京信息科技大学
陈仕伟 北京信息科技大学
李俊贤 北京信息科技大学

针对速度时变下多导弹协同制导问题，设计了一种考虑弹体动力学影响的时间协同和末端攻击角度约束的三维制导框架。在偏航平面，采用广义最优弹道成型制导律(TSG)约束导弹在偏航平面落角；在俯仰平面，根据带攻击角度约束的偏置比例导引（BPNIAC）制导律表达式，求解出导弹实际剩余飞行距离，并根据当前飞行状态和动力学参数预测导

弹在标称剩余飞行时间内速度变化，通过数值积分的方法计算导弹标称剩余飞行距离，然后在BPNIAC 制导律基础上附加反馈控制项使得导弹实际剩余飞行距离跟踪标称值，从而实现在弹体动力学影响下俯仰平面内攻击时间和末端攻击角度控制。仿真结果验证了该制导框架的有效性，能够完成多枚导弹同时攻击目标顶部和侧面的特殊作战要求。

➢ SuA04 - 4 13 : 45 - 14 : 00

[213]Adaptive finite element method for partial differential equations

杜绍洪 重庆交通大学

Firstly, A novel residual-type a posteriori error analysis technique is developed for multipoint flux mixed finite element methods for flow in porous media in two or three space dimensions. The convergence of an adaptive mixed finite element method for convection-diffusion-reaction equations is proved. Secondly, for second order elliptic singularly perturbed problem, a novel dual norm is introduced, under which robust residual-type a posteriori error estimator is developed and analyzed, and is proved to be robust with respect to the singularly perturbed parameters. Finally, we develop robust recovery-based a posteriori error estimator for SUPG method. The flux is recovered through either the local averaging or the global (weighted) L^2 projection in H(div) conforming finite element spaces. Based on the H(div) recovered flux, we introduce a stabilization recovery procedure, and develop completely robust a posteriori error estimator.

➢ SuA04 - 5 14 : 00 - 14 : 15

[861]Theta-Milstein method for stochastic differential equations driven by G-Brownian motion

邓寿年 安徽工程大学
费为银 安徽工程大学
梅春晖 安徽工程大学

This paper mainly focuses on the convergence and stability of the Milstein method for stochastic differential equations driven by G-Brownian motion (G-SDEs). First, a θ-Milstein method is presented for G-SDEs and a strong converge result is obtained under the given conditions. Second, it is proved that the method can reproduce the stability in the sense of mean-square. Finally, numerical examples are given to support our results.

➢ SuA04 - 6 14 : 15 - 14 : 30

[582] 人际信任对集体智慧影响的计算实验研究

胡德强 大连理工大学
党延忠 大连理工大学
岳鑫 大连理工大学

集体智慧是衡量群体绩效、问题解决能力和团队发展的重要指标，且研究表明互动是促进集体智慧形成不可或缺的重要因素。本文以知识型团队这种重要的组织形式为对象进行研究，以人际信任与人际互动的交互作用为出发点，建立 ABM 模型，分别从人际信任与互动行为动态循环的角度进行计算实验，研究人际信任对集体智慧涌现的影响关系。结果不但表明人际信任对集体的形成具有重要影响，而且发现当团队涌现出最高水平的集体智慧时反而对应着一定程度的信任冲突。该结果可以使人们更好的理解什么情境下团队会优于个人，并从人际信任的角度扩展了影响集体智慧形成的相关因素研究，从而有助于更好的利用知识型团队的群体优势，以完成复杂的知识工作。

➢ SuA04 - 7 14 : 30 - 14 : 45

[423] 四旋翼无人机的分数阶终端滑膜姿态控制器

严云龙 江苏科技大学

针对四旋翼无人机易受外界环境因素的影响，本文提出一种分数阶终端滑模控制策略，用以解决无人机姿态控制的问题。目前滑模控制被广泛运用于无人机控制，可传统滑模控制的滑模面是线性的，无法保证系统的跟踪误差在有限时间内收敛为零。比起传统的滑膜控制器，分数阶终端滑膜姿态控制器通过将滑模面改进为非线性滑模面，从而让跟踪误差有着更快的收敛速度，同时还引入分数阶微积分扩展控制范围，分数阶闭环系统与整数阶的相比，其闭环特性优势更明显，更有利于提高被控对象的稳定性以及可靠性，可以使得四旋翼无人机在面对复杂的外界干扰时仍能够快速响应命令，调节姿态来保证机身稳定。

➢ SuA04 - 8 14 : 45 - 15 : 00

[593] 基于深度学习的新混沌信号及其在图像加密中的应用

周双 重庆师范大学

为提高单一混沌系统图像加密的安全性，本文提出了基于深度学习的图像加密算法. 首先，利用超混沌 Lorenz 系统产生混沌序列. 其次，利用长短期记忆人工神经网络 (long-short term memory, LSTM) 复杂的网络结构模拟混沌特征构造新的混沌信号.

然后，利用最大 Lyapunov 指数，0-1 测试，功率谱分析、相图以及 NIST 测试对新信号的动力学特征进行分析．最后，将新信号应用到图像加密中．由于该方法生成的新信号不同于原有混沌信号，而且加密系统具有很高的复杂结构和非线性特征，故很难被攻击者攻击．仿真实验结果表明，本文提出的图像加密算法相比其他一些传统方法具有更高的安全性，能够抵抗常见的攻击方式.

SuA05　　13 : 00 – 15 : 00

腾讯会议：550-241-710

博弈论及应用

主持人：宋乾坤　　重庆交通大学

主持人：王炜烨　　北京信息科技大学

➢ SuA05 - 1　　13 : 00- 13: 15

[16]Feedback Stackelberg-Nash Equilibrium in Linear-Quadratic Mixed-Leadership Stochastic Differential Games

黄琪　　山东大学

史敬涛　　山东大学

This paper is concerned with a linear-quadratic mixed-leadership stochastic differential game in feedback information pattern. Via the solutions of coupled parabolic partial differential equations, explicit representation of the feedback Stackelberg-Nash equilibrium is given. Furthermore, the solvability of coupled Riccati equations which arise from solving the partial differential equations is discussed, and sufficient conditions for the existence of the solutions are derived.

➢ SuA05 - 2　　13 : 15 - 13 : 30

[424]Nash equilibrium and bang-bang property for the non-zero-sum differential game of multi-player uncertain systems with Hurwitz criterion

李茜　　重庆交通大学

宋乾坤　　重庆交通大学

刘玉荣　　扬州大学

How to select the optimisation criterion of the performance function is a pivotal research topic for the uncertain differential game. The Hurwitz criterion is a flexible optimisation measure to allocate some weight between optimism and pessimism to achieve balance for both of them. Based on uncertainty theory, this paper considers the Nash equilibrium and bang-bang property for the multi-player non-zero-sum uncertain differential game model by applying the Hurwitz criterion to optimize the performance function. To coordinate onto the Nash equilibrium, an equilibrium equation is derived. In addition, the application of bang-bang optimal control in the multi-player game problem of the uncertain linear system is investigated. Finally, an example is shown to validate the results obtained.

➢ SuA05 - 3　　13 : 30 - 13 : 45

[414]Robust error bound for convex inequality system under data uncertainty

Li Xiaobing　　重庆交通大学

We mainly provide necessary and sufficient conditions of the global error bound for uncertain inequality systems in terms of the existence of error bound for its robust counterpart, where uncertain parameters are in the uncertainty set. Some necessary and sufficient conditions for the existence of global error bounds are characterized by right derivative, projection operator, normal cone and the basic condition quali cation. Moreover, we show that the dual characterization of the error bounds for convex inequality system under interval uncertainty is necessary but insufficient.

➢ SuA05 - 4　　13 : 45 - 14 : 00

[820]Co-evolution of Vaccination Behavior and Perceived Vaccination Risk can lead to a Stag-Hunt like Game

刘媛　　北京邮电大学

武斌　　北京邮电大学

Voluntary vaccination is effective to prevent infectious diseases from spreading. Both vaccination behavior and cognition of the vaccination risk play important roles in individual vaccination decision making. However, it is not clear how the co-evolution of the two shapes the population-wide vaccination behavior. We establish a coupled dynamics of epidemic, vaccination behavior and perceived vaccination risk with three different time scales. We assume that the increase of vaccination level inhibits the rise of perceived vaccination risk, and the increase of perceived vaccination risk inhibits the rise of vaccination level. It is shown that the resulting vaccination behavior is similar to the stag-hunt game, provided that the basic reproductive ratio is moderate and that the epidemic dynamics evolves sufficiently fast. This is in contrast with the previous view that vaccination is a snowdrift like game. And we find that epidemic breaks out repeatedly and eventually leads to

vaccine scares if these three dynamics evolve on a similar time scale. Furthermore, we propose some ways to promote vaccination behavior, such as controlling side-effect bias and perceived vaccination costs. Our work sheds light on epidemic control via vaccination by taking into account the co-evolutionary dynamics of cognition and behavior.

➢ SuA05 - 5 14 : 00 - 14 : 15

782 一种满意博弈论的机器人自主避险方法研究

王炜烨 北京信息科技大学

基于满意博弈理论，我们提出了一种分布式机器人实时自主避险方法，以解决机器人间的碰撞及与障碍物间的冲突。首先，本研究采用了线性外推的方法对机器人冲突进行预判，提出了一种优先级分配机制，使机器人具有不同程度的合作倾向；然后，从安全和效率两方面构建机器人个体的博弈收益策略函数，通过改变机器人的运动速度和方向来实现自主避让；最后，在规则和随机的运动场景中，对本研究算法进行了仿真验证，仿真结果表明，在高密度运行环境中，本算法能够保证机器人的安全运行，同时在运行效率方面也有很大程度的提升。

➢ SuA05 - 6 14 : 15 - 14 : 30

525 具有批量服务的 M/G/1 排队系统的进队策略分析

卫安妮 昆明理工大学
赵 宁 昆明理工大学

本文研究具有批量服务的 M/G/1 排队系统的进队策略。通过分析个体和社会收益函数，分别讨论可见和不可见情形下的个体和社会进队策略。在可见情形下，根据系统的状态，通过分析顾客的平均逗留时间建立个体收益函数，得到个体进队的均衡阈值；根据系统的稳态分布，分析系统的丢失率并建立社会收益函数，得到社会的最优进队阈值。在不可见情形下，顾客到达系统后按照一定的概率进入系统，通过分析平均逗留时间建立个体和社会收益函数，得到个体均衡策略和社会最优策略。通过数值实验比较可见和不可见情形下系统参数对社会收益的影响，并验证了理论结果的正确性。

➢ SuA05 - 7 14 : 30 - 14 :45

350Natural selection between two games with environmental feedback

袁海蕊 山东科技大学

Evolutionary game theory has extensively investigated situations in which several games are competing against each other at the same time, but the model only assumes symmetric interactions in homogeneous environments. Now, the population is considered in heterogeneous environments, individuals in the population occupy a different quality of patches, and individual fitness depends not only on the interaction between individuals, but also on the quality of the environment. Here, by establishing a mathematical framework, we analyze the natural selection between two strategies and two games in heterogeneous environments. Furthermore, we analyze the natural selection of Prisoner's Dilemma and Hawk–Dove games theoretically to demonstrate the dynamics of cooperators and defectors in their choice of environment and their respective games. As expected, the distribution of games and strategies changes with time. Based on different initial population compositions, we also discuss the invasion problem of games from different perspectives. To one's surprise, we can find that good quality patches attract all individuals; the long-term dynamics in invariant rich environments is the same as the dynamics of symmetric interactions in homogeneous environments.

➢ SuA05 - 8 14 : 45 - 15 : 00

783 大宗商品电子交易市场的治理策略选择：惩罚 vs. 激励

郑泽志 北京信息科技大学
马艳红 北京信息科技大学

为破解大宗商品电子交易市场的监管困局，本文基于大宗商品电子交易平台与交易商的利益互动关系，分别构建政府惩罚机制和政府激励机制下交易平台与交易商的演化博弈模型，分析交易平台与交易商策略的演化路径及影响其策略选择的因素。结果表明，政府惩罚机制下，当政府对交易平台的惩罚力度逐渐增加时，交易平台从倾向于选择“不自律”策略变为选择“自律”策略，但该机制无法促使交易商选择“不违规”策略。政府激励机制下，政府对交易平台进行适当补贴可以促使交易平台选择“自律”策略，交易商选择“不违规”策略。同时，当政府同时实施惩罚机制和激励机制时，交易平台与交易商选择“自律”策略和“不违规”策略的演化速度快于只实施激励机制。

SuA06 13 : 00 – 15 : 00
腾讯会议：358-325-905
系统运筹、优化及调度

主持人：吕莹　　北京交通大学
主持人：彭建文　　重庆师范大学

➢ SuA 06 – 1　　13 : 00 - 13 : 15

159 差分进化算法求解带时间窗的非线性充电的电动车辆路径优化问题

邓佳文　　青岛大学
张纪会　　青岛大学

当下，环境问题备受关注，温室效应是当前亟待解决的环境问题之一，其中二氧化碳的增加是引起温室效应的主要原因。而交通运输业的排放占二氧化碳排放的绝大部分。与传统燃油汽车相比，电动汽车可以有效促进节能减排，此外，路径规划对于交通运输起着至关重要的作用。本文研究了带时间窗的非线性充电的电动车辆路径优化问题，分析了非线性充电约束的车辆路径优化的问题特征、目标特点和约束条件，以最小化旅行时间为目标。并提出一种混合差分进化算法，结合模拟退火来进行优化求解。首先，设计了一种预充电操作策略来加快充电效率和提高充电桩的利用率，其次，结合多种邻域结构和改进的交叉操作来提高算法的性能。最后，充分证明了算法的有效性。

➢ SuA06 - 2　　13 : 15 - 13 : 30

436Risk-aversion multi-mode project scheduling with hybrid uncertainty

刘辉冉　　上海理工大学
房志明　　上海理工大学

This paper proposes a multi-mode stochastic multi-mode resource constrained project scheduling model under risk aversion, which aims at completion time and cost. The duration, resource requirements and costs are assumed to be uncertain and modeled as random variables. In order to take risk aversion into account, a risk aversion decision-making method: conditional value at risk (CVaR) is used. A two-stage robust optimization model is constructed, and an integer measuring the level of cost uncertainty is introduced to adjust the robustness of the proposed method. The decomposition method is used to solve the robust corresponding term of the considered problem. Extensive computational research is carried out on the benchmark example adapted from the project scheduling problem base (PSPLIB). By calculating the random measure of the model, the value of establishing the model is verified. The result analysis based on the project network characteristics and cost uncertainty shows that the smaller the parameter value, the better the algorithm performance, but the lower the robustness of the solution. The influence of risk parameters on the whole goal is analyzed. Therefore, the model can provide different robust solutions for different degrees of conservatism according to the risk perception of decision makers.

➢ SuA06 - 3　　13 : 30 - 13: 45

776 求解多目标优化问题的邻近牛顿法

彭建文　　重庆师范大学

针对一类特殊的多目标优化问题，其每个目标函数为一个二阶连续可微凸函数与一个真凸但不必可微函数之和，提出了邻近牛顿法. 我们引入了带线搜索的邻近牛顿法和不带线搜索的邻近牛顿法. 在适当的条件下，我们证明了由这两类算法产生的序列的每个聚点是多目标优化问题的 Pareto 平稳点. 此外，我们给出了它们在约束多目标优化和鲁棒多目标优化中的应用. 特别地，对于鲁棒性的情况，我们证明了邻近牛顿法的子问题可以看作二次规划问题. 对此，我们还进行了数值实验，验证了该方法的有效性.

➢ SuA06 - 4　　13 : 45 - 14: 00

815E-α-预不变凸区间值函数及最优性条件

彭健益　　重庆交通大学

【目的】在 LU 序关系下提出了一类新的广义凸区间值函数, E-α-预不变凸区间值函数，并给出一些性质以及最优性条件。这是基于 E-预不变凸区间值函数的推广。【方法】理论推导和举例说明相结合。【结果】给出了例子证明 E$-\alpha$-预不变凸区间值函数的存在性，并给出了可微情况下的性质，然后讨论了关于 E-α-预不变凸区间值函数的几个有趣性质，最后，得到了在区间值不等式约束情形下 E-α-预不变凸区间值规划的最优性条件，并证明其成立。【结论】文中将广义凸函数的一些研究成果进行了推广，在一定程度上丰富了广义凸函数的研究。

➢ SuA06 - 5　　14 : 00 - 14 : 15

211 基于灵敏度方法下连续时间 Markov 决策过程中的均值-方差组合优化问题

涂海婷　　暨南大学

在系统工程和金融工程中，均值表示平均收益，方差表示风险，这两个指标具有日渐显著的意义. 本文在连续时间 Markov 决策过程中考虑均值（长期平均性能）和方差的组合优化问题. 值得一提的是，本

文处理的是样本路径方差，而它的计算涉及到长期平均性能，这导致均值-方差组合优化问题不是标准的 Markov 问题. 对此，本文给出广义样本路径方差的定义，在对长期平均性能不做任何约束的条件下，研究了逗留时间、转移概率及性能函数的共同摄动对均值和样本路径方差的影响，推导出均值-方差组合度量的灵敏度公式，并基于此公式给出策略迭代算法. 据我们所知，本文是给出策略迭代型算法以优化连续时间 Markov 决策过程中的均值-方差组合度量的第一项工作.

➢ SuA06 - 6 14 : 15 - 14 : 30

155 改进萤火虫算法求解多维复杂函数优化问题

王李萍 山东科技大学
赵茂先 山东科技大学
张贺杰 山东科技大学

针对传统萤火虫算法在全局寻优中存在精度低、收敛不稳定、易陷入局部极值等缺陷，提出一种基于改进 Chebyshev 混沌映射的新型进化模型的萤火虫算法。首先，用改进的 Chebyshev 混沌映射初始化种群分布提高种群多样性；其次，在算法进化过程中引入非线性动态自适应惯性权重和莱维飞行，调节算法在不同进化阶段的搜索范围和精度，以达到收敛速度和局部寻优能力之间的平衡；然后，引入动态步长和对称边界变异操作解决越界问题，避免陷入局部最优；最后，在 6 个基准测试函数上与传统萤火虫算法和其他改进的萤火虫算法进行对比，实验结果表明，改进算法具有较高的求解精度和较快的收敛速度，有利于更好地平衡全局勘探和局部开发之间的关系。

➢ SuA06 - 7 14 : 30 - 14: 45

310Integrated optimization of metro multi-station passenger inflow control and bus bridging service

王兴蓉 北京交通大学
吕莹 北京交通大学

Passenger inflow control as one of the most cost-effective urban transport demand management measures, is widespread in metro systems of many megacities to ensure the operation safety. The essence of it is to reduce the number of passengers arriving at the metro platforms per unit time at the cost of prolonging passengers' waiting time outside stations or at the inbound gates. To relieve the metro operation pressure as well as save passengers' travel time, this paper aims to introduce a competing bus bridging service network for the interesting metro system. A bi-level programming model is formulated for this complex bimodal system to integratedly optimize the metro passenger inflow control scheme and bus bridging service. The upper lever is to minimize the operating and travel costs of the bimodal system by determining the dynamic passenger inflow control stations and corresponding control rates and bus bridging service routes and corresponding frequencies. The lower level is the combined Logit model considering mode split and the user equilibrium assignment model considering the user's travel demand elasticity and route choice behavior. Considering the model complexity caused by multiple decision variables, a heuristic algorithm is proposed to solve the built bi-level programming model. The Frank-Wolfe algorithm and the adaptive average algorithm are embedded to solve the UE traffic assignment model and the Logit model for mode split, respectively. Results of case study show that the integrated bimodal system can reduce the total passenger travel time efficiently compared to the single metro system taking passenger inflow control measures.

➢ SuA06 - 8 14 :45 - 15 : 00

234 基于低秩正则和组稀疏编码的泊松图像去噪

魏颖 山东科技大学

许多生物医学成像和天文成像设备中的图像采集都受到泊松噪声的破坏。大多数经典的去噪方法都是基于全变分模型的，但全变分模型会导致阶梯效应。近年来，基于稀疏表示的图像去噪方法得到了广泛关注。本文中，提出了一种基于图像非局部自相似性（NSS）特性联合低秩正则的去除泊松噪声的优化模型。针对去除泊松噪声的优化模型，提出了一种带自适应调整参数策略的交替最小化方法。图像去噪实验结果表明，本文提出的低秩正则组稀疏编码（LR-GSC）泊松噪声图像恢复算法在视觉质量和峰值信噪比方面都优于现有的几个方法。

SuA07 13 : 00-15 : 00
腾讯会议：545-850-194
系统运筹、优化及调度

主持人：高见 安庆师范大学
主持人：张惠珍 上海理工大学

➢ SuA07 – 1 13 : 00 - 13 : 15

246 基于风险的重大工程建设项目突发事件多方式协同救援路径优化研究

陈旭浩 北京交通大学
吕莹 北京交通大学

近年来我国重大工程建设中的突发事件频繁发生，应急救援车辆的运输路径优化研究变得尤为重要。本文以规划建设中的川藏铁路为例，基于条件风险价值来衡量由于救援时间对受灾点所造成的伤亡后果大小；在救援过程中采取多种交通运输方式协同救援，并考虑到受灾点伤员和物资需求的不确定性，建立了考虑风险与救援成本的双目标鲁棒优化模型，以确定应急救援设施点的开放状态和交通工具的具体救援路径；利用鲁棒优化方法推导出其鲁棒对等模型，并采用 ε -约束法进行求解；最后设计算例验证了模型的有效性。研究结果表明本文所建立的鲁棒模型可以有效处理不确定条件下的运输路径优化问题，帮助决策者制订合理的救援路径方案。

➢ SuA07 - 2 13 : 15 - 13 : 30

382Scheduling Strategies for Autonomous Mobile Robots in Smart Hospitals with Dynamic Requests

程璐璐 昆明理工大学
赵宁 昆明理工大学

The outbreak of New Coronavirus has caused medical staff to become the most vulnerable members. To ensure the safety of medical staff and relieve the pressure on the medical staff, this paper studies and analyzes the scheduling strategy of autonomous mobile robots (AMRs) in hospitals, where the travel time and service time of AMRs are random and serve two classes of requests (static request and dynamic request). In this paper, a two-stage mathematical programming model to minimize hospital costs is established, and the model is solved by an improved tabu search (TS) algorithm. Using the improved Solomon instance to conduct numerical experiments, the results show that the improved TS algorithm proposed in this paper is feasible and effective, and it is found that the service rate of medical requests decreases with the increase of the system dynamics, and scheduling replenishment when AMR's remaining load is approaching zero improves service rates for medical requests.

➢ SuA07 - 3 13 : 30 - 13: 45

355 基于系统工程的汽车零部件项目风险管理研究

范文扬 中山大学

通过对比、分析国内外汽车零部件项目风险管理的现状，结合当前行业形势及管理要求，面向具体项目和组合多项目，研究并提出了基于系统工程思想的汽车零部件项目风险管理模型，分别明确了各级风险管理组织和职责，定义了风险管理的程序与内容，指出了项目各研制阶段的风险管理重点，做到了技术风险和管理风险管控相呼应、具体项目风险管理与多项目风险管理相结合，结合典型案例分析了风险管理实践，提出了后续深化风险管理的建议，供相关项目借鉴。

➢ SuA07 - 4 13 : 45 - 14: 00

859 考虑运输的低碳柔性作业车间调度

李明 安徽工程大学

针对考虑运输的低碳柔性作业车间调度问题(EFJSP)，提出了一种反馈型帝国竞争算法(FICA)以同时最小化最大完成时间和总能耗，该算法采用新方法构建初始帝国使得大多数殖民国家分配数量相近的殖民地，同化和革命过程引入了反馈机制，并应用新的革命策略和帝国竞争方法以获得高质量解。最后通过大量实验测试 FICA 新策略对其性能的影响并将 FICA 与其他算法对比，实验结果表明 FICA 在求解所研究问题方面具有较强的优势。

➢ SuA07 - 5 14 : 00 - 14 : 15

391A note on “Higher-order generalized Studniarski epiderivative and its applications in set-valued optimization” [Positivity22:1371–1385(2018)]

唐田 重庆交通大学

In this note, we establish a property of the higher-order generalized Studniarski epi-derivative. By virtue of the property, we demonstrate that conditions (6) and (12) of Theorem 4.3 in Anh (Positivity 22:1371–1385, 2018) are incompatible. We provide a modification of Theorem 4.3 in Anh (Positivity 22:1371–1385, 2018). An example is given to illustrate the modified result.

➢ SuA07 - 6 14 : 15 - 14 : 30

819E-半预不变凸区间值函数的性质与区间规划的最优性条件

文铭 重庆交通大学

基于 LU-偏序关系，提出了一类新的广义凸区间值函数——E-半预不变凸区间值函数，它是 E-预不变凸区间值函数的推广。首先，用例子说明了 E-半预不变凸区间值函数的存在性；给出了 E-半预不变凸区间值函数的几个有趣性质，并讨论了 E-半预不变凸区间值函数和 E-半不变凸区间值函数之间的关系；

最后，得到了在实值不等式约束情形下 E-半预不变凸区间值规划的最优性条件，举例验证了所得结果。

➢ SuA07 - 7 14 : 30 - 14: 45

[386] 人机融合环境下自动发药机的药品拣选的路径规划

袁梦鸽 昆明理工大学
赵宁 昆明理工大学

为了提高医院门诊药房的自动发药机在人机融合环境下的处方拣选效率，本文提出在自动发药机中设置两个输入/输出窗口。基于自动发药机中的双命令周期拣选方式，对自动发药机中一个输入/输出窗口与两个输入/输出窗口的拣选路径下的检索请求进行对比分析研究。根据一个输入/输出窗口顺序出货与两个输入/输出窗口交替出货的特点，与药剂师在输入/输出窗口的分拣结合，刻画系统在连续取药、间断取药和不连续取药三种情况下的处方拣选完成时间，建立整数规划模型，运用 Cplex 优化软件进行求解。通过一个输入/输出窗口与两个输入/输出窗口两种不同的设置下的处方拣选完成时间进行实验对比分析，得出应用两个输入/输出窗口的系统规格可使人机融合下处方拣选效率的明显提高。

➢ SuA07 - 8 14 :45 - 15 : 00

[412]Well-posedness and scalarization for set optimization problems via free-disposal sets

曾悦 重庆交通大学

This aim of this paper is to investigate the well-posedness and scalarization for a set optimization problem (l-SOP) via free-disposal sets. Firstly, we introduced three kinds of well-posedness for set optimization problems and showed some relations among three kinds of well-posedness. Then, some sufficient conditions for these kinds of well-posedness of (l-SOP) are given by using the Hausdorff P-semicontinuity of objective set-valued mappings. Furthermore, we established a scalar problem and discuss the equivalence between the solutions of the scalar problem and the set of E-l-minimal solutions of (l-SOP) by employing the generalized oriented distance functions. We also given some examples to illustrate our main results.

SuA08 13 : 00-15 : 00
腾讯会议：304-388-090
系统运筹、优化及调度

主持人：周博 重庆交通大学

主持人：刘媛华 上海理工大学

➢ SuA08 – 1 13 : 00 - 13 : 15

[393]The Equivalence of Three Types of Error Bounds for Weakly and Approximately Convex Functions

白思轩 重庆交通大学

We start by establishing the equivalence of three types of error bounds: weak sharp minima, level-set subdifferential error bounds and Lojasiewicz (for short Ł) inequalities for weakly convex functions with exponent $\alpha \in [0,1]$ and approximately convex functions. Then we apply these equivalence results to a class of nonconvex optimization problems, whose objective functions are the sum of a convex function and a composite function with a locally Lipschitz function and a smooth vector-valued function. Finally, applying a characterization for lower-order regularization problems, we show that the level-set subdifferential error bound with exponent 1 and the Ł inequality with exponent 1/2 hold at a local minimum point.

➢ SuA08 - 2 13 : 15 - 13 : 30

[394]Stability for semi-infinite vector optimization problems via generalized order sets

陈雪静 重庆交通大学

This paper is devoted to investigate the stability of semi-infinite vector optimization problems (SIVO) when the order set is not necessary a convex set or cone. By using properties of recession cone, we first establish the Berge-upper semicontinuity of weak efficient solution mappings for (SIVO). Then, under weaker assumptions, we discuss upper Painlevé-Kuratowski convergence of minimal point, Benson and Henig proper minimal point sets for (SIVO) under functional perturbations of both objective functions and constraint sets. Furthermore, we obtain upper Painlevé-Kuratowski convergence of efficient solution sets, Benson/Borwein/Henig proper efficient solution sets for (SIVO). And, some examples are formulated to illustrate that the obtain results are interesting.

➢ SuA08 - 3 13 : 30 - 13: 45

[415]Optimality conditions and duality for E-differentiable fractional interval-valued optimization problems with generalied convex

邓春艳 重庆交通大学

The LU-E-invex fractional interval value function and LU-E-preinvex fractional interval value function is presented and studied under the order relation LU and CW, respectively. Firstly, give the definition of LU-E-invex fractional interval value function and LU-E-preinvex fractional interval value function, and the existence of these two kinds of fractional interval-valued function is verified by example. Secondly, the LU-E-invex fractional interval-valued optimization problem (FIVP-E)is studied. And the concept of weak LU-E-Pareto solution and the LU-E-Pareto solution solution for generalized convex fractional interval-valued optimization problems is given. It proved that the optimality conditions of necessity and sufficiency conditions. Finally, the so-called Lagrangian E-dual problem (DFIVP-E1) and Mond-Weir E-dual problem (DFIVP-E2) are defined for the problem (FIVP-E), and several E-duality theorems are established under generalized convex.

➢ SuA08 - 4 13 : 45 - 14: 00

[481] 基于三级分配网络的应急资源分配决策模型

董银环 昆明理工大学

为快速准确地满足突发事故发生后应急救援物资的动态需求，提高应急物资的救援效率，研究基于三级分配网络的应急资源分配决策模型。由于突发事故发生后所造成的损失与受灾点对应急资源的需求紧迫程度、受灾点的灾情指数以及受灾点的未满足量有关，因此以突发事故发生后救灾系统的总损失最小为目标构建一个包含“应急物资集散点—应急物资配送中心—受灾点”的三级应急资源调度模型，并对模型进行数值求解和仿真分析，由此验证模型的有效性。为突发事故的应急救援调度提供有益方案，能更好的满足受灾点对突发事故应急物资的需求情况。

➢ SuA08 - 5 14 : 00 - 14 : 15

[413]Inertia subgradient extragradient method for solving pseudomonotone variational inequality problems in Banach spaces

彭志莹 重庆交通大学

In this paper, we introduce an inertial algorithm for solving variational inequalities with Lipschitz continuous and pseudomonotone mapping in Banach spaces. The method considered in this paper does not require the knowledge of the Lipschitz constant, using the inertia term and the new inertia step rule. The convergence of the new algorithm is established without the knowledge of the Lipschitz constant of the 2-uniformly convex Banach spaces which is also uniformly smooth. Furthermore, we report some numerical experiments to illustrate the performance of this method.

➢ SuA08 - 6 14 : 15 - 14 : 30

[814]Generalized Robust Duality in Constrained Nonconvex Optimization

王杰 重庆交通大学

In this paper, the general dual problems in robust optimization without any convexity or concavity assumptions are investigated by using the image space analysis. A generalized Lagrange function is proposed by the class of regular weak separation functions. Then, two types of generalized robust dual problems are established. Under the appropriate assumption, the equivalent assertions of the zero duality gap property are characterized between the robust counterpart of an uncertain constrained optimization problem and the optimistic counterpart of its uncertain generalized Lagrange dual. Similarly, these theories and results can be extended to the deterministic dual pair of the robust counterpart and its Lagrange dual.

➢ SuA08 - 7 14 : 30 - 14: 45

[421]A Wasserstein distributionally robust chance constrained programming approach for emergency medical system planning problem

袁月飞 重庆交通大学
宋乾坤 重庆交通大学
周博 重庆交通大学

This paper proposes a distributionally robust chance constrained programming model for an emergency medical system location problem with uncertain demands. By minimising the total expected cost, the location of emergency medical stations, the allocation of the ambulances and demand assignments of system are optimised. The Wasserstein-metric is employed to construct the ambiguity set centred at an empirical distribution with a proper radius, which contains all the probability distributions of the uncertainties. We introduce a big-M technique to reformulate distributionally robust chance constrained programming

into a corresponding mixed integer programm, which can be inner and outer approximated by Value-at-Risk (VaR) and Conditional-Value-at-Risk (CVaR). Numerical experiments are illustrated to demonstrate the effectiveness of the formulations.

➢ SuA08 - 8 14 :45 - 15 : 00

[284]Planning PEV Fast-Charging Stations Using Data-Driven Distributionally Robust Optimization Approach Based on Phi-divergence

周博 重庆交通大学

Plug-in electric vehicles are widely acknowledged as an effective tool for numerous environmental and economic concerns. In this paper, a novel model for the planning of fastcharging stations is established based on data-driven distributionally robust optimizaton approach, which aims to minimize the expected planning cost for both transportation network and distribution network. Phi-divergence, a statistical measure, is utilized to establish the service ability constraints. On the other hand, a modified capacitated flow refueling location model is employed to develop the location constraints. In addition, AC power flow constraints are developed to model the operation of distribution network with the penetrations of plug-in electric vehicles. Finally, a case study is illustrated to validate the proposed planning model.

SuA09 13 : 00-15 : 00

腾讯会议：721-975-304

系统安全、运筹、优化及调度

主持人：刘翠玲 北京工商大学

主持人：陶杰 上海理工大学

➢ SuA09 – 1 13 : 00 - 13 : 15

[215] 南方 6 省水生蔬菜重金属含量特征及其膳食暴露评估

刘翠玲 北京工商大学
张述敏 北京工商大学
杨桂玲 浙江省农业科学院
张冉 北京工商大学

水生蔬菜重金属污染越来越受到人们的关注。为评价水生蔬菜中重金属污染现状和健康风险，本研究在湖南、湖北、江苏、浙江、安徽和广西 6 省抽取了 359 份莲藕、192 份茭白和 148 份茭白样品，采用电感耦合等离子体质谱仪(ICP-MS)检测样品中 7 种有害重金属(Cr、Ni、Cu、Cd、Pb、Hg、As)的累积水平，结果表明：莲藕中 Pb、As、Cr、Cd 含量超过国家安全标准，超标率分别为 7.8%、3.3%、1.4%、0.8%；茭白中 Pb、Cd 含量超标，超标率分别为 25%、1.6%；荸荠中 Pb、Hg、Cr 含量超标，超标率分别为 7.4%、6.1%、1.4%。南方 6 省中，湖南省水生蔬菜的重金属污染情况最为严重。结合中国居民不同年龄组人群的蔬菜消费量数据与体重信息，采用非参概率方法对水生蔬菜中重金属的膳食暴露量进行评估，将膳食暴露评估结果比照美国国家环境保护局(USEPA)推荐的安全参考剂量(RfD)，发现儿童和成人长期大量食用这 6 省的水生蔬菜会存在健康风险，且儿童的健康风险是成人的两倍,因此建议减少儿童对水生蔬菜的食用。水生蔬菜中 7 种重金属产生健康风险的大小依次为：As>Hg>Pb>Cu>Ni>Cd>Cr，As 的风险贡献率显著高于其它重金属，因此建议加强对水生蔬菜 As 污染的监测。

➢ SuA09 - 2 13 : 15 - 13 : 30

[521]An accelerated subgradient extragradient algorithm for solving bilevel pseudomonotone and non-Lipschitz Continuous variational inequality problems

李丹 重庆交通大学

In this paper, an accelerated subgredient extragradient algorithm with new non-momotonic stepsize is prosed to solve the bilevel pseudomonotone and non-Lipschitz continuous variationa inequality problems in Hilbert spaces. Two new iteration steps are proposed in the iterative schemes that are significant they make work without the prior knowledge of the Lipschitz constant of the mapping. The strong convergence theorem of the proposed algorithm is obtained under non-Lipschitz continuous. Some numerical tests are given to demonstrate the advantages and efficiency of the schemes over previously know ones.

➢ SuA09- 3 13 : 30 - 13: 45

[505]A note on “New higher-order weak lower inner epiderivatives and application to Karush-Kuhn-Tucker necessary optimality conditions in set-valued optimization”[Japan Journal of Industrial and Applied Mathematics. 37,851-866(2020)]

吕茂媛 重庆交通大学

In this note, we establish a property of higher-order weak lower inner Studniarski epiderivative. By virtue of the property, we demonstrate that Proposition 2 in Peng et al.(Japan Journal of Industrial and Applied

Mathematics 37:851-866, 2020) is incorrect and provide a modification of the proposition. An example is given to illustrate the modified result. Some remarks on the existing results in this note are given from our results.

➢ SuA09 - 4 13 : 45 - 14: 00

520 基于回溯线搜索的新型共轭梯度法

尹玉玲 重庆交通大学

该文提出了一种基于回溯线搜索的新共轭梯度法，并证明了该算法的全局收敛性，并将该算法与原始共轭梯度法进行了数值实验对比，解决了图像去噪问题，实验结果表明该算法是有效的.

➢ SuA09 - 5 14 : 00 - 14 : 15

613 A new adaptive nonmonotone Newton algorithm

袁柳洋 武汉科技大学
晋慧慧 武汉科技大学

In this paper, a new adaptive nonmonotone line search technique is proposed. Based on the new nonmonotone line search rule, an adaptive nonmonotone Newton algorithm is developed. Under suitable assumptions, the global convergence of the new algorithm is proved. The Numerical results show the feasibility and effectiveness of the new algorithm.

➢ SuA09 - 6 14 : 15 - 14 : 30

508 集值优化问题 Benson 真有效解的最优性条件

张雨荷 重庆交通大学

近几十年来，国内外大量的科研工作者和学者对于集值优化问题的讨论及研究，投入了大量时间和精力，不仅在集值优化问题各类解的最优性条件方面获得了一些珍贵的理论成果，而且关于各种优化解的研究方法也不断地在改善和进步。但是，借助于集值映射的二阶导数来研究集值优化问题 Benson 真有效解的最优性条件仍需不断地充实和完善，因此引入新的、更加合理的集值映射的导数来研究 Benson 真有效解的最优性条件，是很有意义的。本文中，为了更好地研究集值优化问题 Benson 真有效解的最优性充分条件和必要条件，首先我们引入了集值映射的二阶合成相依邻近上导数，并且讨论和建立了该导数的一些基本性质；然后，利用该二阶合成相依邻近上导数及其性质，建立了无约束集值优化问题 Benson 真有效解的最优性充分性条件和必要性条件；最后，借助该二阶合成相依邻近上导数导数及其性质，建立了约束集值优化问题 Benson 真有效解的最优性充分性条件和必要性条件，并且举出例子证明所得到的一些结果。

➢ SuA09 - 7 14 : 30 - 14: 45

595 Distributed optimization with hybrid linear constraints for multi-agent networks

郑燕玲 东南大学
刘庆山 东南大学
汪秒 东南大学

This article investigates the distributed constrained optimization with hybrid linear constraints for multi-agent networks, in which all the agents collaboratively minimize the global objective function with a sum of convex local objective functions, while the constraints are more general with local and global restrictions on the agents. Based on matrix and graph theories, a discrete-time algorithm under distributed manner is designed to deal with the organized problems. In addition, the optimality of the presented algorithm is obtained under certain initial restriction for the agents. By virtue of a novel Lyapunov function and the optimal conditions, rigorous analysis shows the convergence of the multi-agent networks with undirected and connected graphs. Finally, two simulation examples are presented to validate the theoretical consequence.

➢ SuA09 - 8 14 :45 - 15 : 00

504 集值优化问题弱有效解的二阶合成径向导数型最优性条件

张云淞 重庆交通大学

运筹学的运用越加广泛且重要，其中集值优化问题便是一个重要研究方向.特别的，在集值优化问题弱有效解的求解上，虽然众多学者做出了诸多研究，但是到现在，集值优化问题弱有效解的二阶最优化条件的研究仍值得继续完善. 本文中，首先，我们引入了一种条件更为宽松的集值映射的上导数——二阶合成径向上导数，并建立了这种二阶合成径向上导数的一些性质.然后，借助该二阶合成径向上导数获得了无约束集值优化问题弱有效解的二阶最优性充分条件和最优性必要条件.最后，利用该二阶合成径向上导数，建立了有约束的集值优化问题的二阶最优性充分条件和最优性必要条件.并且提供一些例子验证得到主要的结果.

SuA10 13 : 00-15 : 00
腾讯会议：668-170-040
人类行为、社会系统、金融系统

主持人：王先甲 武汉大学

主持人：黄中意 上海理工大学

➢ SuA10 – 1 13 : 00 - 13 : 15

697 基于 QQ 群的群体交流行为动力学建模

陈嘉妮 广西师范大学

基于 QQ 群发言数据，发现不同群由于群的活跃性不同，其群成员发言时间间隔分布分为双模分布，双幂律分布，单幂律分布。运用任务队列理论思想，提出一个多个体交互模型去解释类似的群体交流行为的动力学机制，复现 QQ 群中具体的聊天过程及群成员发言行为，研究群体交互行为对消息传播、舆论控制的影响。

➢ SuA10- 2 13 : 15 - 13 : 30

834Exploring routine dynamics from the 'bottom-up': A mixed-method approach by combining agent-based modeling and laboratory experimental research

高德华 山东工商学院

Routines capture the typical ways in which organizations accomplish their tasks. It has been widespread consensus that routines are certain practices with internal structure, processes and dynamics that contribute to both stability and change in organizations. During the past decades, some scholars resorted to agent-based modeling (ABM), whilst others employed laboratory experiments, to explore routine dynamics from the 'bottom-up'. In this paper, based on a brief overview of the literature, we describe the potential and benefits to combine ABM with laboratory experiments in routines dynamics research. We then present a theoretical framework for doing this, and shortly discuss both challenges and limitations of the work. Even the fact that either ABM or laboratory experimental research have matured in various disciplines and that merging the two methods can offer a lot for both sets of researchers, publications on integrating them together are still rare in organization studies, let alone the field of organizational routines. We admit that our discussions in the paper are just theoretically and rooted in a summary of literature, and that the framework needs to be validated and further developed when considering specific research questions regarding organizational routines in the future work. Nevertheless, we contribute to the current literature by bringing forward some theoretical and methodological foundations for an innovative mixed-method approach which would throw light on enriching people's understanding of the underlying dynamics of organizational routines.

➢ SuA10- 3 13 : 30 - 13: 45

842Effect of decay behavior of information on disease dissemination in multiplex network

霍良安 上海理工大学
孟世光 上海理工大学

The diseases dissemination will bring serious problems in the economy and livelihood issues. It is necessary to study the law of disease dissemination from multiple dimensions. Information quality about disease prevention has a great impact on the dissemination of disease, that is because only the real information can inhibit the dissemination of disease. In fact, the dissemination of information will involve the decay of the amount of real information and the information quality becomes poor gradually, which will affect the individual's attitude and behavior towards disease. In order to study the influence of the decay behavior of information on disease dissemination, in the paper, an interaction model between information and disease dissemination is established to describe the effect of the decay behavior of information on the coupled dynamics of process in multiplex network. According to the mean-field theory, the threshold condition of disease dissemination is derived. Finally, through theoretical analysis and numerical simulation, some results can be obtained. The results show that decay behavior can change the final size of disease dissemination. The larger the decay constant, the smaller final size of disease dissemination.

➢ SuA10- 4 13 : 45 - 14: 00

863 通胀不确定下银行存款价值与资本结构优化

黄玉喜 安徽工程大学
潘海峰 安徽工程大学
费为银 安徽工程大学

在动态银行理论中，存款是银行的生产性资本，为银行创造价值。然而，不像非金融公司的生产性资本有一个正的边际 q 值，存款边际价值对于资本不足的银行可能变成负值。由于活期存款账户允许持有人随意提取或存入资金，所以银行无法完全控制杠杆率。因此，对于股权资本不足以缓冲风险的银行来说，存款流入及未来杠杆的不确定性可能会有损价值。另一方面，通胀风险对银行资金的价值产

生冲击。本文研究在通胀不确定下银行存款价值与最优资本结构。首先利用随机分析得到了银行股东的实际价值过程，其次利用动态规划原理构建银行股东实际价值所满足的哈密尔顿-雅克比-贝尔曼（Hamilton-Jacobi-Bellman）方程，最后对其结果进行了数值模拟，从经济学的角度分析了通胀风险、杠杆约束、存款波动风险和无风险利率等因素对银行存款价值与资本结构的影响。

➢ SuA10 - 5 14 : 00 - 14 : 15

[176] 学术名著产出的时空特征分析

李晓凯 北京邮电大学
张鹏 北京邮电大学
曾安 北京师范大学

以往的科学计量学研究，主要以论文为研究对象，研究的时间范围集中在近现代。但是在科学发展的早期，许多学术成果是通过书籍来展现的，尤其是社会科学领域。本研究收集了 1687 年到 1953 年这 267 年间物理学、哲学、数学、经济学等九个学科领域的共计 2001 本学术名著的出版时间和出版地等数据，利用科学计量学、产品空间、经济复杂性等研究领域的技术方法，以定量方式研究学术史，分析学术名著产出的时空特征。研究发现，学术名著的产出表现出地理上集聚的特征。其次，利用年代之间的接近度构建的“年代空间”，研究了产出结构的连续性，发现年代上不连续特征及其跟学术史的对应关系。最后，利用修改的适应度和复杂度算法衡量了城市的领导力和年代的繁荣程度。

➢ SuA10- 6 14 : 15 - 14 : 30

[323]Construction and robustness of directed-weighted financial stock networks via meso-scales

苏青青 武汉科技大学
涂俐兰 武汉科技大学
王先甲 武汉大学
荣航 武汉科技大学

In order to investigate the evolution of stock market in any period of time, in this paper, combined with sliding window method, Granger causality test and cointegration test, a novel algorithm of constructing directed-weighted financial stock networks via meso-scale. We use the proposed algorithm on the financial stock data of the Shanghai Stock Exchange from January 1st, 2016 to December 31st, 2020 divided at the meso-scale level to construct some directed-weighted financial stock networks with fixed meso-scale and different meso-scale. Analyzing the topology and robustness of these constructed networks indicates that the robustness of financial stock networks with fixed meso-scale (assuming one year) is generally poor. By comparison, in 2018, the financial stocks were closely in contact with each other while the stock market was relatively stable. We also noted that the financial stock networks with different meso-scale show a high level of robustness when being attacked according to descending arrangement of in-degree or out-degree. They are however less robust against attacks according to descending arrangement of degree. Besides, the networks perform best for a meso-scale of 190. Hence, long-term investors are advised to consider a 190-day holding.

➢ SuA10 - 7 14 : 30 - 14: 45

[340] 基于可编辑 VR 实验平台的突发事件下跟随效应研究

田赛 上海理工大学
黄中意 上海理工大学
房志明 上海理工大学

建立了可编辑 VR 疏散动力学实验平台，并招募 100 名大学生开展地铁车厢内的虚拟实验，探究突发事件下的跟随效应。每次实验中有一名实验人员和 20 名非玩家乘客(NPC)参与，共设置 5 个场景探究不同比例的运动 NPC 对参与者预动作行为和运动行为的影响。通过分析问卷、预动作时间、出门选择、运动距离等数据，发现：1.少量同向运动人群的增加(0%-25%)便可提供足够明显的疏散方向信息，使注意到人群疏散方向的参与者比例提升 53.15%；2.实验中存在跟随等待人群或跟随移动人群两种跟随效应，在极端情况下(所有 NPC 等待和所有 NPC 运动)两种效应所导致的参与者预动作时间相差 80.6 s；3.与等待相比 NPC 的运动释放的信息更加强烈，当等待和运动 NPC 占比从 0%提升至 50%，等待和运动参与者占比分别提高 10 和 60%。

➢ SuA10 - 8 14 :45 - 15 : 00

[122] 几种儿童易感病传染率比较分析

翟夏菲 青岛大学
赵继军 青岛大学

以中国四种常见儿童易感病（百日咳、猩红热、风疹、腮腺炎)为例，估算全国范围内四种儿童易感病传染率的季节性，分析可能导致传染率季节性的影响因素及其异同。采用时间序列 SIR(Time Series

Susceptible Infected Recovered(TSIR))模型，模型中的参数由马尔科夫蒙特卡洛方法(Markov Chain Monte Carlo，MCMC)估计。结果表明，中国四种儿童易感病的传染率均存在较为显著的季节性，传染率的峰值主要集中至每年 2-3 月春运期间，7-8 月传染率达到最低，且细菌性感染的传染率高于病毒性感染的传染率。这些研究结果有助于分析中国常见儿童易感病的传播特性和传播动态，为传染病的防控与治疗提供合理的方法。

SuA11　　13 : 00 - 15 : 15
腾讯会议：621-637-380
交通系统复杂性

主持人：韩晓　　北京交通大学
主持人：王嘉文　　上海理工大学

➢ SuA11 – 1　　13 : 00 - 13 : 15

[78] 群体出行选择行为建模和实验

韩晓　　北京交通大学

交通系统是人车路组成的复杂系统，其中探究群体的出行选择行为对于理解群体出行复杂性具有重要意义。本报告拟介绍我们近期在出行选择行为建模和实验方向的一些工作。我们通过建模的方式研究了出行前信息对于不确定条件下出发时间和路径选择行为的影响。讨论了包括信息准确度、路径容量下降程度和频率、两条路径的相关性、以及一条路径上自由流时间和路径容量下降关系等因素对于出行成本的影响。我们提出一种简单的均衡计算的方式给出了一般路径容量分布情况下的均衡解，并且发现提供准确出行前信息可能造成“信息悖论”。同时，我还会报告我们在交通出行方式选择协调的一些实验室实验的结果，包括影响出行方式协调的一些因素，以及如何提高协调水平等。

➢ SuA11- 2　　13 : 15 - 13 : 30

[200] 城市交通网络冗余性的幂律分布研究

胡一冰　　同济大学
许项东　　同济大学

交通网络作为城市系统的“生命线”，其应对常态扰动和重大冲击的韧性直接影响城市运行和居民活动。相较于加强系统在遭遇重大冲击后的的应急响应能力，适度提升事前规划设计阶段的抵抗能力—交通网络冗余性，能更主动地降低未知突发事件的影响。交通网络冗余性可定义为出行起讫点对之间可供出行者选择的替代有效路径数量。本文从交通网络冗余性这一新视角，研究我国一、二线及新一线共 49 个城市道路交通网络的结构特征。研究结果表明，交通网络冗余性遵循幂律分布，幂指数能综合反映网络冗余性的异质性和分布均匀性，幂指数越大意味着路网整体冗余性更高。此外，研究发现路网冗余性与路网规模无直接关系，道路等级级配合理的网格型城市交通网络在面对扰动时具有较高的冗余性水平。本研究有助于更好地认知、评价与改善城市交通网络的结构性能，同时也可为其他基础设施系统的韧性建设提供理论支持。

➢ SuA11- 3　　13 : 30 - 13: 45

[696] Traffic management framework with dedicated connected automated vehicle lane considered in a mixed traffic environment

尚影　　北京交通大学

Connected and automated vehicles (CAVs) are regarded as one of the effective ways to enhance traffic efficiency and driving comfort. However, the realization of 100% CAVs will take a long time. In this paper, a traffic management framework is proposed to plan and control the trajectories of CAVs at isolated signalized intersections with dedicated CAV lane in a mixed traffic environment, which consists of human-driven vehicles (HVs), connected and automated buses (CVBs) and CAVs. In the framework, both the lane-changing behavior of vehicles and the stochasticity of HVs are considered. The whole framework consists of a planning module, a running module and a switching module. In the planning module, the discrete time-based models for only longitudinal trajectory planning and trajectory planning with lane-changing are formulated to optimize the trajectories of CAVs and CVBs in different situations. Furthermore, a local priority algorithm is designed to reduce the computational complexity. In the running module, CAVs and CVBs follow the planned trajectories, while HVs follow the car-following model considering stochasticity. In the switching module, CAVs will switch to HVs once the safety conditions are violated. A rolling horizon control scheme is applied to cope with the dynamic changes of traffic. At different traffic demand levels, numerical experiments are conducted to validate the advantages of the proposed framework. Compared with no trajectory planning for CAVs, the average vehicle travel time is significantly reduced, and the driving comfort and intersection throughput are significantly improved,

especially in high CAV penetration and at the high demand level. In addition, setting the dedicated CAV lane in high CAV penetration is more helpful to improve the overall traffic performance.

➢ SuA11- 4 13 : 45 - 14: 00

[38]Pre-trip Reservation Enabled Route Guidance and Signal Control Cooperative Method for Improving Network Throughput

王嘉文 上海理工大学
杭佳宇 常州大学

With the ever-increasing traffic demand, efficient urban traffic operation is facing more and more pressure and challenges. Route guidance and signal control is an effective method to enhance the existing urban traffic capacity and realize the sustainable development of traffic systems. In this paper, a collaborative optimization method of route guidance and intersection signal controlling is proposed under the background of a pre-trip reservation. Vehicles were divided into reserved and non-reserved vehicles, which corresponds to pre-trip reservation and random travel, respectively. Firstly, route guidance models considering both road network efficiency and vehicle travel time are proposed for different types of vehicles. Then, based on the impact of different travel modes on traffic flow distribution, a collaborative optimization for route guidance and intersection signal control was realized through the proposed dynamic signal optimization method. The experimental results showed that road network capacity was improved by 16% under the condition of high traffic flow by using the proposed optimization method. The proposed method can also alleviate the congestion of some sections without causing the transfer of congestion. The effectiveness of the proposed method was verified by simulation experiments, which can provide a theoretical reference for traffic control and management in the context of pre-trip reservation.

➢ SuA11 - 5 14 : 00 - 14 : 15

[223]Managing merging from a CAV lane to a human-driven vehicle lane considering the uncertainty of human driving

熊邦凯 北京交通大学
姜锐 北京交通大学

This paper proposes a control strategy for a freeway merging bottleneck consisting of a Connected and Automated Vehicle (CAV) exclusive lane and a human-driven vehicle (HDV) lane, aiming to achieve fuel economy and increase traffic efficiency. The trajectories of CAVs are optimized to enable them to smoothly merge into the gaps on the HDV lane. We utilize a stochastic car-following model to incorporate the uncertainty of HDVs and adopt the concept of α-percentile trajectory proposed in our earlier work (Xiong and Jiang, 2021) to estimate the trajectories of HDVs. Based on these, an optimization model is constructed to optimize the merging sequence and the merging trajectories of CAVs simultaneously. We use dynamic programming to solve the optimization model. Dividing RECTangles algorithm and Hamiltonian analysis are imbedded in it to obtain the energy efficient merging trajectory of each CAV. Simulation results show that the proposed control strategy is capable of reducing average fuel consumption and travel time under a wide range of inflow rates. The benefits depend on the inflow rate and the trajectory percentile α. When the total inflow rate is low, the impact of α is insignificant. If the total inflow rate increases to a high level, the impact of α becomes remarkable and the maximum benefits would be achieved at an intermediate range of α. Moreover, the computation efficiency of the proposed system is fast enough and can be implemented in real-time in the near future.

➢ SuA11- 6 14 : 15 - 14 : 30

[490] 三支决策理论在多属性/多准则决策中的应用研究

尹龙军 重庆邮电大学

在处理多属性/多准则决策问题时，现有的方法大多是通过对备择方案进行排序，然后选择排序第一的方案实施，而实际决策中，我们往往不需要对方案排序，只需要得到哪些方案是可行的（或者不可行的）；另外在对属性/准则的权重选取时，同一属性/准则在不同的备择方案中权重往往是相同的，这在某些情况下可能并不合理。本文采用三支决策的方法，通过比较对每一备择方案采取不同策略时的损失代价，将备择方案分类为三类：可行的、不承诺和不可行的。首先，本文利用阴影集中三个区域相互转换的思想，提出了对每一备择方案在每一属性/准

则下采取三种不同策略时所产生的损失函数的计算方法，然后利用贝叶斯决策原理，得到三支决策的阈值；其次提出了一种新的属性/准则权重的计算方法，可以确定同一属性/准则在不同备择方案下的权重；最后，数值实验结果表明了本文所提出的方法在处理多属性/多准则问题中是效性的和实用的。

➢ SuA11- 7 14 : 30 - 14: 45

[228]Inference of ride-splitting patterns and evaluation of CO2 reduction capacity

支丹月 北京交通大学
吕莹 北京交通大学

In the context of carbon neutrality and carbon peaking, the transportation sector has become a major and fastest-growing contributor to greenhouse gas emissions, promoting low-carbon travel patterns is critical to mitigate this problem. With the proliferation of 'mobility-on-demand' platforms, a technology-enabled new form of ride-hailing has emerged. Ride-splitting is a special kind of ride-hailing that can reduce carbon emission allowing passengers with similar routes to share trips. The forms of ride-splitting are complex, and although its simple patterns have been studied, there still lacks systematic and detailed exploration. This study aims to explore multiple patterns of ride-splitting systematically and compare the carbon reduction capacity of each pattern. First, this study derives the theoretical types of ride-splitting patterns and proposes the methods to identify different patterns, and then verifies them using empirical data from Beijing and Xiamen. The shared mileage of passengers in various patterns is calculated and combined with the COPERT model, the CO2 emission reduction of each pattern can be obtained. The results show that there are 20 ride-splitting patterns in empirical data, and they generally appear in the morning and evening peaks. The shared mileage under ride-splitting all follows the lognormal distribution, and it is on average 1.30 km less than the shortest route in the non-ride-splitting situation. By comparing the carbon reduction capacity of each pattern, we find that it is not the more trips involved in the ride-splitting that are better, but the capacity of the pattern with a maximum of three passengers in the vehicle simultaneously is the most outstanding. Moreover, the mean emission of CO, NOx, HC, and FC of ride-splitting trips is much lower than that of single trips. Our study provides convincing evidence for understanding the advantage of ride-splitting in reducing emissions, to support the promotion of low-carbon travel patterns.

➢ SuA11 - 8 14 :45 - 15 : 00

[76]Identifying intracity freight trip ends from heavy truck GPS trajectories

杨一涛 北京交通大学
贾斌 北京交通大学
闫小勇 北京交通大学
姜锐 北京交通大学

Intracity heavy truck freight trips are basic data in city freight system planning and management. In the big data era, massive heavy truck GPS trajectories can be acquired cost effectively in real time. Identifying freight trip ends (origins and destinations) from heavy truck GPS trajectories is an outstanding problem. Although previous studies proposed a variety of trip end identification methods from different perspectives, these studies subjectively defined key threshold parameters and ignored the complex intracity heavy truck travel characteristics. Here, we propose a data driven trip end identification method in which the speed threshold for identifying truck stops and the multilevel time thresholds for distinguishing temporary stops and freight trip ends are objectively defined. Moreover, an appropriate time threshold level is dynamically selected by considering the intracity activity patterns of heavy trucks. Furthermore, we use urban road networks and Point-of-Interest (POI) data to eliminate long-stay temporary stops to improve method accuracy. The validation results show that the accuracy of the method we propose is 88.79%. Our method incorporates the impact of the city freight context on truck trajectory characteristics, and its results can reflect the spatial distribution and chain patterns of intracity heavy truck freight trips, which have a wide range of practical applications.

➢ SuA11 - 9 15 :00 - 15 : 15

[837] 考虑土地利用性质的公交—地铁复合节点重要度识别方法

张梦瑶 北京工业大学
周雨阳 北京工业大学

城市公交—地铁复合交通系统作为一个复杂巨系统，衡量复合节点的重要性对城市公共交通运输网络的鲁棒性研究和应急管理具有重要意义。本研究利用北京市居民出行链数据及图论方法构建地铁—公交复合网络，引入客流量作为网络边权值，通过加权聚类系数与加权介数分别计算公交、地铁网络的节点重要度。根据地铁及公交站点的空间关系确定公交—地铁复合节点。考虑到交通站点所处地理区位及周边土地利用性质对站点客流的影响，将土地利用性质纳入复合节点的重要度影响因素，形成考虑交通网络拓扑结构、网络客流量及复合节点周边土地利用性质的公交—地铁复合交通网络复合节点重要度识别方法。本研究对公交—地铁一体化运营管理与高客流应急预警具有实际应用意义。

SuA12　　13 : 00 - 15 : 15
腾讯会议：483-667-636
交通系统建模与复杂性

主持人：孙凤兰　　重庆邮电大学
主持人：赵靖　　上海理工大学

➢ SuA12 – 1　　13 : 00 - 13 : 15

[174] 基于乘客异质性的早高峰单起点多讫点公交均衡研究

卢昱臻　　北京交通大学

分析早高峰单起点多讫点公交系统的均衡乘车行为。考虑乘客对拥挤敏感程度不同的异质性，分析其成本构成，乘客在拥挤成本、延误时间成本和乘车时间成本之间权衡，做出乘车班次选择，以此建立均衡乘车模型。通过数学推导，得出了不同类型乘客间混乘的状态和不同讫点乘客的乘车特点，并用算例验证了本文推导的结论。研究结果有利于加深对公交乘车行为的理解，进一步完善公交均衡模型的相关研究。

➢ SuA12- 2　　13 : 15 - 13 : 30

[191] 纯电动公交多模式充电调度优化

石意如　　北京交通大学
谢东繁　　北京交通大学

本文从纯电动公交车调度的角度出发，考虑快、慢充和换电三种充电模式，以最小化公交车辆成本、充/换电成本为目标，构建允许微调时刻表的纯电动公交车多模式充电调度优化模型，通过优化车次任务分配、充电模式、充电时间、时刻表微调多个决策变量，得到与全天电价协调、车辆购置成本合理的电动公交充电调度计划方案。并设计了定制遗传算法求解该模型，为提高求解精度，设计两阶段求解，第一阶段为调度问题的遗传算法求解，第二阶段为调度方案下充电计划枚举求解。采用北京市 651 路实际数据进行案例分析，结果表明模型算法针对电动公交车辆充电调度具有很好的适用性；线路用车数与充电模式存在博弈关系；采用多模式充电可以缓解运营高峰期充电压力。

➢ SuA12- 3　　13 : 30 - 13: 45

[501]Group Consensus of Heterogeneous Multi-Agent Systems Based on Cooperative-Competitive Networks with Packet Loss and Second-Order Agent Speed is Unknown

孙凤兰　　重庆邮电大学
武肖帅　　重庆邮电大学
朱伟　　重庆邮电大学

The group consensus problem of discrete-time heterogeneous multi-agent systems (MASs) is investigated, where the speed of second-order agents in the system is unknown and the system suffers from time delays and packet loss. Using the knowledge of graph theory and matrix analysis, and taking into account the cooperative-competitive relationship between agents under fixed and switched topological structures, a novel group consensus control protocol is designed using a frequency domain approach. Some sufficient conditions for group consensus are obtained, and the maximum upper bound on the allowed delay of the system is calculated. Finally, a series of simulation experiments are presented to verify the performance of the proposed control protocol.

➢ SuA12- 4　　13 : 45 - 14: 00

[224]Modeling multi-line bus bunching considering capacity constraint and transfer passengers' routing behavior

王智超　　北京交通大学
姜锐　　北京交通大学

The vast majority of studies on bus bunching have problems in modeling interaction among different bus lines since they depend on strict assumptions and oversimplified configurations. This paper is motivated to advance existing studies by taking into account capacity constraints and transfer passengers' routing behavior in multi-line configurations. First, we develop a capacitated bus motion model, within which the bus motions are determined by travel demand composed by

all passenger groups as well as transfer passengers. Then, a novel transfer-based transit assignment is proposed to obtain transfer passengers' routing choices and formulated as a Variational Inequality (VI) problem with the concept of approach-proportion. Numerical experiments contain an artificial example and a real-world case in Beijing. Artificial experiments are designed to show the mechanism by which the propagation of bus bunching was affected by capacity constraint, transfer passengers as well as their routing behavior. The real-world case assessed bus bunching effects and interactions among different lines under different setups.

➢ SuA12 - 5 14 : 00 - 14 : 15

[231] 基于 Seq2Seq 架构的理论与数据协同驱动的跟驰模型研究

王立峥 北京交通大学
谢东繁 北京交通大学

以往对车辆跟驰行为的研究大致分为理论驱动类模型和数据驱动类模型两大类。本文提出了一种理论与数据混合驱动的跟驰模型，使其具有理论驱动模型更高泛化能力和安全性的前提下，同时尽可能的具有数据驱动类模型较高的准确度。模型的主体架构采用 seq2seq 架构，进一步考虑预测值之间的序列依赖性从而实现结果多时间步预测输出，同时引入注意力机制进一步提升模型性能。利用理论模型仿真得到准确的安全数据，结合原始 NGSIM 数据构建新的数据集，通过混合数据集和考虑安全约束的方式训练新的协同驱动模型。通过实测数据对比与仿真验证，本文提出的模型在车辆轨迹复现上比 IDM 模型具有更高的预测精度，相较于传统循环神经网络结构也拥有更好的预测效果，同时车队仿真实验也证明了模型可以很好的模拟传统交通行为并且减少交通堵塞，提高交通效率。

➢ SuA12- 6 14 : 15 - 14 : 30

[208] 基于深度学习的数据驱动入匝道换道模型

韦凯 北京交通大学
谢东繁 北京交通大学

强制换道作为基本驾驶行为之一，影响着交通效率和安全。入匝道场景作为高速公路的典型瓶颈，该区域的车辆换道效率直接影响整个路网的吞吐量。由于入匝道和干线车辆速度不同的频繁换道和驾驶员驾驶行为的不确定性，对车辆换道过程的建模具有挑战性。为解决这一问题，本文提出一个基于数据驱动的入匝道车辆换道模型，采用双向长短时记忆网络对换道过程进行建模，利用 NGSIM（Next Generation Simulation）提供的入匝道车辆轨迹数据，对所提出的模型进行训练和测试。结果表明，所提出的车辆换道模型能够准确地预测入匝道车辆的换道轨迹。

➢ SuA12- 7 14 : 30 - 14: 45

[136] A multi-task ride-sourcing gap prediction method based on deep learning convolution

许广曈 北京交通大学
吕莹 北京交通大学
孙会君 北京交通大学

Ride-sourcing system is a typical part of the whole complex transportation system with rapid growth in recent years. As one of the most basic components of vehicle deployment, the supply and demand forecast has important theoretical and practical significance for improving the operational efficiency and service level of the ride-sourcing platform. The demand and supply have interdependence and spatiotemporal correlation, which makes it complex to study the generation mechanism of supply-demand gap. In view of the limitations of previous studies only using the outstanding orders to indicate the supply-demand gap, this paper first proposed a gap index considering both demand and supply. Then, a multi-task deep learning method named Fusion Convolutional Long Short-Term Memory (ConvLSTM) and 3D Convolution Network (MFLC-Net) is proposed for passenger demand and idle vehicle supply prediction of ride-sourcing platform. 3D convolutional layers and ConvLSTM layers are fused to better capture the spatial correlation and temporal continuity of explanatory variables. Other related features (weather conditions, driving speed, POI, etc.) are also feed into the network by module fusion to improve the prediction accuracy. The models are validated on real-world data in Xiamen. The results show that the two MFLC-Nets outperform the benchmark algorithms. For supply prediction, the MFLC-Net with full-variables outperforms the best benchmark 3D CNN by 25.5% in RMSE, and for demand prediction, it outperforms the best benchmark ConvLSTM by 10.01% in RMSE. Finally, according to the forecast results of the proposed model, the gap index

is also forecast by completing from the two aspects of supply and demand. Therefore, it is possible to grasp the spatial-temporal non-uniformity of supply-demand gap, analyze the distribution of gaps, and understand the internal mechanism for the formation. The impact of supply and demand on the whole ride-sourcing system is reflected.

➢ SuA12 - 8 14 :45 - 15 : 00

[227] 混合公交系统排班优化

余亚鹏 北京交通大学
谢东繁 北京交通大学

随着自动驾驶技术的发展，自动驾驶公交已经开始步入实践。未来几年，城市公共交通必将会朝着自动驾驶公交与传统电动公交混合运营的场景转变。基于此，本文将自动驾驶技术引入公交系统，并配备安全员以降低交通事故发生的概率，针对由自动驾驶公交和传统电动公交组成的混合公交系统，构建了一种基于传统电动公交人车绑定、自动驾驶公交人车不绑定的充电计划、车辆调度、人员排班协同优化模型。该模型考虑了快充、慢充、换电三种充电模式并存，续驶里程限制，驾驶员、安全员工作强度满足相关的劳动法规，班次衔接等约束，使得公交运营商总成本最小化。

➢ SuA12 - 9 15 :00 - 15 : 15

[410]Joint optimisation of regular and demand-responsive transit services

赵靖 上海理工大学
孙思诚 上海理工大学

This study aims to jointly optimise regular and demand responsive transit (DRT) services, which can offer opportunities for leveraging on their respective advantages. An optimisation model with the objective of minimising the total travel time of passengers and the total fleet size is proposed. The terminal bus stops of regular bus lines, the service area of the DRT, and the fleet size of both regular and DRT are optimised simultaneously. A rule-based optimisation preparation step is added to the proposed model to obtain a reasonable design scheme and to reduce the computational load. The model is solved using a tailored boundary-start-based two-step heuristic algorithm. The performance of the mixed network is affected by the preference of the decision maker and the operation mode adopted for the DRT service. A reduction in the operational level of the DRT results in a considerable increase in the travel time of DRT passengers.

SuB01 15 : 15 – 17 : 15
腾讯会议：663-542-505
交通系统、物流系统建模与复杂性

主持人：邝华 广西师范大学
主持人：龚燕萍 河南农业大学

➢ SuB01 - 1 15 : 15 - 15: 30

[483] 求解旅行商问题的波动降温模拟退火算法

陈晟宗 青岛大学
张纪会 青岛大学

针对传统模拟退火算法在求解旅行商问题时运算时间长，易陷入局部最优，且随着求解问题规模的增大缺陷愈发明显的情况，对传统算法的内循环过程和降温机制进行了改进，使内循环的搜索强度根据温度的变化自适应调整，同时提出波动降温机制，使得算法在保持温度幅值递减的总趋势下实现多次升温过程，增强了求解效果，缩短了求解时间，并通过 TSPLIB 数据库提供的大量实例得以验证。

➢ SuB01 - 2 15 : 30 - 15 : 45

[450]A novel mixed car-following model with consideration of self-stabilizing control under V2X environment.

蓝礼礼 广西师范大学
何金芳 广西师范大学
邝华 广西师范大学
白克钊 广西师范大学

Vehicle-to-vehicle (for short, V2V) communication technology is regarded as a promising technology to improve traffic efficiency and safety. In this paper, the characteristics of mixed traffic flow containing human-driving and autonomous cars are investigated. A novel mixed car-following model is proposed to simulate heterogeneous traffic flow by considering self-stabilizing effect of autonomous car under V2V environment. The stability condition of this model is obtained by applying the linear stability theory. The phase diagram comparison and analysis show that the mixed traffic flow can be stabilized with the increase of the percentage of the autonomous car. That is to say, autonomous car's self-stabilizing control effect can effectively enhance the stabilization of mixed traffic system. It is also found that autonomous car's the time gap between the current velocity and the historical

velocity has an important impact on the stability criterion. Furthermore, the evolution of traffic congestion and the corresponding energy consumption are discussed. The numerical simulation is carried out to validate the theoretical analysis results, and indicates that the autonomous car's self-stabilizing control effect play an important role in suppressing the traffic jam, reducing energy consumption, and improving the stability of the mixed traffic flow.

➢ SuB01- 3 15 : 45- 16 :00

[427]A New Three-lane Lattice Hydrodynamic Model Considering the Mean Expected Velocity Field Effect in ITS Environment

杨凤兰 广西师范大学
蓝礼礼 广西师范大学
邝华 广西师范大学
白克钊 广西师范大学

The modeling of traffic flow has become one of the most exciting topics and has attracted considerable attention in the field of system science and traffic engineering. In reality, most of the highways consists of multi-lanes (i.e., two or more than two lanes). However, almost all previous studies in terms of developing lattice hydrodynamic models are limited to one or two-lane system only. In order to improve the applicability of the lattice hydrodynamic model for real scenario, an extended three-lane lattice hydrodynamic model is presented to simulate realistic traffic by considering the mean expected velocity field effect in ITS (i.e., intelligent transportation system) environment. The stability condition of this model is obtained by using the linear stability analysis. The phase diagram comparison and analysis show that the mean expected velocity field plays an important role in improving the stabilization of traffic system. Furthermore, it is demonstrated that the considering the lane changing in three-lane traffic system is more effective than single-lane or two-lane traffic system to alleviate traffic congestion. Nonlinear analysis is performed to derive the mKdV equation by applying the reductive perturbation method and the evolution properties of traffic density waves are explored. Numerical simulation is carried out to validate the theoretical results, and indicates that traffic jam can be suppressed effectively via taking into account the mean expected velocity field effect in ITS environment.

➢ SuB01 - 4 16 : 00 - 16 : 15

[276]时空演化视角下地下轨道交通的脆弱性

周方 河南农业大学
龚燕萍 河南农业大学
宁一博 河南农业大学

为避免潜在的危险因素导致交通系统损毁的后果，针对当前理论知识与实践需求间存在较大差距的问题，提出在时间和空间的演化视角下降低地下轨道交通脆弱性的观点。基于复杂网络的基础理论，使用 Space L 法构建级联失效模型并计算各个站点对于蓄意攻击的脆弱性，以郑州市地铁网络为例，对比分析 2020 年、2022 年和 2024 年地下轨道交通网络的度分布和节点介数等情况，以鉴定对网络效率影响最大的关键站点。研究表明：地下轨道交通网络度数高的节点和介数高的节点并不完全相同，随着网络的演化重要节点又有新增，加快轨道交通建设的同时，对这些重要节点进行保护或者在周围增设可替代站点将会增加未来地下轨道交通网络鲁棒性。

➢ SuB01- 5 16 : 15 - 16 : 30

[306]城市多方式交通网络承载能力计算方法

赵芳 北京交通大学
四兵锋 北京交通大学

科学计算城市多方式交通网络承载力（Capacity of Urban Multimodal Transportation Network, CMTN）是优化配置交通资源的重要工作。已有研究多关注单方式交通网络，忽视了多种交通方式间的相互影响。本文从系统角度出发，研究了 CMTN 的计算方法。首先，基于超网络理论构建了多方式交通系统的超网络模型；其次，构建了计算 CMTN 的双层规划模型，上层为 CMTN 优化模型，下层为考虑多方式交通间影响的随机用户均衡模型；然后，分别设计了基于近似迭代与基于灵敏度分析的求解算法；最后，小规模算例验证了前者算法计算效果优于后者，基于 Sioux Falls 网络的算例进一步发现提高公共交通发车频率会增大 CMTN，而减小换乘费用却非如此，分析可知由于最短路概念是相对的，减小 OD 间出行费用不一定会增多出行备选路段，路段被饱和占用的概率不会必然减小，因而 CMTN 也不会必然增大。文章的贡献为考虑了交通系统中多种交通方式的相互影响下给出了 CMTN 计算方法。

➢ SuB01 - 6 16 : 30- 16 : 45

[316]基于列生成算法的自动定制公交系统调度优化

周广京 北京交通大学

自动驾驶技术引入定制公交系统对于提高通勤者的出行体验具有重要意义。本研究针对由自动驾驶车辆运营的定制公交系统，充分考虑速度调控和容量变化，构建了多目标非线性规划模型以实现自动驾驶定制公交的规划和运营。模型考虑了需求覆盖、车辆到站时间窗、车辆里程、载客人数等约束，最小化企业运营和乘客出行成本。并且对问题进行分解，提出了基于列生成的定制遗传算法对问题进行求解。案例证明本研究提出的算法解决了速度变化和路径选择的协同优化问题，相比“生成+选择”算法，效率提升了 95.6%。并且实际案例证明了自动定制公交因其灵活的速度调控和公交单元拼接特性，使部分定制公交规划线路可以进行合并，从而降低了运营成本和提高了乘客体验。

- SuB01 - 7 16 : 45- 17 : 00

[241] 基于无码头共享单车的出行扩张聚集特征研究

张沛然 北京交通大学
高亮 北京交通大学

无码头共享单车的行程具有无固定起讫点的特点，能够直接反映用户的出行需求。本文基于不同时间段内的单车订单，分别计算每一个小时内所有行程的起点间以及终点间的平均距离，以此衡量出行需求的空间分布。结果表明，一天之内，出行的分布具有离散到集中到离散的特征。接着，本文就起点与终点分布的差异性，提出了出行扩张指数，将出行划分为扩张型出行以及聚集型出行。本文发现，扩张与聚集与时间段有高度相关性。本文提出的扩张与聚集型出行识别能够从更加系统性的角度理解出行行为的动态性特征，有利于交通部门设定更具有针对性的措施，缓解交通压力。

- SuB01 - 8 17 : 00- 17 : 15

[352]Learning-based restoration sequence ordering for multi-site traffic signal failure

赵婷婷 北京交通大学

Traffic signal failures could result in significant local and system-level performance degradation. Sequencing the restoration of failed signals with limited resources is a challenging problem-capturing dynamic changing transportation system performance following a feasible solution requires tedious computation, and the short time frame for restoring failed signals makes these decisions time-sensitive and should be determined in a timely manner. Feasible Signal Restoration Sequence Ordering (SRSO) problem, as a critical building block to optimize the restoration sequence, has not been well-studied in the existing literature, nor have solutions to address the computational burden issue. In this work, a machine learning model based on Structural Recurrent Neural Network (SRNN) is proposed to predict system performance, i.e., aggregated accumulated total delay, following a given restoration sequence, to address the computational burden of the simulation-based performance evaluation. Spatio-temporal (ST) graph representation is leveraged in this methodology to take the topological information, i.e., how adjacent movements interact with each other, into consideration. Although microscopic simulation is used to obtain the ground truth performance, which is still time-consuming for a group of signal failure scenarios, a trained machine learning model can surrogate the tedious computation in the decision-making process in a timely manner. The challenges to build this machine learning model effectively and efficiently are two-folds. First, a transportation system is a typical dynamic system whose behavior is constrained by the topology of the network. Therefore, both spatial and temporal interactions between road sections should be captured to predict system performance effectively. Second, in the context of signal failure, system performance is exposed to a disrupted control strategy, which makes it even more challenging to predict system performance effectively. The original SRNN model could address the first challenge, and the movement feature representation and its integration to the SRNN model proposed in this work could address the second. A case study was conducted to demonstrate the operability and effectiveness of the proposed methodology. It is demonstrated that the signal restoration sequence could impact system performance during and after the restoration process significantly. Then, both Aggregated Accumulated Total Delay (AATD) prediction accuracy and the performance of restoration sequence ordering is evaluated for the case study network. Outcomes of the case study show that the learning-based model can help identify sequences ranked in top 8% of optional sequences referring to ground truth information. Furthermore, in terms of the fine-tune of the learning

rate, the Cosine-Annealing-LR strategy leads to both lower loss value, better ordering performance, and shorter delay experienced in the restoration process, compared to the Step-LR strategy.

SuB02　　15 : 15 – 17 : 30
腾讯会议：356-209-161
人工智能及类脑计算

主持人：于重重　　北京工商大学
主持人：王大辉　　北京师范大学

➢ SuB02 - 1　　15 : 15 - 15 : 30

[500]Ritt-Wu Characteristic Set Method for Laurent Partial Differential Polynomial Systems

胡又壬　　重庆交通大学

In this paper, a Ritt-Wu characteristic set method for Laurent partial differential polynomial systems is presented. The concept of Laurent regular differential chain is defined and its basic properties are proved. The authors give a partial method to decide whether a Laurent differential chain A is Laurent regular. The decision for whether A is Laurent regular is reduced to the decision of whether a univariate differential chain A1 is Laurent regular. For a univariate differential chain A1, the authors first give a criterion for whether A1 is Laurent regular in terms of its generic zeros and then give partial results on deciding whether A1 is Laurent regular.

➢ SuB02 - 2　　15 : 30 - 15 : 45

[383] 基于级联森林的不平衡样本癌症亚型分类研究

姜春晓　　山东科技大学

不同的癌症又细分为不同的亚型，而不同的癌症亚型对治疗方案有着截然不同的预后反应和治疗结果。癌 症亚型的发现和确定在癌症的治疗过程中至关重要。由于癌症亚型基因具有小样本、高维、样本不平衡等特点，利用传统的机器学习方法对癌症亚型进行分类仍具有一定的挑战，容易造成过拟合。gcForest 是机器学习算法和深度神经网络的结合，是一种决策树集成方法，其超参数比深度神经网络要少得多，其模型的复杂度可以以一种依赖于数据的方式自动确定，无需使用反向传播就可以实现深度模型，它的性能对超参数设置具有相当强的鲁棒性。另外，由于样本数据中有一些冗余特征，我们对样本进行了特征提取。特征提取主要应用的是决策树的方法，实验表明，它有效提升了分类模型的分类性能。

➢ SuB02 - 3　　15 : 45 - 16 : 00

[283] Mask Wearing Detection Based on Deep Learning under complex illumination conditions

冉鹏飞　　青岛大学
赵东杰　　青岛大学未来研究院
于继宇　　青岛大学
徐茂　　青岛大学
朱林　　青岛大学
Shuzhi Ge　　新加坡国立大学

COVID-19 has sickened hundreds of millions of people and severely affected the global economy. Wearing a mask can minimize the spread of COVID-19, and mask inspection is also an important means of epidemic management in crowded places. However, the mask wearing detection task is often disturbed by complex illumination. To solve this problem, this paper proposes an improved mask checking algorithm (YOLOMWD) based on YOLOV4 under complex illumination. YOLOMWD first introduce the dual attention mechanism model in the backbone feature extraction network, and then adde a cross-stage local network in the feature pyramid part. In order to increase the number of samples under complex illumination, this paper proposes an image screening algorithm to select samples that satisfy complex illumination. The experimental results show that the mean average precision of YOLOMWD can reach 92.1% under complex and changeable illumination conditions, which is higher than 80.9% of YOLOv4, and higher than 74.4% of the two-stage detection algorithm Faster R-CNN.

➢ SuB02 - 4　　16 : 00 - 16 : 15

[32] 基于多主体分布式宽度学习的多特征脑电情绪识别

施水玲　　昆明理工大学
刘文奇　　昆明理工大学

近年来，情绪识别已成为人工智能领域的一个研究热点。脑电图(EEG)数据是情绪识别研究领域的常用数据。本文将分布式学习的思想运用于宽度学习对脑电特征进行建模，提出了多主体分布式宽度学习（Multi-agent distributed broad learning system，MAD-BLS），该方法先对脑电特征进行手工多特征提取，然后将提取到的多特征作为输入送入 MAD-BLS。在”DEAP”数据集上，通过该方法对多特征脑电情绪进行分类，发现该方法能够有效地提高分类

精度。另外，该方法也表明，多主体之间的相互作用会明显影响脑电情绪识别效果。

➢ SuB02 - 5 16 : 15- 16 :30

624 物理神经网络研究现状与展望

田松岩 中山大学
陈洪波 中山大学

神经网络往往被认为是“黑箱”模型，因此主要用于大数据领域，挖掘未知的潜含规律。而在流体力学等第一性原理占主导的学科，神经网络的主要应用方法仍基于数据，多用于试验数据处理，或基于高精度数据提高湍流模型预测精度。2017 年出现的物理神经网络，将控制方程融入神经网络损失函数，通过物理约束极大地降低了训练数据量及求解空间，打破神经网络“黑箱”的面纱，令神经网络技术在流体预测、热传递问题等微分方程控制的物理场求解中大放异彩。本报告重点介绍物理神经网络的研究现状，从神经网络在流体力学领域的典型应用出发，介绍物理神经网络的提出与意义，并从应用的网络类型、研究重点等方面详细分析其发展现状。

➢ SuB02 - 6 16 : 30 - 16 : 45

103 Controllability Analysis of InSCC Topology

肖朋朋 国防科技大学
纪志坚 国防科技大学

This paper studies the controllability of a class of multi-agent systems. The concept of InSCC structure is proposed for the first time, and the topology composed of InSCC structure, InSCC and road map is analyzed by using tools such as PBH criterion. To ensure the controllability of the system, we provides a leader selection method. Inspired by this, based on the InSCC structure, the communication edge is added between different InSCC structures and the road map. It is proved that adding the communication edge in a certain way does not change the controllability of the multi-agent system. At the same time, according to these InSCC structural characteristics, the controllable subspace of more general network topology is estimated, and the lower bound of the dimension of controllable subspace is obtained. According to the characteristics of InSCC structure, this paper provides a construction method of controllable topology, and gives necessary and sufficient conditions for the controllability of multi-agent system with InSCC structure under switching topology according to the characteristics of InSCC structure and the choice of leaders. Finally, several numerical examples are given to verify the relevant conclusions.

➢ SuB02 - 7 16 : 45- 17 : 00

196Intelligent Online Tuning Control Method Based on an improved Wavelet Neural Network and NARX Prediction

朱爱云 青岛大学
于海生 青岛大学
孟祥祥 青岛大学

Most industrial processes exhibit inherent nonlinear characteristics. Hence, classical control strategies which use linearized models are not effective in achieving optimal control. Therefore, artificial intelligent based improved classical control is highly valued in control fields. In this paper, Firstly, an improved BP neural network based PID method and an improved wavelet neural network based PID method are proposed to control a nonlinear double tank liquid level system. Secondly, NARX prediction- based WNN PID method is proposed. The NARX neural network is designed as a time series predictor to predict the output of the control system, then control parameters are adjusted according to the predicted output. Thirdly, comparative simulations of all the above methods are implemented to verify the improved effects.

➢ SuB02 - 8 17 : 00 - 17 : 15

277Indoor Navigation based on Deep Reinforcement Learning with Potential Energy and Curiosity Mechanism

朱林 青岛大学
赵东杰 青岛大学
徐茂 青岛大学
牛超群 青岛大学
Shuzhi Ge 新加坡国立大学

Robot navigation research is the basic research of robots. Current researchers use deep reinforcement learning for robot navigation that can learn navigation strategies from raw sensory input without relying on maps. However, it is difficult for deep reinforcement learning to learn effective policies in sparse reward environments, and indoor navigation environments are reward sparse environments. To address this issue, we design the potential-based external reward function to enable the

robot to learn an efficient navigation strategy. Meanwhile, curiosity is used as an internal reward to encourage the robot to explore better navigation strategies. To test our designed method, we design two real simulation environments using ROS and Gazebo, and select PPO as the basic deep reinforcement learning algorithm. Experiments show that our method can help PPO learn the navigation strategy with the average navigation success rate of 58.87% in the static simulation environment and the navigation strategy with the average navigation success rate of 35.94% in the dynamic simulation environment. Meanwhile, the basic reinforcement learning PPO algorithm can not learn the effective navigation strategy in both environments.

➢ SuB02 - 9 17 : 15 - 17 : 30

[802]Brain-inspired Highly Energy-Efficient Stochastic Computing System Based on Memristors

赵钰迪 北京信息科技大学
缪旻 北京信息科技大学

In the era of big data, the amount of data is explosively growing every day especially the non-structured data such as pattern, voice and video. However, due to the von Neumann bottleneck, the traditional computing paradigm is hard to handle the task of large amount of non-structured data. In recent years, brain-inspired computing system has developed rapidly and has demonstrated great advantages in the fields of recognition and information processing. In this work, the highly fault-tolerant and energy-efficient memristor-based brain-inspired stochastic computing system will be introduced to realize image processing tasks. Different from the traditional binary computing, stochastic computing operates on stochastic bit-steams, which emulates the neural spikes processed by the brain in the form of long sequences of noisy voltage spikes, with the key features of using low-cost and low-power logic elements to implement complex numerical operations. To address the issue of the huge hardware and energy consumption overhead brought by traditional CMOS-based random number generator, we employ the intrinsic physics of the emerging memristor device as the true random number source, which has the advantages of simple structure, low cost and low power consumption. Specifically, new models and computing algorithms are developed for the device-circuit co-design of the whole system. The established stochastic computing system demonstrates excellent performances in image edge detection and image compression tasks. Moreover, we combine the computing and storage together using the memristor-based nonvolatile logic to further improve the energy efficiency of the system, which demonstrates the superiority in terms of seamless conversion, excellent parallelism and reconfiguration. This work can provide crucial architecture and design methods for brain-inspired computing chips that break through the energy efficiency bottleneck of von Neumann architecture.

SuB03 15 : 15 – 17 : 15
腾讯会议：935-712-196
人工智能、系统安全及系统建模

主持人：倪渊 北京信息科技大学
主持人：何建辉 江苏科技大学

➢ SuB03 - 1 15 : 15 - 15: 30

[816]基于 ARIMA 和 LSTM 的黄淮海平原土壤含水量预测

丁玉盼 重庆交通大学

黄淮海平原常见旱涝灾害，这两种灾害与土壤水分密切相关，土壤水又对农业生产来说必不可少，因此对黄淮海平原一带农田土壤的含水量进行预测至关重要。本文选取了 2019 年到 2021 年河南封丘农业生态实验站的不同深度的土壤含水量监测数据，对不同监测区各个土壤深度分别建立了差分自回归移动平均模型(ARIMA)模型和基于 Adam 优化算法的长短期记忆网络(LSTM)模型。结果显示 ARIMA 模型和 LSTM 模型的均方根误差分布范围分别为[0.1617,0.4808]及[0.0195,0.15]，两者的可决系数分别为[0.7689,0.9738]及[0.9775,0.9996]；LSTM 模型整体拟合效果高于 ARIMA 模型，其中 ARIMA 模型在 20cm，30cm 及 110cm 处拟合效果较好，LSTM 模型则在不同深度的土壤含水量预测中均具有更好的预测能力。研究成果为黄淮海平原一带农田土壤含水量预测提供了参考模型，有利于提高监测长期农田土壤水分的准确性，对农作物生长具有重要意义。

➢ SuB03 - 2 15 : 30 - 15 : 45

[631]A Two-Stage Network for Age Estimation by Fine-Grained Learning and Label Attention

胡春龙 江苏科技大学

Image based human age estimation has been an important task in the field of face attribute recognition. Concerning the greatest dilemma of age estimation is the similar appearance of adjacent age labels, this paper presents a two-stage age estimation model based on the idea of coarse-to-fine decision strategy and fine-grained feature learning mechanism. Firstly, a global deep network is employed to perform a global age estimation, then an adaptive age range is obtained for each image by local adjusted the global age estimation result. The first stage gives the global age trend of the input image. Secondly, in the second stage, a local regression in generated coarse age range is performed based on a sub-network combining label attention mechanism and hierarchical fine-grained feature pooling. The proposed label attention provides guidance of age-sensitive regions for fine-grained age distinguishing in the second stage. The formulation of the proposed two-stage framework is intuitive and end-to-end trainable, and experiments on two popular age estimation benchmarks achieve the state-of-the-art results.

➢ SuB03 - 3 15 : 45 - 16 : 00

[634]Compact facial age estimation by multi-modal distribution learning

何建辉 江苏科技大学
胡春龙 江苏科技大学

Facial age estimation is promising for a wide range of applications in security access control, biometrics, recommender systems, and human-computer interaction. Current age estimation methods based on classification and regression usually ignore the ordinal information and inter-class correlation embedded between age labels. The estimation methods based on label distribution learning focus on the ambiguity of age labels, but suffer from the problem of inconsistent training and testing objectives. In this paper, we combined the ideas of label distribution learning and multi-task learning and propose a new age label coding method called MPD (Multi-Peak Distribution), which incorporates multiple peak-shaped age distributions and enriches the stage and ambiguity representation of age labels. The prediction results are then shared with the regression task learning, which improves the accuracy of age prediction by avoiding the direct-to-regression error propagation of distributions in cascade learning. In addition, we construct a lightweight neural network model with parameters and size only 1/786 and 1/700 of VGGNet.Our experimental results on two age estimation datasets, MORPH II and MegaAge, show that the model can obtain state-of-art estimation accuracy.

➢ SuB03 -4 16 : 00 - 16 : 15

[828]Fractional modeling and parameter identi cation of lithium-ion battery

蒋泽宇 南通大学
李俊红 南通大学
顾菊平 苏州科技大学

To simulate and control the lithium-ion battery system more effectively, it is necessary to establish a specific physical model of lithium-ion battery. The partnership for a new generation of vehicle (PNGV) model is a kind of equivalent circuit models which has low-complexity. Firstly, this paper introduces the PNGV model, and then derives the fractional PNGV model improved by fractional-order impedance elements. Furthermore, a random mutation ant colony optimization (RMACO) adapted to the fractional parameter identification is proposed, which uses the collected voltage and current data to perform parameter identification of the fractional PNGV model. Finally, the proposed algorithm is compared with the particle swarm optimization (PSO) algorithm, the absolute error and the average relative error of the RMACO are all less than the PSO. The results show that the RMACO has better parameter estimation effectiveness.

➢ SuB03 - 5 16 : 15- 16 :30

[638]基于深度 Q 网络与行为克隆算法的无人机路径规划

孔富晨 江苏科技大学
王琦 江苏科技大学
于化龙 江苏科技大学
高尚 江苏科技大学

无人机因其体积小、机动性强、灵活便捷等优点在诸多领域都得到了广泛的应用。针对无人机路径规划问题的研究也成为了一个重要的课题。本文使用深度 Q 网络、行为克隆算法与人工势场法相结合来为无人机寻找最佳路径，人工势场法作为指导智能

体选择动作的先验知识的同时，也作为行为克隆算法参考的专家策略，并使用改进的神经网络将深度 Q 网络与行为克隆算法进行结合，最终智能体的动作由网络输出的 Q 值与网络输出的动作分布综合产生。本文在栅格化的环境中对提出的算法进行了测试，仿真实验表明，与经典深度 Q 网络相比本文提出的算法具有更快的收敛速度与更强的鲁棒性。

➢ SuB03 - 6 16 : 30 - 16 : 45

627 基于高阶关联矩阵的抗噪声储备池算法

刘胜钰 北京邮电大学
高健 北京邮电大学
Jinghua Xiao 北京邮电大学

随着神经网络在混沌研究领域得到越来越广泛的关注和应用，一种新型的的递归神经网络算法——储备池计算，以其简单的结构和训练方式，给混沌时序预测带来了新的突破，尤其是最近提出的 NG-RC 算法[1]，比传统储备池计算需要更少的训练成本且能带来更好的预测效果，但储备池算法仍缺乏对噪声处理的有效方式。本文中，我们提出了一种新型的抗噪声储备池算法，即将储备池计算与 HOCC 算法[2]相结合,利用噪声与关联向量的去相关性质达到抗噪目的。新算法无论在无噪还是有噪的情况下，预测效果都逼近两种算法的最优值，继承了两种算法各自的优点。这一研究较显著的提高了储备池算法的抗噪能力，对学习和预测实验数据等含有噪声的时间序列具有应用价值。参考文献：[1]Gauthier D. J., Bollt E., Griffith A., et al.. Next generation reservoir computing[J]. Nature Communications, 12, 5564, 2021. [2]Zhang Z., Zheng Z., Niu H., Mi Y., Wu S. and Hu G.. Solving the inverse problem of noise-driven dynamic networks[J]. Physical Review E, 91(1), 012814, 2015.

➢ SuB03 - 7 16 : 45 - 17 : 00

663 基于 DDQN 和 Q 学习联合策略的双阶段无人机动态路径规划算法

潘德民 江苏科技大学
王琦 江苏科技大学
于化龙 江苏科技大学
高尚 江苏科技大学

无人机因具备多项优点，已在许多领域得到广泛应用。其自身在导航、控制等方面所面临的技术挑战也逐渐成为当下研究热点。针对动态障碍存在的环境中无人机路径规划需求，本文提出了一种基于 DDQN-Q 学习联合策略的双阶段无人机动态路径规划算法。与传统单一强化学习算法进行路径规划的方法相比，本方法将 DDQN 与 Q 学习进行优化组合，分阶段处理静态和动态障碍物，避免了动态障碍在单一算法情况下对 Q 值网络拟合的不良影响。其次，本文提出一种启发式探索策略，以加快算法的训练速度，并采用 B 样条曲线法处理轨迹规划结果，以产生符合无人机运动学特征的无碰撞路径。实验仿真结果证明，在不同场景下应用该方法可以有效的提升无人机动态路径规划的整体性能。

➢ SuB03 - 8 17 : 00- 17 : 15

654Preventing False Data Injection Attacks in LFC System via the AEG Model and KF Algorithm

张志勋 东南大学
胡建强 东南大学
卢剑权 东南大学
曹进德 东南大学

The load frequency control (LFC) system, as an important component to maintain the frequency stability of the smart grid, is vulnerable to invisible false data injection attacks (FDIAs). These FDIAs can bypass the bad data detection (BDD) system and do enormous damage to SG operations. This paper proposes a detection and defense model against unobservable FDIAs in LFC system based on the combination of the attack-detection evolutionary game (AEG) model and Kalman filtering (KF) algorithm. Two detection algorithms of AEG model including support vector machines (SVM) and K-Nearest neighbor (KNN) are trained by collecting the historical data of the frequency deviation, the tie-line power deviation and the active power load deviation in the system responding to two different kinds of FDIAs. The optimal detection algorithm is provided by analyzing the evolution of the equilibrium point of the game. Furthermore, a defense method based on the KF algorithm is proposed, in which the optimal control signal is estimated and issued to the LFC system in order to restore the system frequency stability. Simulation results on a two-area interconnected power system demonstrate the effectiveness of the proposed detection and defense strategies.

SuB04 15 : 15 – 17 : 15
腾讯会议：918-721-390
人机交互协同与网络安全

主持人：李辉 北京师范大学

主持人：孟飞　　上海理工大学

➢ SuB04 - 1　　15 : 15 - 15 : 30

656G-quadruplex and Au-NPsdual signal amplificationopticalmicrofiber interferometerbiosensor

陆杭林　　广西师范大学

An ultrasensitive detection deoxyribonucleic acid (DNA) optical microfiber interferometer biosensor is proposed that uses G-quadruplex and gold nanoparticles (Au-NPs) assistance for dual signal amplification. The G-rich single-stranded DNA (DNA-r) was immobilized on the surface of Au-NPs, it will self-fold to form the G-quadrant when it captured the potassium ion (K+), and the G-quadrant stacked to form the G-quadruplex. The DNA detection was adopted "sandwich" strategy, a probe DNA (DNA-p) was immobilized on the surface the optical microfiber inter-ferometer, and then hybridization with the target DNA (DNA-t) to realize detection, after it, the DNA-t hybridization with the DNA-r (binding with Au-NPs) to realize signal amplification. The experimental results demonstrate that assistance of Au-NPs and the G-quadruplex dual signal amplification, the linear detection range from 0.1 fM to 10 nM with a limit of detection (LOD) of 0.13fM. The proposed amplification strategy shows high sensitivity, stability, and reproducibility and can become a promising platform for other biological samples detection.

➢ SuB04 - 2　　15 : 30 - 15 : 45

786 基于卵巢囊肿超声图像的轻量级深度学习分类模型

刘娟琴　　北京信息科技大学
范军芳　　北京信息科技大学
李俊贤　　北京信息科技大学
豆登辉　　北京信息科技大学

卵巢囊肿作为育龄妇女的一种常见病，筛查方式主要采用超声检查。近年来越来越多的超声检查，增加了医生的工作量，同时超常工作量带来的漏诊误诊也会对病人的病情产生负面影响，甚至导致医疗费用的增加。我们提出了一个用于卵巢囊肿分类诊断的轻量级深度学习网络，即 Ocys-Net。此方法采用反向瓶颈设计策略设计基础模块，提取卵巢囊肿病理全局特征信息，同时使用有效的通道注意(ECA)模块，使网络对病理关键特征信息给予足够的关注，并有效弥补通道降维带来的缺陷。此方法考虑了模型的高效学习性能，并获得了高达 95.93%的分类精度。结果表明所提出的方法在临床环境中具有一定可行性，可为临床医生快速识别和诊疗卵巢囊肿提供一种新方法。

➢ SuB04 - 3　　15 : 45 - 16 : 00

581Conformable 分数阶随机 SIR 模型的参数估计

聂娜　　武汉科技大学
蒋君　　武汉科技大学
冯育强　　武汉科技大学

本文给出了分数阶 SIR 模型和相应的随机模型，利用概率生成函数得到分数阶随机 SIR 模型与分数阶 SIR 模型之间的关系。给出了分数阶随机 SIR 模型的极大似然估计和 MCWM 算法的参数估计结果。最后利用英国寄宿学校的数据对比了分数阶随机 SIR 模型和整数阶随机 SIR 模型的参数估计结果，结果表明分数阶随机 SIR 模型拟合原始数据效果更好，且参数估计的误差更小。

➢ SuB04 - 4　　16 : 00 - 16 : 15

267 基于改进 3D U-net 神经网络的脑部 CT 肿瘤图像分割方法

王浩聪　　山东科技大学
孙裕洋　　山东科技大学
陈明　　山东科技大学

近年来，随着高端医学影像技术的发展，三维、高精度的医学影像大数据在各种系统疾病诊疗中起到了关键的作用。如何从大量信息中快速准确提取感兴趣信息一直是研究和技术开发热点。对于以体素存储的三维医学影像数据，图像可以看作由块状组成，如果对图像一片一片进行分割效率很低，而且处理块状数据的预处理方式又比较繁琐，导致模型的精度和准确率不高。针对三维体素存储的 CT 图像，我们将 ResNet 残差模块与 3d U-Net 进行组合训练，使用 random crop 技巧将图片随机裁切成固定大小的模块，并将未标记的像素设置为 0，让网络更好的学习肿瘤粒子，从而达到普适性地特点，针对训练过程中的梯度震荡问题，使用 Batch Normalization 实现数据归一化处理，残差模块的加入使得 Batch Normalization 梯度的传输更加便捷。数值实验中使用了三维脑部肿瘤 CT 图像，实验结果表明该分割模型的准确率得到了提升。

➢ SuB04- 5　　16 : 15- 16 : 30

672Leader-following Consensus Control of Unknown Nonlinear MASs under False Data Injection Attacks

王梅溶　　东南大学

胡建强 东南大学
曹进德 东南大学

This paper studies distributed leader-following consensus problem of unknown nonlinear multi-agent systems (MASs) under false data injection attacks (FDIAs), where the followers connected to the leader may receive the injected false data from the leader. Fuzzy logic systems (FLSs) are applied to approximate the unknown nonlinear dynamic by estimating the weight matrix. The observers are proposed to estimate the follower's state, the injected false data and the weight matrix of the unknown nonlinear functions, then the resilient consensus control protocol is designed to offset the impact of the attacks and the existence of the unknown nonlinear dynamic. Two algorithms are presented for undirected and directed communication topologies respectively to guarantee each follower synchronizes to the leader within the bounded error. Finally, the simulation results verify the feasibility of the proposed consensus algorithms.

➢ SuB04 - 6 16 :30- 16 : 45

[596]Resilient Penalty Function Method for Distributed Constrained Optimization under Byzantine Attack

许晨涛 东南大学
刘庆山 东南大学

Distributed optimization algorithms have the advantages of privacy protection and parallel computing. However, the distributed nature of these algorithms makes the system vulnerable to external attacks. This paper presents two penalty function based resilient algorithms for constrained distributed optimization under static and dynamic attacks. The objective function of the optimization problem is extended to non-smooth ones and the convergence of the proposed algorithms in this case are proved under some mild conditions. Simulation experiments are performed and compared with some existing resilient primal-dual optimization algorithms using median-based mean estimator. For static attack, the proposed algorithm has better performance and faster convergence rate in the simulation experiments. For dynamic attack, the proposed algorithm has better performance and robustness in the simulation experiments, which illustrate that the proposed algorithms are more effective.

➢ SuB04- 7 16 : 45 - 17 : 00

[23] 论中医学的基础方法论是归属论

薛公佑 北京中医药大学

学界当前对中医学方法论的认识尚不统一，阻碍了中医学的传承与创新。出现此种现象的主要原因有二：一是目前中医学公理尚不明晰，二是部分学者对方法论与方法间的界定不明，将某些中医方法误作方法论。借系统科学语境将中医哲学诠释为关系场论后，可彰显中医哲学的公理性，揭示中医学的理论实在乃是关系场实在，中医学的方法论则可以概括为归属论。归属论的内涵有三：一是辨识事物的关系场之属，即确定事物所处的系统层次，二是辨识事物在场内的关系之属，即辨识所进行认知事物的内在组分与何种关系模型契合，三是恢复组分之正属，即恢复事物在关系协调稳态中应有的位置。归属论与还原论的区别在于其反基础主义的特性，适于处理作为元整体的系统。

➢ SuB04 - 8 17 : 00 - 17 : 15

[50] 中医经络本质与气血关系的系统学讨论

赵良举 重庆大学

从天人合一的思想出发，把人体当作一个动力系统，与火电厂系统进行对照分析，发现经络系统对人体的作用与疏水系统对电厂的作用类似，提出了经络呼吸辅助系统假说。假说认为经络是一个组织间隙通道，收集人体代谢产生却未能进入血液循环系统的废气和废液，并将其通过皮肤毛孔排出体外。在此基础上，探讨经络系统与血液循环系统和淋巴系统的关系，发现经络系统在解剖学上与淋巴前通道系统是同一系统，起着调节微循环和代谢的作用。从阴阳哲学出发，探讨气与血的关系。《黄帝内经》提到宗气、卫气和营气三种气，有宗气行呼吸、卫气和营血的说法。用现代医学解释三种气的化学成分，发现“血为气之母、气为血之帅”的原理，探讨卫气调节营血的作用。

SuB05 15 : 15 – 17 : 30
腾讯会议：627-623-776
群体智能理论及应用

主持人：刘文奇 昆明理工大学
主持人：刘磊 上海理工大学

➢ SuB05 - 1 15 : 15 - 15 : 30

[660] 一种半角距离变化的差分进化处理约束优化问题

苟辉朋 贵州民族大学
潘峰 贵州民族大学

李伟 贵州民族大学

针对传统差分算法在求解约束优化问题时存在收敛速度慢、精度低等问题，提出了一种基于半角距离变化的差分进化算法 HDDE。此方法由父代产生两个子代，利用可行性规则选出最好的子代，再对选出的子代进行约束违反度预处理。当满足半角距离变化，则计算子代的真实约束违反度，否则子代的约束违反度为无穷。若经过预处理之后的子代约束违反度小于父代的约束违反度，使用可行性规则比较，否则保留父代。通过对 12 个基准约束优化问题仿真表明，HDDE 在收敛速度、精度方面有一定的优势。

➢ SuB05 - 2 15: 30 - 15 : 45

[30]Distributed Multi-Agent Learning is More Effectively than Single-Agent

柯淑雅 昆明理工大学
刘文奇 昆明理工大学

Interpretable distributed group intelligence techniques have emerged as an essential topic in artificial intelligence. The mathematical interpretability of prediction outcomes is critical for improving the reliability of machine learning, especially in random scenes. Although some experimental results published so far show that the prediction of group intelligence is better than individual intelligence, establishing a mathematical foundation for the superiority of distributed group intelligence is still a challenging problem for enhancing the interpretability of learning systems. Through the Radermacher complexity principle, we proved mathematically that the learning quality of group machine intelligence is better than its subset machine intelligence with a high probability, significantly better than any individual among them if the number of individuals in the group is large enough. We proposed a multi-agent distributed learning method for time series forecasting by incorporating multi-agent cooperation in cognitive processes into machine learning. In addition, since the way of cooperative interaction between multi-agent affects the training effect of the model, we provide a generalized interaction approach and prove its convergence. We conduct sufficient experiments on predicting time series for classically chaotic systems, and the results indicate that distributed group intelligence significantly improves the prediction accuracy of individual intelligence. The experiments result shows that the prediction error reduces substantially as the number of agents increases, confirming the theoretical accuracy and the model's validity. This work provides new ideas for theoretically exploring how group intelligence emerges.

➢ SuB05 - 3 15 : 45 - 16: 00

[689] 一类具有输入时滞的线性多智能体系统在切换拓扑条件下的一致性控制方法

李长江 江苏科技大学
暴琳 江苏科技大学
叶树霞 江苏科技大学
王梓池 江苏科技大学
王建树 江苏科技大学

本文研究了一类线性网络化多智能体系统的一致性控制问题。考虑的网络拓扑为非对称切换拓扑，考虑的网络时滞为固定输入时滞。通过网络化预测方法估计滞后状态，在此基础上提出一种基于网络化预测的一致性控制方法。通过一定的状态变换和 SIA 矩阵分析，建立了系统的一致性条件。结果表明，如果系统拓扑矩阵具有一个周期性的有向生成树，且各智能体系统矩阵不具有单位圆外的特征值，那么协议可以保证系统的渐进一致性。通过数值仿真证明了该结果的有效性。研究中给出的状态变换和 SIA 矩阵相结合的分析方法，对于分析含自身滞后状态的一致性控制系统的一致性，具有一定的理论意义。

➢ SuB05 - 4 16 : 00 - 16 : 15

[114] The construction of controllable graphs based on equipotential node

刘萌萌 青岛大学
纪志坚 青岛大学

This paper conducts a preliminary investigation into the relationship between the eigenvalue of Laplacian matrix and the controllability of multi-agent system with multi-signal input. Through plentiful studies of topologies, we discuss the dimensions of the controllable subspace of system with single-signal input and multi-signal input. A class of controllable graphs obtained by analyzing the graphs of five nodes in detail, and the forms of the eigenvectors of their Laplacian matrices are given in this paper. A leader selection method is provided that makes multi-agent system is controllable. In addition, we discover the relationship between the topological

structure of new graphs and the eigenvector of Laplacian matrix, which is the key step of arriving at these conclusions.

➢ SuB05 - 5 16 : 15 - 16 : 30

659 一种基于自适应进化的混沌布谷鸟搜索算法

李伟 贵州民族大学
潘峰 贵州民族大学
苟辉朋 贵州民族大学

针对基本混沌布谷鸟搜索算法(CS)的精度低、收敛速度慢等缺点，本文提出一种基于自适应进化的混沌布谷鸟搜索算法(Chaotic Cuckoo Search Algorithm based on Adaptive Evolution)．该算法在初始化种群阶段就采用了 Logistic 映射机制来增加种群多样性；然后利用自适应进化机制对新解进行动态调整；最后根据双扰动策略对种群进行扰动之后再选择丢弃. 全局优化基准函数的仿真结果表明，AESCCS 算法优于原来的 CS 算法，具有精度高、收敛速度快、强鲁棒性来找到全局最优的优点．最后，利用 AESCCS 算法解决了一个焊接设计优化问题，结果与其他文献比较有较好可行性．

➢ SuB05 - 6 16 : 30 - 16 :45

543 融合反向学习与精英演化的哈里斯鹰优化算法

李雨恒 江苏科技大学
高尚 江苏科技大学
于化龙 江苏科技大学
孟祥宇 江苏科技大学

为了提升哈里斯鹰优化算法的寻优精度和鲁棒性，提出一种融合反向学习与精英演化的哈里斯鹰优化算法(OEHHO). 首先，引入精英反向学习机制，以动态变化的精英中心为对称中心进行反向学习，从而优化种群结构，提升种群质量，增强算法跳出局部最优的能力；其次，对探索阶段位置更新公式增加随机扰动以增强算法的全局探索能力，对逃逸能量更新公式进行改进以更好地平衡算法的探索和开发能力；最后，引入精英演化策略，并根据自适应概率选择精英交叉和精英融合来进行演化，增强算法局部开发能力，加快算法收敛速度。为验证 OEHHO 算法的有效性，本文选取 15 种标准测试函数，将 OEHHO 算法与 HHO 算法、其他改进 HHO 算法、其他群智能算法进行仿真实验. 实验结果表明，OEHHO 算法能够较好地平衡探索和开发能力，寻优精度更高，鲁棒性更强.

➢ SuB05 - 7 16 : 45 - 17 : 00

458 矩阵结构遗传算法

潘峰 贵州民族大学

针对传统遗传算法在函数优化问题中的不足，提出构建一种矩阵结构种群的遗传算法 MGA（Matrix Structure Genetic Algorithm）。MGA 采用矩阵形式的数据结构，借助于矩阵的行、列及主对角线等概念描述种群，并在此结构上对选择、交叉和变异三种算子均进行改进。选择算子是通过逐行寻优构建父代精英种群，具体操作是每行最优个体移动到所在行的主对角线位置；交叉算子采用父代精英种群中任意两个个体 $A(i,i)$和 $A(j,j)$交叉产生两个子代个体 $A(i,j)$和 $A(j,i)$，并分别置于关于主对角线对称的位置(i,j)和(j,i)；变异算子是对种群全体逐一进行克隆变异，若克隆变异结果优于原个体则选择克隆变异结果，否则不变。经过上述三步的若干次循环迭代，最终以矩阵种群中的最优个体为问题的最优解。通过对若干函数优化问题的实验测试表明，该方法收敛速度很快，全局收敛性能显著提高，可以推广到其它演化算法。

➢ SuB05 - 8 17 : 00 - 17 : 15

123 基于模拟退火机制的自适应粘性粒子群算法

孙一凡 青岛大学
张纪会 青岛大学

为了进一步提升粒子群算法在离散优化问题中的性能，针对粘性二进制粒子群算法缺乏全局搜索能力、容易陷入局部最优和收敛速度慢的缺点，提出了一种新的自适应参数策略和粒子散度指标，并结合模拟退火机制来改善该算法的寻优能力。为了检验改进算法的效果，利用不同维数的背包问题算例库以及不同规模的 UCI 特征选择问题算例库对新算法进行测试，并对实验数据进行统计分析，实验结果表明新算法在寻优精度、算法稳定性和收敛速度上均优于原算法,寻优能力得到显著提升。

➢ SuB05 - 9 17 : 15 - 17 : 30

326 群体速度异质性对集群运动的影响

唐威振 北京师范大学
韩战钢 北京师范大学

社会性生物利用集群运动能够有效应对捕食风险。在集群运动过程群体表现出高度凝聚力与信息快速传播是能够应对捕食风险的关键 。群体中存在异质性可能会削弱群体的凝聚力，然而生物个体之间的差异是普遍存在的事实。有关群体中异质性对集群行为的影响正是当前集群行为理论模型研究所忽略的。本文选取速度异质性研究引入速度异质程度以及群体异质规模对群体集群运动的影响。研究不同

速度异质情况下，群体的构型、分布及运动行为。进一步通过利用群体中速度的差异性调控群体行为。

SuB06　　15 : 15 – 17 : 15
腾讯会议：121-492-788
博弈论及系统建模

主持人：何亚荟　　北京工商大学
主持人：张广　　上海理工大学

➢ SuB06 - 1　　15: 15 - 15 : 30

745 图博弈的比例分离解

顾雯玮　　上海理工大学
张广　　上海理工大学

本文研究了一类具有图结构限制的合作博弈（简称图博弈），将比例分配理念和分配过程进行结合，提出了图博弈的一个分配规则，并基于一致性公理探讨了其公理刻画。随后，将提出的分配规则应用于大气污染治理成本的分摊问题中，并通过算例分析了新分配规则在大气污染治理中的合理性。

➢ SuB06 - 2　　15 : 30 - 15 : 45

868 政府干预下智能动力电池逆向供应链主体行为演化研究

高一凌　　安徽工程大学

动力电池作为动力汽车关键部件之一平均寿命为五至八年。借助区块链技术具有可溯源与不可篡改等优势，构建智能动力汽车电池逆向供应链有利于电池回收和再利用，从而延长电池寿命。本文考虑由一个具有回收再利用废旧动力电池资质的动力汽车制造商和缺乏资质的第三方动力电池回收商所组成的逆向供应链，采用演化博弈理论对政府是否干预、动力汽车制造商应否采用区块链技术以及第三方动力电池回收商能否与动力汽车制造商合作进行分析。结果表明政府干预下第三方动力电池回收商的合作回收策略是最佳选择；汽车制造商选择应用区块链策略的概率超过（低于）阈值时政府倾向不干预（干预）；在工业初期低补贴和罚款令汽车制造商更拒绝区块链的应用。

➢ SuB06 - 3　　15 : 45- 16 : 00

51The rapid detection of Cu+2 in food based on QDs membrane

何亚荟　　北京工商大学

As an essential trace element for human body, Cu2+ plays a key role in the normal metabolic balance of human body. Excessive intake of Cu2+ will cause health problems such as tissue and organ diseases, anemia, apoptosis damage and central nervous system damage (such as Alzheimer's disease and Parkinson's disease. A novel rapid technology of CdSe/ZnS QD composite membrane used to detect Cu2+ was researched in this paper. CdSe/ZnS QDs was used to modify polyethersulfone (PES) polymer membrane to improve the antifouling performance. The method was demonstrated portable, compatible, rapid response, environment-friendly with low detection limit and high sensitivity. The correlation coefficient of R2 was 0.9964, and the detection sensitivity can reach 0.07 μ Mol / L when it was used to detection Cu^{2+} in food.

➢ SuB06 - 4　　16 : 00 - 16 :15

546Fractional order game model of green and low-carbon innovation evolution in manufacturing enterprises and its discretization

姜楠　　武汉科技大学
冯育强　　武汉科技大学
王先甲　　武汉大学

This paper tries to develop a fractional-order game model of green and low-carbon (GLC) innovation evolution in manufacturing enterprises, using fractional-order replication dynamic equations to describe the process of learning and modifying strategies. We investigate the ESS of the game. The results indicate that enterprises can develop into a stable situation where all enterprises adopt GLC innovative technologies if their income exceeds their investment. Through numerical simulation, we find that when we decrease the fractional order in the model, it will increase the convergence rate to ESS, and will decrease the stability of the system.

➢ SuB06 - 5　　16 : 15 - 16 : 30

650Existence and stability of fuzzy Pareto-Nash equilibrium for generalized multi-objective fuzzy games

李文　　武汉科技大学
李德宜　　武汉科技大学
冯育强　　武汉科技大学

A new class of generalized multi-objective fuzzy games (abbr., GMFGs) is concerned in this paper. By introducing interval support functions derived from convex geometry, the existence theorem of fuzzy Pareto-Nash equilibrium for GMFG is established. On this basis, the abstract rationality function of GMFGs

with fuzzy Pareto-Nash equilibrium is given by using nonlinear scalarization function. Then, a series of results, such as robustness and structural stability to ϵ-equilibrium, are obtained.

➢ SuB06 - 6 16 : 30- 16 : 45

[738] 响应变量随机缺失下偏正态众数混合专家模型的参数估计

鲁钰 昆明理工大学
吴刘仓 昆明理工大学
王格格 昆明理工大学

数据缺失是众多影响数据质量的因素中最常见的一种. 若处理不好缺失数 据, 会直接影响分析结果的可靠性, 进而达不到分析的目的. 本文针对随机缺失偏 正态数据, 研究了偏正态众数混合专家模型的参数估计. 推广了众数回归插补, 将 之与聚类相结合, 提出了分层众数回归插补. 利用机器学习插补和统计学插补的 方法, 进一步比较研究了三种机器学习插补方法: 支持向量机插补、随机森林插补 和神经网络插补, 三种统计学插补方法: 分层均值插补、众数回归插补和分层众数 回归插补的缺失数据处理效果. 通过 Monte Carlo 模拟和实例分析结果表明, 分层众数回归插补的优良性.

➢ SuB06 - 7 16 : 45 - 17 : 00

[396]Some Dynamical Behaviors of Fractional-Order Commutative Quaternion-Valued Neural Networks via Direct Method of Lyapunov

夏砚楠 重庆交通大学

Some dynamical behaviors of fractional-order commutative quaternion-valued neural net- works (FCQVNNs) are studied in this paper. First, because the commutative quaternion does not satisfy Schwartz triangle inequality, the FCQVNNs are divided into four real-valued neural networks (RVNNs) through quaternion commutative multiplication rules. Furthermore, several types of dynamical behaviors including global Mittag-Leffler stability, the boundedness with bounded disturbances, complete synchro- nization and quasi-synchronization of FCQVNNs are studied. Simultaneously, several conditions for these dynamical behaviors are driven by fractional-order Lyapunov direct method, some inequality techniques and fractional differential equation theory. At last, the effectiveness and feasibility of the obtained theoretical results are verified by several numerical simulation examples.

➢ SuB06 - 8 17 : 00 - 17 : 15

[866]Provincial CO2 emission efficiency analysis in China based on a game cross-efficiency approach with a fixed-sum undesirable output

张孝琪 安徽工程大学

Measuring CO2 emission efficiency can help policymakers become familiar with the true level of CO2 emissions, and data envelopment analysis (DEA) is frequently used by scholars to analyze and measure CO2 emission efficiency. Considering that the sum of CO2 emissions is sometimes constrained to specific levels, some DEA-related CO2 emission efficiency studies treat CO2 as a fixed-sum undesirable output and construct an equilibrium efficient frontier (EEF) to calculate the efficiency. However, previous studies have paid less attention to the nonuniqueness of the EEF and the game relationship between DEA decision making units (DMUs), which can lead to DMUs rejecting the results because of the inconsistency in the evaluation criteria. This paper proposes a peer-evaluation mode to assess CO2 emission efficiency from a cross-efficiency perspective. For this purpose, we propose a cross-EEF evaluation approach and further develop a game cross-EEF evaluation approach. The proposed models are applied to evaluate the CO2 emission efficiency in 2019 of 30 provincial-level regions in China. We report the empirical results and demonstrate the effectiveness and practicality of our method compared to other methods.

SuB07 15 : 15 – 17 : 30
腾讯会议：147-458-474
复杂系统管理、辨识与控制

主持人：张珣 北京工商大学
主持人：刘亚威 重庆交通大学

➢ SuB07 - 1 15: 15 - 15 : 30

[127]Robustness of rank aggregation methods for malicious disturbance

陈冬梅 北京师范大学（珠海）
吴俊 北京师范大学

Rank aggregation has widespread applications in social choice, information retrieval, and bioinformatics. Given the enormous social and economic implications of these applications, and the consequent incentives for malicious users to disturb the aggregated ranking,

evaluating the robustness of rank aggregation methods for malicious disturbance is a key challenge. In this article, we first propose an experimental data generation method, which can generate the required rankings with adjustable malicious disturbance. Then, we introduce the relative Kendall tau distance as a new measure of rank aggregation robustness. Extensive experiments demonstrate that our method can effectively compare the robustness of different rank aggregation methods. Moreover, the experimental results show that the robustness of rank aggregation methods for malicious disturbance may be very different to that for random error.

➢ SuB07 - 2 15 : 30 - 15 : 45

523 城市特大降雨中道路交通动态疏散组织研究

杜进华 北京交通大学
刘家林 北京交通大学
李新刚 北京交通大学

在城市特大降雨疏散中，不同区域的洪水深度随降雨动态变化，直接影响车辆行驶速度和路径选择行为。本文为了研究洪水动态变化与疏散交通的动态影响关系，更安全地组织车辆疏散，提出一种考虑自由流速度变化的路段传输模型（LTM）来动态模拟洪水中车辆疏散的过程。进一步，将车辆动态疏散问题描述为混合整数线性规划（MILP）模型，约束条件包括多模式车速选择、车辆动态加载等。以“7·20 郑州特大暴雨”为背景，在某区域路网中进行算例分析，结果表明：（1）受路网瓶颈的限制，疏散中并非所有路段都被占用，路网利用率存在上限；（2）洪水疏散中要重点识别积水区域及水位深度，根据不同水深对车辆行驶速度进行分级管理，动态调整疏散路线。

➢ SuB07 - 3 15 : 45- 16 : 00

311 Effects of supply reliability, risk aversion and wealth on retailer's optimal order strategy

刘亚威 重庆交通大学

This study examines the effects of supply reliability, risk preferences, and wealth on retailers’ optimal order strategy in the case of uncertain demand. A more practical model of optimal ordering strategy, considering supply reliability, demand uncertainty, risk preferences and retailer wealth, is proposed, in which two random variables–supply reliability factors and demand–are introduced into the retailer's function of expected utility. To avoid non-convergence at both ends, the demand follows a triangular rather than normal distribution. It is found that the optimal order quantity will increase with the improvement of supply reliability when the risk-averse degree is fixed. The results also show that the optimal order quantity of risk-averse retailers is smaller than that of risk-neutral retailers. Furthermore, the risk-averse retailer’s optimal order quantity decreases as the degree of risk aversion increases, when supply reliability is fixed. Further research shows that retailers with more wealth have a more optimal order quantity than those with less wealth when the conditions of risk-aversion and supply reliability remain unchanged. This study provides valuable insights for sustainable supply chain management and marketing.

➢ SuB07- 4 16 : 00 - 16 :15

194 个体动机对团队绩效的影响：一种自下而上与自上而下任务分配方式的对比

王少妮 大连理工大学
党延忠 大连理工大学

通常认为，如果团队由优秀成员组成，那么团队也会表现良好。但实际上，这些优秀的个体在团队中也会表现不理想，有时会遭受过度的协调时间，有时会丧失处理任务的动机。根据 Deci 和 Ryan 的自我决定理论(SDT)理论，在工作环境中，员工有三种基本心理需求：胜任力需求，自主权需求和归属感需求。个体之间的复杂交互性、个体的动态适应性是传统实证研究方法难以探索的。故，本文通过 ABM 建模方法，来探究在自上而下和自下而上两种方式下，任务分配对团队绩效的影响情况。实验结果表明：1) 适当的动机阈值可帮团队减少任务完成时间。2)任务越简单，任务分配时间占总任务完成时间的比例越高。3)自上而下与自下而上的两种任务分配方式下的团队绩效与任务特性相关。

➢ SuB07 - 5 16 : 15 - 16 : 30

272 基于 SHAPLEY 值的多层网络重要节点价值评估

夏庭汉 北京师范大学
赵东波 机电研究院
樊明 机电研究院
陈清华 北京师范大学

随着信息化和智能化的发展，智能复杂体系占据越来越多的重要位置，发挥的作用越来越大，相关的研究也愈加必要而紧迫。在现代智能复杂体系中，

各个要素或子系统之间彼此联系更加紧密，相互作用更加强，而且这种联系和作用具有多样性，而最后元素或子系统的功能则由这些种类的作用复合而成。正确评估智能复杂体系中节点或子系统的重要性，具有科学意义，与体系设计、体系对抗与协作关系密切。本文厘清智能体系中的基本作用，按作用方式将其映射为一个多层网络，以此为基础提出重要节点或子系统评价的 Shapley 值算法。这种方法可以应用于社会经济系统、智能作战系统等复杂体系中的重要节点评价。

➢ SuB07 - 6 16 : 30- 16 : 45

[469] A Robust Rating Aggregation Method based on User Homolaterality for Collusive Disturbance

祝欢 北京师范大学（珠海）
吴俊 北京师范大学

As rating behavior is prone to be observed, compared, and quantified than other forms of evaluation, many online systems have built their online rating mechanisms to allow users to rate objects and browse historical ratings. To obtain the comprehensive evaluation of a object, the most straightforward rating aggregation method is to calculate the arithmetic mean, the median, or the mode of all the ratings on the object. Due to the existence of spammers, the reputation-based method for individual disturbance(IDR) and user similarity-based for collusive disturbances(CDUS) have been proposed in the last few years. However, these method does not consider a more disguised collusive disturbance between the properties of individual and collusive disturbance, which causes that the IDR method is easily mastered by collusive numerical superiority and the CDUS method is easily confused by reliable users and collusive groups. Consequently, we propose a new aggregation method for collusive disturbance based on user homolaterality(CDUH), which is capable of resisting the numerical superiority and distinguishing the confusion from the disguised collusive disturbance. In this paper, the results of examples and experimental analyzes also demonstrate that the CDUH method is more robust than the IDR and CDUS methods and dealing with the effect of disguised collusive disturbance in the rating system.

➢ SuB07 - 7 16 : 45 - 17 : 00

[169] 多目标数字标牌优化选址——以北京市六环内为例

张珣 北京工商大学
王雨雪 中国农业大学
梁春芳 北京工商大学
张滨 北京工商大学
毛珩懿 北京工商大学

合理的布设数字标可以使得市民生活更加便利，促进城市的智能互联建设，为社会带来一定的利用价值。当前数字标牌主要依靠经验进行广告投放，广告投放效率低，欠缺结合地理环境、布设成本和用户需求等方面的约束。本文基于数字标牌及其影响因子等多源要素，分析数字标牌多尺度建模因子序列特征，并对其进行重采样分级处理，在此基础上，将最大覆盖模型与遗传算法相融合，构建了数字标牌优化选址模型。以北京市六环路以内的数字标牌为研究对象，使用本文提出的方法进行数字标牌空间优化选址实验。使用覆盖率、覆盖数量作为评价指标进行了多组对比实验，验证了本文基于多目标最大覆盖模型的数字标牌优化选址模型的有效性和正确性。

➢ SuB07 - 8 17 : 00 - 17 : 15

[186] Spatiotemporal Characteristics and Driving Factors of Black Carbon in Augsburg, Germany: Combination of Mobile Monitoring and Street View Images

张珣 北京工商大学
张佳亮 北京工商大学
吴立杰 北京工商大学

The study investigates the spatial pattern of black carbon (BC) at a high spatial resolution in Augsburg, Germany. Sixty two walks were performed to assess the concentrations of equivalent black carbon (eBC), ultraviolet particulate matter(UVPM), and equivalent brown carbon (eBrC) in different seasons and at different times of the day with a mobile platform (i.e., trolley). Along with BC measurements, images of street microenvironments were recorded. Meteorological parameters, including temperature, relative humidity, and wind speed, were monitored. The BC concentrations showed significant spatial heterogeneity and diurnal variations peaking in the morning and at night. The highest BC concentrations were observed near dense traffic. The correlations between BC and street views (buildings, roads, cars, and vegetation) were weak but highly significant. Moreover,

meteorological factors also influenced the BC concentration. A model based on street view images and meteorological data was developed to examine the driving factors of the spatial variability of BC concentrations at a higher spatial resolution as different microenvironments based on traffic density. The best results were obtained for UVPM and eBC (71 and 70% explained variability). eBrC (53%), to which other sources besides road traffic can also make significant contributions, is modeled less well.

➢ SuB07 - 9 17 : 15 - 17 : 30

[119] 基于深度强化学习的预测避撞跟驰算法

郑钰琪 北京交通大学
严瑞东 北京航空航天大学
贾斌 北京交通大学
姜锐 北京交通大学

近年来，自动驾驶技术逐步发展。与人驾驶汽车相比，自动驾驶汽车能耗小，效率高，对于缓解城市交通拥堵问题具有重要意义。然而，自动驾驶汽车的普及面临着多重阻碍，其中如何保障自动驾驶汽车的安全性是一个不可忽视的重要问题，提高自动驾驶车辆的安全性具有十分重要的现实意义。本研究基于深度强化学习算法对自动驾驶车辆进行速度控制，提出了一种新的预测避撞方法，该方法利用模型进行预测，并根据预测结果修改动作值，从而避免碰撞，提高安全性。本研究利用 NGSIM 数据，搭建了跟驰实验环境，通过与单独强化算法的实验对比，验证了预测避撞方法的可行性与有效性。

SuB08 15 : 15 – 17 : 30
腾讯会议：559-918-463
复杂系统工程

主持人：赵文虓 中国科学院
主持人：金学波 北京工商大学

➢ SuB08 - 1 15: 15 - 15 : 30

[62] A Deep Network Prediction Model for Heavy Metal Cadmium in the Rice Supply Chain

Xuebo Jin 北京工商大学
张佳帅 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学
苏婷立 北京工商大学

Cadmium and its compounds are currently known as Class I carcinogens, and excessive intake can cause severe health damage to humans. Rice has a strong absorption effect on cadmium, and rice products with excessive cadmium con- tent have caused several significant public health contamination incidents. It is essential to predict the development trend of cadmium hazards in the rice supply chain so that countermeasures can be formulated to reduce the hazards. This paper proposes a deep prediction model for cadmium hazards in the rice supply chain based on the regularization method. Firstly, a long and short-term memory (LSTM) network is used to build the depth prediction model by using the regularization method, and the noise penalty term is added to reduce the model fitting to the noise and prevent the over-fitting caused by the noise. Finally, the optimization of the model hyperparameters was carried out using a Bayesian Optimization approach to develop the prediction performance. Then, Early warning system for prediction of cadmium hazards in the rice supply chain is built based on the deep prediction model proposed in this paper with SOA architecture, including data resource, business logic, and application service layers. The proposed model performs well on an actual data set of cadmium hazards in the rice supply chain and fits the data well.

➢ SuB08 - 2 15 : 30 - 15 : 45

[63] A Reversible Automatic Selection Normalization (RASN) Deep Network for Predicting in the Smart Agriculture System

Xuebo Jin 北京工商大学
张佳帅 北京工商大学
孔建磊 北京工商大学
白玉廷 北京工商大学
苏婷立 北京工商大学

Due to the nonlinear modeling capabilities, deep learning prediction networks have become widely used for smart agriculture. Because the sensing data has noise and complex nonlinearity, it is still an open topic to improve its performance. This paper proposes a Reversible Automatic Selection Normalization (RASN) network, integrating the normalization and renormalization layer to evaluate and select the normalization module of the prediction model. The prediction accuracy has been improved effectively by scaling and translating the input with learnable parameters. The application results of the prediction

show that the model has good prediction ability and adaptability for the greenhouse in the Smart Agriculture System.

➢ SuB08 - 3 15 : 45- 16 : 00

[322]Solving Fredholm integral equation of the first kind using Gaussian process regression

邱仁军 国防科技大学

Fredholm integral equation of the first kind is a typical ill-posed problem, and it is usually difficult to obtain a stable numerical solution. In this paper, a new method is proposed to solve Fredholm integral equation using Gaussian process regression (GPR). The key to this method is that the right-hand term of the original integral equation is reconstructed by the GPR model to obtain a new integral equation in a reproducing kernel Hilbert spaces (RKHS). We present an analytical approximate solution of the new equation and prove that it converges to the exact minimal-norm solution of the original equation under the L2-norm. Especially, for the degenerate kernel equation, we obtain an explicit formula of the exact minimal-norm solution. Finally, the proposed method is verified to be very effective in accuracy by multiple examples.

➢ SuB08- 4 16 : 00 - 16 :15

[45] Research on traceability of grain and oil quality and safety based on trusted blockchain and trusted identification

许继平 北京工商大学
韩佳琪 北京工商大学
张新 北京工商大学
王小艺 北京工商大学

The management and traceability of grains and oils quality and safety life cycle information is an important guarantee for grains and oils quality and safety. At present, there exists many security problems in grains and oils quality, the reliable interconnection and efficient interoperability of data between heterogeneous systems. Firstly, based on the analysis of the information flow characteristics of grains and oils quality and safety chain, the grain and oil quality and safety chain architecture are constructed, and the key information of typical links is classified. Then, based on the trusted blockchain and trusted identity, the trusted traceability model of grains and oils quality and safety is constructed, the block data structure, identity resolution, coding rules and storage mode are defined and reconstructed, and the concept and specific architecture scheme of chain network connector are innovatively put forward, It provides a solution for the integration and application of blockchain traceability system and industrial Internet identity resolution system in grains and oils quality and safety traceability. Finally, taking the typical grains and oils variety wheat as an example, based on the Hyperledger Fabric open source framework, the wheat quality and safety and trusted traceability system is designed and developed, and the system implementation verification and case analysis of the model are carried out. The results show that the research model and system realize the interconnection of grains and oils quality and safety chain information, ensure the safety of cross chain information interaction and the traceability of the whole process, and provide a solution and feasible scheme for information enabled food security.

➢ SuB08 - 5 16 : 15 - 16 : 30

[41]Research on Optimization of Grain and Oil Quality and Safety Blockchain Based on DEMATEL-ISM

许继平 北京工商大学
张博洋 北京工商大学
张新 北京工商大学
赵峙尧 北京工商大学

The entire grain and oil supply chain has the characteristics of multiple types of risk factors, complex main links, cross-domain supply networks, and difficulty in opening up the information chain. Traditional supervision and traceability technologies face some problems. The new generation of information technology represented by the blockchain provides new solutions and application models for food safety assurance and traceability. However, the migration of blockchain technology originating from digital currency is applied to grain and oil quality safety assurance and traceability scenarios. New systemic risks have been introduced, and there are also some performance and safety challenges. Based on the analysis of the risks and information characteristics of the grain and oil quality and safety blockchain, this article improves and optimizes the general-purpose blockchain structure in

the existing completely untrusted execution scenario. At the network layer, a special blockchain network structure suitable for grain and oil quality and safety in non-completely trusted execution scenarios is proposed, and a Kafka consensus optimization algorithm P-Kafka based on PBFT improved Byzantine fault tolerance and in line with the characteristics of grain and oil quality and safety blockchain is proposed at the consensus layer. The performance of P-Kafka is compared with the traditional consensus algorithm from the perspectives of correctness and decentralization, security, scalability, consensus efficiency and consistency. Through analysis and comparison, the network node partition and sub chain partition proposed in this paper save the operation cost of blockchain system and improve the privacy security of nodes to a certain extent. The improved P-Kafka consensus algorithm has Byzantine fault tolerance and inherits the high throughput characteristics of Kafka partition optimization, making it more suitable for grain and oil quality and security application scenarios.

➢ SuB08- 6 16 : 30- 16 : 45

[113]Parameter identification for the fractional-order chaotic, chaotic with noise and hyper-chaotic financial systems via Fractional-order Chaotic cuckoo search algorithm

杨忠保 黔南民族师范学院

Identifying the parameters of the chaos phenomena in the economic-financial systems is a critical issue to control and avoid the financial crises and bogging the market down. Therefore, in this paper, an efficient and reliable optimization algorithm is developed to identify the corresponding parameters of that chaotic dynamical behavior in the fractional-order chaotic, chaotic with noise, and hyper-chaotic financial systems. The introduced algorithm is a cooperation among the fractional calculus (FC) perspective and the basic chaotic cuckoo search algorithm to enhance the stochastic cuckoo's walk via considering the cuckoo's earlier behaviors from memory. The developed fractional-order chaotic cuckoo search (FO-CCS) is validated with twenty-eight functions of CEC2017 with different dimensions. Several measures and non-parametric statistical tests are presented to demonstrate the superiorly of the introduced algorithm while compared with the FO-CS and the state-of-theart techniques. The results show that merging of FC properties magnifies FO-CCS's efficiency, convergence speed, and robustness against the complexly of the considered CEC benchmarks suite and the non-linearly of the fractional-order chaotic, chaotic with noise, and hyper-chaotic financial systems.

➢ SuB08 - 7 16 : 45 - 17 : 00

[26]Adaptive Regulation of Block-Oriented Nonlinear Systems Using Binary Sensors with Applications to Automotive Engine Control

赵文虓 中国科学院

In this paper, adaptive regulation of block-oriented nonlinear systems, i.e., Hammerstein and Wiener systems, with binary-valued measurements of the regulation errors is considered. Compared with the classical framework for stochastic adaptive control, the new feature here is that only binary-valued observations of regulation errors are available to the controller. An adaptive regulator based on stochastic approximation algorithm is proposed and it is proved that the regulator is optimal in the sense that it minimizes the long-run average of the squared regulation errors almost surely. Numerical examples as well as real applications of the proposed algorithms to automotive engine control are given.

➢ SuB08- 8 17 : 00 - 17 : 15

[42]Information Traceability Model for the Grain and Oil Food Supply Chain Based on Trusted Identification and Trusted Blockchain

张新 北京工商大学
李悦 北京工商大学
许继平 北京工商大学
赵峙尧 北京工商大学

Grain and oil food are the basic guarantee for people's survival and social development. Therefore, the safety management of grain and oil food is particularly important. Due to the complex structure of the grain and oils food supply chain, long turnover cycle and numerous stakeholders, it is challenging to maintain the security of the entire grain and oils food supply chain, while the traditional traceability mechanism has low reliability and transparency due to its centralized

storage. As a result of the characteristics of decentralization and immutability, blockchain technology can not only solve the problem of information asymmetry between participants in the supply chain, but also ensure the reliability and transparency of traceable data. Based on blockchain technology and credible identification technology, this research constructs an information traceability model for the entire supply chain of grain and oil food products, on the basis of the model, three operating mechanisms, namely the trusted identification mechanism, the data dual-mode storage mechanism, and the trusted traceability mechanism, are designed and constructed to ensure the integrity of the trusted traceability model, so that the model can better fits all aspects of the grain and oil food supply chain. This model solves the problems of traditional centralized traceability mechanism, low data security and transparency, and improves the efficiency and accuracy of information traceability. The establishment of a grain and oil food supervision model is of great significance for ensuring the safety of grain and oils food supply and improving supervision efficiency.

➢ SuB08- 9 17 : 15 - 17 : 30

[43]Dynamic supervision model of rice supply chain based on blockchain and smart contract

张新 北京工商大学
彭祥贞 北京工商大学
许继平 北京工商大学
王小艺 北京工商大学

Rice supply chain has the characteristics of long life cycle, complex participation roles of main links, many harmful species, multi-dimensional and multi-source heterogeneity of information and so on. The realization of dynamic supervision of rice supply chain is conducive to the guarantee and traceability of rice quality and safety. Driven by blockchain smart contract, this paper constructs a dynamic model suitable for the information flow characteristics of rice supply chain, and carries out contractual implementation and prototype verification. Firstly, based on the analysis and classification of rice supply chain supervision information, a dynamic supervision model framework of rice supply chain is constructed based on blockchain smart contract. Secondly, under the logical framework of the regulatory model, six types of smart contracts, including initialization smart contract, data calling smart contract, model verification smart contract, data transmission smart contract, contribution evaluation smart contracts, and credit assessment smart contract are custom-designed. And the smooth operation of the model is analyzed. Finally, based on the dynamic supervision model and smart contract, the rice supply chain supervision prototype system is designed and developed. And simulation analysis and case verification are carried out. The results show that the dynamic supervision model and prototype system constructed in this paper can solve the whole process real-time management of rice supply chain business information, hazard information and personnel information, and realize the dynamic and credible supervision of rice supply chain in the whole life cycle at the information level. This research is the research and application of a new generation of information technology in the efficient coordination and resource sharing of the food supply chain, and provides ideas for the digital transformation of the grain industry.

SuB09 15 : 15 – 17 : 15
腾讯会议：133-246-077
系统建模与分析

主持人：崔雪锋 北京师范大学
主持人：李俊红 南通大学

➢ SuB09 - 1 15: 15 - 15 : 30

[245] 基于机器学习全球肉类消费预测模拟

崔雪锋 北京师范大学

随着生活水平的提高，人们肉类消费的需求日益增长，为环境和粮食供给带来巨大的压力。我们通过机器学习，检测肉类消费的影响因子，并据此发展未来评估模型。通过评估，发现模型能较好地预估不同经济类型国家的消费需求增长。结合 IPCC 的社会经济情景数据，可以提供不同发展路径的人口、经济、社会等发展情况，利用我们的模型可以预测出不同的肉类消费路径。对比这些未来情景，可以清楚看到 1）大部分情景在 2050 后都有下降趋势，其中 SSP1 的下降最为明显和开始的最早，体现了应对气候变化的国际合作的可能性。 2）东亚国家的肉类消费未来下降很快，主要是由于人口的总数下降引起的。以中国为代表，2030 后人口总数大幅下

降，引起的肉类消费也下降明显。 3）非洲国家未来主要由于经济的崛起，肉类消费也相应增加较快；4）欧美国家人均肉类消费较高，未来变化也不明显。但是随着人口的稳定小幅增长，未来肉类消费是主要区域。为了身体健康，环境保护，气候减排，各国都在努力减缓温室气体排放，减少肉类消费会是改变生活习惯的方式之一。我们呼吁更环境友好的饲养方式，各国要重视宣传和技术革新，通过国际合作，降低畜牧业的环境影响，共创美好未来。

➢ SuB09 - 2 15 : 30 - 15 : 45

[108] 麻疹在中国的空间传播

韩世峰 青岛大学

麻疹是一种由麻疹病毒(Measles Virus,MV)引起的急性呼吸道传染病。在中国每年都会有数量巨大的发病人群。空间行波是传染病空间传播动态的一个重要特征，通过空间行波可以帮助推断疾病的空间传播机制。行波可以由对适当的时空分辨率发病数据进行分析检测得到。我们使用小波时间序列分析来描述中国 31 个省级行政区 2004-2016 年麻疹流行期间的非平稳性。通过小波相位角发现：1）在全国补充强化免疫前后，行波在空间中出现不同的形式。2)阐明了气候对于麻疹在我国空间中传播机制的影响。我国大部分省份的麻疹发病不受气候因素的影响。而在气候因素与麻疹发病同相，即同步发生的省份，气候因素是否影响当地的麻疹发病还需要进一步的研究。

➢ SuB09 - 3 15 : 45- 16 : 00

[549]Parameter identification of Hammerstein–Wiener nonlinear systems with unknown time delay based on the linear variable weight particle swarm optimizatio

李俊红 南通大学
宗天成 南通大学
陆国平 南通大学

This paper deals with the parameter estimation of Hammerstein–Wiener (H–W) nonlinear systems which have unknown time delay. The linear variable weight particle swarm method is formulated for such time delay systems. This algorithm transforms the nonlinear system identification issue into a function optimization issue in the parameter space, then utilizes the parallel searching ability of the particle swarm optimization and the iterative identification technique to realize the simultaneous estimation of all parameters and the unknown time delay. Finally, parameters in the linear submodule, nonlinear submodule and the time delay are separated from the optimum parameter. Moreover, two illustrative examples are exhibited to evaluate the effectiveness of the proposed method. The simulation results demonstrate that the derived method has fast convergence speed and high estimation accuracy for estimating H–W systems with unknown time delay, and it is applied to the identification of the bed temperature systems.

➢ SuB09- 4 16 : 00 - 16 :15

[695] 基于深度强化学习的移动机器人密集人群导航方法

孙雪莹 江苏科技大学
徐雯煜 江苏科技大学
暴琳 江苏科技大学
季雅君 江苏科技大学

智能移动机器人越来越多地应用于机场超市等人机共融场景，因此机器人需要自主完成在密集移动人群中的导航功能，其主要挑战在于机器人能否准确理解人群的行为并做出决策。由于机器人与行人以及行人与行人之间的交互机制比较复杂，随着人群密度的增加，现有方法的导航性能有所降低。本文提出一种基于深度强化学习的导航方法，通过时空图模型对人机以及行人之间的交互进行建模并预测行人轨迹；将行人运动轨迹预测引入到强化学习模型中，通过无模型深度强化学习训练网络。仿真结果表明，在密集人群场景中所提出的导航方法有效地降低了碰撞率，提高了导航效率。

➢ SuB09 - 5 16 : 15 - 16 : 30

[297]Neural network-based emotional speech expression in human-computer interaction systems

王智 青岛大学
Shuzhi Ge 新加坡国立大学
yinhua liu 青岛大学

As an integral part of the human-computer interaction process, speech emotion plays a crucial role that directly affects whether humans feel "comfortable" when they hear the robot's response. Since humans have rich emotions, how to integrate these rich emotions into machine-synthesized speech during human-computer interaction has always been a difficult problem. To solve this problem, we propose a neural network-based speech synthesis model that contains an encoder, an attention mechanism, and a decoder. At the same time,

we perform statistics on the parameters related to emotional speech, find the parameter patterns of different emotional states, and correct the speech synthesized by the model in order to make the speech more emotionally rich. The experimental results show that our method can synthesize speech with different emotional states and improve the comfort level of human-robot interaction.

➢ SuB09 - 6 16 : 30- 16 : 45

[812]Adaptive sliding mode control for MEMS gyroscopes based on immersion and invariance theory

张罗玉 南通大学
郭云翔 南通大学
张新松 南通大学
卢成 南通大学

This paper presents an immersion and invariance (I&I) theory based adaptive control scheme to improve the trajectory tracking performance of micro-electronic-mechanical-system (MEMS) gyroscopes under external disturbance. Firstly, an disturbance observation is constructed based on the I&I theory to estimate the external disturbance and the disturbance estimation is utilized in the after-mentioned sliding mode controller to help reduce chattering phenomenon in the control force. Secondly, a sliding mode controller is designed based on I&I theory to accurately drive the proof mass in the gyroscope to track a given trajectory using the disturbance observer mentioned above and the stability of the entire control system is proved using Lyapunov stability theory. Finally, simulation is conducted to verify the validity and feasibility of the proposed method.

➢ SuB09 - 7 16 : 45 - 17 : 00

[20]Microbiological predictive modeling and risk analysis based on the one-step kinetic integrated Wiener process

赵峙尧 北京工商大学
陈谦 北京工商大学
王小艺 北京工商大学

The actual growth-monitoring data of microbial hazards in food are characterized by uncertainty, accumulation, discreteness, and nonlinearity, and thus it is difficult to accurately predict and analyze food safety microbiological risks in real time. Hence, we propose an approach of microbiological predictive modeling and risk analysis based on the one-step kinetic integrated Wiener process (OS-WP). First, the microbial tertiary prediction model was directly constructed through one-step kinetic analysis. Then, the WP was integrated with a tertiary model for predictive modeling of the actual microbial stochastic growth. Second, an indicator, “remaining safety life” (RSL), was introduced to analyze the potential microbiological risk on the basis of the established prediction models. Finally, the maximum likelihood estimation was used obtaining the model parameters online, and for calculating the RSL value in real time. The OS-WP approach was applied to a case study of the mixed mildew hazard during wheat storage. For different datasets, the root mean square error (RMSE) of the microbiological predictive model was less than 1.5; the relative RMSE of the RSL prediction reached 6.77%; the running time was less than 0.6 s. The result showed that the proposed approach is effective and feasible in modeling the actual growth of microbial hazards in food and can achieve online risk analysis. It can provide valuable microbiological early warning information to risk-management and decision-making departments for ensuring food safety.

➢ SuB09 - 8 17 : 00 - 17 : 15

[402]Poincaré model shows how heterogeneity in light sensitivity can alter circadian clock function

周建 上海理工大学
顾长贵 上海理工大学
杨会杰 上海理工大学

Exposed to the natural light-dark cycle, living beings show robust 24 h rhythms in physiology and behavior. Interestingly, even in the absence of a light-dark cycle, for example in constant conditions, such as under the constant darkness or the constant light, living beings maintain a robust rhythm of which the endogenous period (named free running period, FRP) is close to 24 h. The endogenous rhythms are regulated by a master clock located in the suprachiasmatic nucleus (SCN) of mammals, where the SCN neurons show heterogeneity in the sensitivity to the light. In this article, we examined how this heterogeneity influences the FRP under constant light. Using a Poincaré model for the SCN network it is shown that the FRP increases with the

increase of the degree of heterogeneity in the sensitivity of neuronal subpopulations to light. Moreover, the presence of a critical value where the periods of the subpopulation diverge, presents a mechanism dictating how some animals remain rhythmic under constant light conditions, while others loose their rhythms completely. Our findings help to understand how the neuronal heterogeneity to light sensitivity in the SCN influences the circadian behavior of the animal.

SuB10　　15 : 15 – 17 : 15
腾讯会议：586-885-744
系统建模分析与应用

主持人：邓小媛　　昆明理工大学
主持人：任磊　　南通大学

➢ SuB10 - 1　　15: 15 - 15 : 30

685 基于多标签分类的增量模糊概念认知学习

邓小媛　　昆明理工大学

增量学习是在动态环境下获得数据知识。概念被引用到概念认知学习与概念聚类中用于概念分类与概念知识发现。目前对于概念认知学习的研究主要集中于单标签分类，然而在实际生活中一个事物往往被赋予多个标签，所以对于多标签分类的增量学习是一个值得探究的问题。因此，本文提出了一个增量式模糊概念认知学习算法，基于该算法构建了多标签的模糊概念学习系统(MLFCLS)，具体的，本文首先给出了关于 MLFCLS 的基本概念，用面向对象模糊概念和面向属性模糊概念相似度衡量概念相似度；提出 MLFCLS 及其相关算法；最后用数据实验表明本文提出的方法有较好的分类性能。

➢ SuB10 - 2　　15 : 30 - 15 : 45

813 考虑多类型市场主体的日前能量—调峰联合优化

高希　　南通大学

新型电力系统建设背景下，我国电网风电渗透率持续攀升，调峰需求也随之增加。日前能量-调峰联合出清是充分调动各市场主体调峰意愿，支撑大规模风电消纳的有效措施之一。在对燃煤机组、风电场与储能等多类型市场主体调峰能力与报价规则进行分析的基础上，建立了综合考虑燃煤机组深度调峰、启停调峰，风电场主动“弃风”调峰与储能充电调峰的日前能量-调峰联合优化模型。模型以能量与调峰辅助服务总采购成本最小为优化目标，同时考虑各市场主体技术约束、投标约束与电网潮流约束，是大规模混合整数线性规划（Mixed integer linear programming，MILP）模型，可采用 CPLEX 求解器求解。基于改进 IEEE 14 节点系统的仿真实验验证了本文所提日前能量-调峰联合优化模型与求解方法的有效性。此外，结合仿真实验对各市场主体参与调峰辅助服务的收益进行了详细分析。

➢ SuB10 - 3　　15 : 45- 16 : 00

550 联想机制下的概念认知模型

郭可依　　昆明理工大学

形式概念分析与人脑认知过程的最小计算单元都是概念，这使之成为进行模拟人脑认知过程的天然工具. 不同认知思维方法所构建的概念认知模型决定了概念认知结果，是概念认知过程的重要载体. 目前现存的概念认知模型都以逻辑思维为核心，如以寻找与线索最接近的粒概念作为主要思想的充分必要粒逼近模型，以线索的渐近认知为核心的渐进式概念认知模型等. 但是概念认知模型使用逻辑思维整理，以非逻辑思维开拓思路，才更符合人类的思维过程. 非逻辑思维的形式之一联想是各种观念以不同方式的连结组合，目前以对比联想与接近联想作为两大原则. 本文首先提出了联想认知模型的对比算子和接近算子得到联想概念集合并给出了联想认知模型的算法；其次给出正向偏好和反向偏好的定义以在联想概念集合中选出最终概念作为认知结果；最后用充分必要里逼近模型搭配联想概念认知模型作为最终概念认知模型进行数值实验，实验表明认知结果比单独使用各方法的认知结果更加丰富全面.

➢ SuB10- 4　　16 : 00 - 16 :15

614 单节点储备池学习能力的非线性动力学分析 ——以 logistics 映射为例

蓝秀文　　北京邮电大学
陈伟　　北京邮电大学
高健　　北京邮电大学
Jinghua Xiao　　北京邮电大学

储备池算法作为神经网络的一种算法，广泛适用于时间序列的学习以及分析中。储备池算法的超参数对于学习的效果有很大的影响。本文考虑最为简单的单节点储备池，将学习看作一个动力学过程，采用非线性动力学和稳定性理论对学习的过程和机制进行研究。但是单节点储备池的功能并不“简单”，能观察到参数空间发生倍周期分岔、切分岔、霍普夫分岔，产生丰富的动力学状态，具有较强的学习能力。超参数对学习效果的影响与输入信号的状态有关。以 logistics 映射为例，对不同的输入信号，利

用雅可比矩阵的特征值判断输出信号的状态和稳定性。随着输入信号的复杂度增加，可以学会的超参数范围相应减少。通过稳定性分析的理论结果和数值实验的结果相一致。本研究将加深对储备池算法以及循环神经网络(RNN)学习过程的理解。

➢ SuB10 - 5 16 : 15 - 16 : 30

[271]A spiking network model accounting for multi-peaked distribution in visual working memory task

雷力行 北京师范大学
王大辉 北京师范大学

Working memory is critical to cognition. However, the working memory becomes inaccurate as time goes by and the amount of task object exceeds the capacity of working memory. In recent research of delay estimation experiment, researchers have found a very interesting phenomenon that when given color stimuli in a uniform distribution, the reported color distribution is multi-peaked. In addition, the distribution of error between reported color and stimuli color is Gaussian shaped. Researchers also have constructed a discrete attractor dynamic model which can just produce the multi-peaked distribution. To complete the result, we here propose a spiking network model with heterogeneous connection and short-term plasticity. Our neural model can reproduce the both distribution.

➢ SuB10 - 6 16 : 30- 16 : 45

[727] 基于虚拟阻抗的两级式单相逆变器二次纹波电流传播特性研究

任磊 南通大学
张新松 南通大学

两级式单相逆变器的输出瞬时功率包含两倍于输出电压频率的脉动功率，致使前级直直变换器的输入存在二次谐波电流。前级直直变换器控制环路的优化是解决该问题的有效且低成本的方式。本文从虚拟阻抗的角度对二次谐波电流的抑制方法展开了研究：首先分析了输入二次谐波的产生机理，指出电感电流二次谐波是最主要原因；给出了负载到电感电流二次谐波的增益函数，并对控制框图进行了等效变换，给出了开环、单闭环控制以及双闭环控制的等效电路模型；在此基础之上，统一归纳了现有控制策略的抑制原理，并指出了各自存在的局限性，给出了优化方案；最后，对一台 1500VA 的两级式单相逆变器模型进行了仿真，验证了等效模型的正确性以及优化方案的有效性。

➢ SuB10 - 7 16 : 45 - 17 : 00

[827]Application of bidirectional DC/DC converter based on sliding mode control in DC microgrid

尹玉强 南通大学
茅靖峰 南通大学

In order to mitigate the influence of negative impedance characteristics on the stability of DC microgrid with constant power load and the influence of nonlinear characteristics of bidirectional converter on DC bus voltage, a control strategy of bidirectional converter based on sliding mode control is proposed. The state equations of converter with constant power load and resistive load are analyzed. The output voltage error, inductor current error and its integral are used as the state variables to design the sliding mode controller. Then, a fast power approach law is introduced into the controller to improve the response speed of traditional sliding mode control and reduce suppress chattering. The stability and existence of sliding mode control system and the selection of control parameters are discussed. Finally, the MATLAB/Simulink software is used to simulate the proposed control method. Compared with PI controller, the proposed controller has faster response speed and smaller voltage deviation.

➢ SuB10 - 8 17 : 00 - 17 : 15

[170]Pre-shooting Electroencephalographic Activity of Professional Shooters in a Competitive State

张洁 青岛大学
Shuzhi Ge 新加坡国立大学
蒋婉玥 青岛大学

This study investigated the influence of competitive state on cerebral cortex activity of professional shooters with10m air rifle before shooting. Generally, professional athletes have higher neural efficiency compared with ordinary people. We recruited 11 national shooters to complete 60 shots under both noncompetitive and competitive shooting conditions, and simultaneously collected their electroencephalogram (EEG) and electrocardiogram (ECG) information. Theta, alpha, and beta power were computed in the last three seconds preceding each shot from average-reference 29-channel EEG, while EEG characteristics under two conditions were analyzed. The results showed a significant linear correlation between

shooting accuracy and EEG power of anterior frontal, central temporal, and occipital regions in beta and theta bands. In addition, the theta power in occipital regions, alpha power in frontal-central and left occipital regions, and beta power in frontal and mid-occipital regions were higher than those in noncompetitive state. However, heart rate (HR) and shooting accuracy did not change significantly under the two conditions. These findings reveal the changes of cortical activity underlying competition shooting as well as providing further understanding of the neural mechanisms of the shooting process and lay a foundation for the subsequent neuro-modulation research.

SuB11　　15 : 15 – 17 : 30
腾讯会议：765-187-033
人工智能、进化算法与应用

主持人：陈贵词　　武汉科技大学
主持人：黄中意　　上海理工大学

➢ SuB11 - 1　　15: 15 - 15 : 30

[292]Finite-time dissipative filter design for discrete-time
陈贵词　　武汉科技大学
周鑫　　武汉科技大学
张青　　武汉科技大学

The finite-time dissipative filtering problem for a kind of discrete-time stochastic interval system with time-varying delays whose parameters are taken in a convex hull is investigated in this paper. Taking a representative subsystem from a stochastic convex hull system, based on convex analysis and matrix theory, a new interval matrix method is proposed to study the finite-time dissipative filter problem, which can deduct the conservativeness. Then, the finite-time dissipative filter is designed by employing a complex Lyapunov-Krasovskii functional together with the improved Wirtinger inequality technique. Correspondingly, some novel sufficient conditions are obtained to ensure the filtering error system with time-varying delays robustly stochastically finite-time bounded and the dissipative index is satisfied. Next, the desired filter gains are achieved in terms of linear matrix inequalities. Finally, the effectiveness of the designed filter is demonstrated by a numerical example with simulations.

➢ SuB11 - 2　　15 : 30 - 15 : 45

[356]Robust minimum cost consensus model for multi-criteria decision making under uncertain circumstances
戴泽兴　　上海理工大学

Recently, the consensus model of group decision-making in uncertain circum- stances has received extensive attention. Existing models focus on either minimum cost (maintain the total budget) or maximum utility (improve satisfaction). Based on the minimum cost consensus model, a new multi-criteria robust minimum cost consensus model with utility preference is proposed in this paper. Firstly, considering the inherent uncertainty of input data, the unit adjustment cost of experts is described under three robust scenarios. Subsequently, a cost consensus model that expresses the views of decision-makers in a variety of un- certain preference forms such as utility function and Gaussian distribution is proposed. Finally, through the application in emergency decision-making, the cost model and the utility model were compared and analyzed to verify the effectiveness and superiority of the proposed model.

➢ SuB11 - 3　　15 : 45- 16 : 00

[377]基于元胞自动机的森林火灾模型
郭宇宁　　上海理工大学
房志明　　上海理工大学

森林火灾会对森林资源、人类社会等产生巨大的破坏，模拟林火蔓延过程、探索林火蔓延机理以应用于森林防火工作具有重要的意义。在现有研究中，元胞自动机在森林火灾模型中的应用集中于森林密度对火灾的影响，影响林火行为的因素难以考虑全面；考虑多个影响林火行为因素的模型通常在Unity3D 中就某一特定区域进行林火蔓延仿真，不具备普遍性。基于此，本文以经典的森林火灾模型（考虑蒙特卡洛模拟的元胞自动机模型）为基础，构建了考虑可燃物（树木之间的差异性、树种差异）、气象因素（风向、风速、相对湿度、空气温度、连续无降水日）、地形（坡度、坡向）等多因素耦合的元胞自动机模型，得到了一款林火蔓延仿真软件；经检验，模型能有效模拟林火蔓延过程。

➢ SuB11- 4　　16 : 00 - 16 :15

[625]基于信息传播模型的社交网络营销策略研究
黄宇灵　　上海理工大学
刘磊　　上海理工大学

基于信息传播模型的社交网络营销策略研究：随着互联网技术的不断发展，人们的生活节奏逐渐加快，

对信息数量以及实时性的要求越来越高。依托于互联网技术，在线社交网络迅速普及，越来越多的用户加入到在线社交网络中，购物方式逐渐从线下发展到线上。在一些社交网络中，网络舆论信息的发生和演化传播速度非常快，其通过一些有影响力较大的用户传播几分钟就可以影响到上百万用户，进而影响用户的购物行为。因此针对不同社交网络、用户状态及购物行为的特征，了解并预测信息传播效果和产品销售情况，对于热点信息的传播与企业的产品宣传销售有着重要的意义。本文以复杂网络理论和信息传播建模为基础，考虑到用户间交互行为在信息传播中的决定性作用，基于传染病模型的思想对在线社交网络中用户的信息传播和购物行为规律进行研究，首先通过 NetLogo 软件针对生活中两种典型的网络构建了两类在线社交网络信息传播销售仿真模型，多次进行仿真实验讨论不同仿真参数对仿真结果即信息传播效果和产品销售情况的影响，然后采用层次聚类方法对仿真结果进行分类，最后基于仿真实验数据训练支持向量机机器学习模型实现在线社交网络信息传播销售模型仿真结果的预测。仿真结果表明：社交网络、用户状态与购物行为三个方面的基础特征对仿真结果都具有一定程度的影响，且影响程度呈现出一定的规律，除此之外社交网络的多信息状态、用户的退网行为及企业的干预行为也具有一定的影响力；不同仿真结果的细分以及预测模型的应用，则是能够帮助企业对不同情况下的网络进行传播效果和产品销售情况的快速预测，从而为企业做出管理决策提供参考方向，有针对性地为企业提出营销策略建议。

➢ SuB11 - 5 16 : 15 - 16 : 30

357 基于感知层优化的深度强化学习人群疏散研究

梁荣 上海理工大学
黄中意 上海理工大学
房志明 上海理工大学

如何提高智能体对环境的感知能力与疏散过程中的决策能力是人群疏散研究的两个主要挑战。引入深度强化学习的疏散模型在这两方面具有更好的表现，过去的强化学习疏散模型主要针对智能体决策层面进行研究，本文提出了基于感知层优化的双深度 Q 网络强化学习疏散模型。根据设计的环境扫描算法对智能体特定范围内的环境信息进行提取，作为强化学习的环境状态，优化智能体对环境的感知，能够提高疏散模型训练的收敛速度，降低收敛波动性，学习效率与训练效率得到提升。通过实验对比，证明所提出的方法使疏散效率得到提高，具有更好的适应性与真实性。

➢ SuB11 - 6 16 : 30- 16 : 45

465 基于改进免疫粒子群算法的电力-天然气系统分布鲁棒经济调度问题

刘玉兵 上海理工大学

在电力系统中，随着天然气发电机组的使用，天然气消耗显著增加。本文在随机环境下，提出了一种考虑电力系统和天然气系统一体化的多目标经济调度优化模型，并建立电力系统与天然气系统的耦合约束。为解决模型中的随机问题，引入分布鲁棒优化。考虑统计的显著性，将随机变量限制在二阶矩分布集合内。由于双目标优化是 NPhard，为解决粒子多样性以及算法的早熟现象，本文改进了免疫粒子群算法，并增加了解的接受概率。通过数值实验分别与其它算法进行比较，结果表明，该算法在求解双目标优化问题上具有有效性，模型与算法的适用性凸显。

➢ SuB11 - 7 16 : 45 - 17 : 00

715 The effects of node arrangement in ring-coupled power grid

黎雪风 华侨大学

The stability of dynamical systems under strong or weak perturbations is an important part of nonlinear science, especially in connected systems. In this paper, we use a concept of basin stability, which is to measure the basin volume in stable operation of power systems to evaluate the ability of system to restore equilibrium after disturbance. This paper aims to study the influence of power plant and user arrangement on the stability of ring coupling power grid. The numerical results show that the arrangement of nodes plays a key role in the stability of ring power grid, which is similar to the previous research that the arrangement strategy of nodes affects the synchronization performance of the network. Moreover, the higher the proportion of incomplete node connections on the ring, the better the stability of the system, the reverse is not true. Our work presents the stable operation of power grids is related to the arrangement of power plant and users, which highlights the importance of network topology to the stable performance of power grids.

➢ SuB11 - 8 17 : 00 - 17 : 15

762 Segregation dynamics driven by network leaders

王文璇 北京邮电大学

Network segregation – a critical problem in real-life networks – can reveal the emergence of conflicts or signal an impending collapse of the whole system. However, the strong heterogeneity of such networks and the various definitions for key nodes continue to pose challenges that limit our ability to foresee segregation and to determine the main drivers behind it. We here show that a multi-agent leader-follower consensus system can be utilized to define a new index, named leadership, to identify key leaders in real-life networks. We then study the emergence of network segregation that is driven by these leaders based on the removal or the rewiring of the relations between different nodes in agreement with their contribution distance. We finally show that the observed leaders-driven segregation dynamics reveals the dynamics of heterogeneous attributes that critically influence network structure and its segregation. We thus provide a theoretical method to study complex social interactions and their role in network segregation, which ultimately leads to a closed-form explanation for the emergence of imbalanced network structure from an evolutionary perspective.

➢ SuB11 - 9 17 : 15 - 17 : 30

728 考虑怀疑及辟谣机制的 SEMIR 谣言传播模型

左飞宇 贵州民族大学

针对谣言传播过程中,传播个体特性以及影响传播的因素考虑不充分的问题,为揭示网络谣言传播的真实情况，基于传染病动力学模型的特点，引入怀疑者以及辟谣机制建立了 SEMIR 模型.本文采用微分方程动力学和下一代矩阵法计算了模型在无谣言状态和谣言盛行状态的平衡点和基本再生数 R0;此外,基于 Routh-Hurwitz 判据确定了模型在平衡点处的局部渐近稳定性.仿真实验表明该改进的谣言传播模型能有效地抑制舆情爆发的规模，推迟爆发的时间并且可以减少谣言的持续时间.

SuB12 15 : 15 – 17 : 30

腾讯会议：538-197-693

多主体系统与复杂系统动力学

主持人：孙凤兰 重庆邮电大学

主持人：黄良玉 广西师范大学

➢ SuB12 - 1 15: 15 - 15 : 30

553 带恒功率负载的 DC-DC 变换器的非线性特性分析

黄良玉 广西师范大学

带恒功率负载（CPL）的 DC-DC 变换器具有强非线性特性，会导致包含该类电力电子级联拓扑的现代分布式电源系统中极易产生不稳定运行。本文以带 CPL 的电压型 CCM 模式 BUCK 变换器为例，建立了该类级联拓扑的精确线性化离散模型，基于此模型研究了 CPL 对该级联系统非线性特性的影响。研究发现，随着 CPL 功率的增大，该类级联系统呈现出丰富的非线性分岔特性，如周期序列分岔、加周期分岔、轨道交织及混沌等。基于 Farey 加法原理推导了周期序列分岔和加周期分岔的分岔规则及不同周期轨道存在的参数区间，实验结果验证了理论分析及数值模拟的有效性。本文研究结果可为实际分布式电源系统参数选择及状态预测提供理论支撑。

➢ SuB12 - 2 15 : 30 - 15 : 45

680 Combining superpixel information with Markov random field for segmentation of liver tumors

姜燕 重庆邮电大学

Automatic segmentation of tumors in CT images is crucial in many clinical applications, such as postoperative evaluation, surgical planning, pathological diagnosis of liver diseases, etc. However, segmentation is very challenging due to the large variability in size, shape and location of liver tumors. In response to this, this paper proposes a simple and powerful segmentation strategy based on support vector machines and Markov random fields. At the same time, combining intensity, gradient information, region and boundary information, a new feature vector is proposed to represent tumor features. And with this new feature set as input, the initial segmentation is performed using the support vector machine method. Then during segmentation, Markov random fields are used to enhance the smoothness of the labels. Specifically, first, the input image is denoised using curvature filtering, which preserves information about tumor boundaries. At the same time, superpixel segmentation is performed in preprocessing, and based on this, support vector machine is used to perform label classification on the proposed feature channel. Then use Markov random field to refine the label classification, and finally smooth the segmentation results through morphological processing. We apply the proposed new method to public datasets as well as in-house CT liver tumor data, and the experimental

results show that the proposed segmentation method performs well on these liver tumor datasets.

➢ SuB12 - 3 15 : 45- 16 : 00

[479]Event-triggered stochastic consensus for networked Lagrangian systems with semi-Markov switching topologies and communication delays

潘素英 重庆邮电大学

In this paper, the event-triggered stochastic consensus for networked Lagrangian systems with semi-Markov switching topologies and communication delays is considered. An event-triggered sampling control strategy is used to design the distributed stochastic consensus scheme of networked Lagrangian systems for two cases with leader and leaderless. Two delay-dependent consensus criteria are derived in the sense of mean square by use of a suitable Lyapunov-Krasovskii functional and the stochastic delayed Halanay inequality, respectively. A key feature of the developed event-triggered consensus algorithm is to introduce a suitable adjustment parameter on consensus control gains characterizing the effect of both semi-Markov switching topology and communication delay. Finally, a numerical example of four manipulators with two links is presented to illustrate the effectiveness of the developed event-triggered methodology.

➢ SuB12- 4 16 : 00 - 16 :15

[467]Image Space Analysis for Set Optimization Problems with Applications

徐阳栋 重庆邮电大学

In this paper, we consider a set optimization problem with a partial order relation, which rn is defined by Minkowski difference. By using the image space analysis, we establish the rn relationships among the set optimization problem, a vector optimization problem and a rn set-valued optimization with vector criterion related to the image of the set optimization rn problem. In addition, two nonlinear regular weak separation functions are proposed rn for the set optimization problem. Based on the two nonlinear regular weak separation rn functions, saddle point sufficient optimality conditions, gap functions and error bounds rn for the set optimization problem, are obtained. Finally, we explore some applications rn of the obtained results to investigate robust multi-objective optimization problems and rn verify the validity of the results in shortest path problems with data uncertainty and rn multi-criteria traffic network equilibrium problems with interval-valued cost functions.

➢ SuB12- 5 16 : 15 - 16 : 30

[514]Fixed-time formation tracking for multiple nonholonomic wheeled mobile robots based on distributed observer

孙凤兰 重庆邮电大学
李浩 重庆邮电大学

This paper studies the distributed fixed-time formation tracking problem of multiple nonholonomic wheeled mobile robots system over directed fixed and switching topologies. Through a classical rn nonlinear transformation, the formation control problem is transformed into a consensus problem. New control protocols based on a distributed observer are proposed. The directed communication topology between multiple nonholonomic wheeled mobile robots is considered. Some sufficient conditions of multiple robots achieving the desired formation shape are given. All follower robots can form the desired formation shape within a fixed settling time and make the leader in the geometric center of the formation. By adopting graph theory and fixed-time stability theory, an upper bound of settling time that is independent of the system's initial states is obtained. Finally, four examples are presented to illustrate the correctness of the main results.

➢ SuB12- 6 16 : 30- 16 : 45

[511]Spherical fuzzy prospect theory based on optimal reference matrix for emergency decision-making

王宇泰 重庆邮电大学
陈六 重庆邮电大学

The optimal aggregation model (OAM) is an effective tool for dealing with weighted clustering problems, which could provide the theoretical support for information fusion in emergency decision-making (EDM). At present, a series of heuristic algorithms have been studied to solve OAM problems. However, due to the uncertain information constraints, the OAM could not deal with the information fusion problem in the fuzzy environment very well. Therefore, a spherical fuzzy convex optimization model with fuzzy constraints

is proposed to integrate decision matrices with different expert authorities, the optimal aggregation matrix calculated by different heuristic algorithms represents the group decision matrix with the least disagreement among experts. After that, the extended prospect theory based on optimal reference matrix is proposed to describe EDM information with risk preference. Taking the optimal aggregation matrix as the reference matrix, the prospect matrix is calculated and then the optimal alternative is selected. Finally, An illustrative experiment and a series of comparative analyses are presented to verify the superiority of the proposed method.

➢ SuB12 - 7 16 : 45 - 17 : 00

[395]Deep Neuro-dynamic Programming for Real-time Control Strategy Optimization of An Integrated Power System

叶贝 上海理工大学
高岩 上海理工大学

We investigated an integrated power system's real-time optimal control strategy problem with two energy sources at two electricity prices. The problem is separated into two parts and formulated in two models from the prospective of the user and utility company, respectively. The user welfare maximization model is time-independent, whereas the company total profits optimization is a dynamic problem involving real-time microgrid parameters. For this interactive power system, we proposed a new architecture of neuro-dynamic programming with one critic network and four action networks, all the networks are constructed in multilayers so that the Backpropagation in deep learning can be supported. Five neural networks operating with a system dynamic are all constructed and implemented in the simulation. The whole system starts with a set of initial parameters and runs 30 time slots, the networks keep converging over the time. Hence the optimal control strategy is printed as the optimal solution for the utility company. Meanwhile, the user-side optimal solution is solved inside the system dynamic by responding to the real-time electricity prices.

➢ SuB12- 8 17 : 00 - 17 : 15

[527]Perturbation analysis and condition numbers of mixed least squares-scaled total least squares problem

张平平 重庆邮电大学

This paper considers the mixed least squares-scaled total least squares (MLSSTLS) problem which unifies the mixed least squares-total least squares (MTLS) problem and the scaled total least squares (STLS) problem. Firstly, we present the explicit expression of the MLSSTLS solution under some conditions. Then, the perturbation analysis and condition numbers of the MLSSTLS solution are obtained. Theses results can reduce to some corresponding published results of the MTLS problem and the STLS problem, respectively. Finally, numerical experiments are given to illustrate our results.

➢ SuB12- 9 17 : 15 - 17 : 30

[555]Global attracting set and asymptotic behavior for a class of impulsive functional Hopfield neural networks by a novel vector inequality

周伟松 重庆邮电大学
李桂铧 重庆邮电大学
朱伟 重庆邮电大学

In this paper, we concern with a class of nonlinear and non-autonomous functional Hopfield neural networks with impulsive effects. The existence of attracting set and invariant set of the desired impulsive Hopfield neural networks is established. Firstly, we construct a novel vector inequality, which considers rn the features of M-matrix. Based on the more general vector inequality, we ensure the positive variant set and global attracting set for a class of the impulsive functional Hopfield neural networks. By means of numerical simulation the effectiveness of our theoretical results is demonstrated.

防疫指南

根据上海市疫情防控及安全保障要求，为确保第六届中国系统科学大会顺利举行，确保参会人员健康安全，请您仔细阅读并遵守本指南。

一、参会要求

所有参会人员需出示随申码、健康码(绿码)、行程码以及 48 小时内核酸检测阴性证明。外地来沪人员在抵沪后 24 小时内必须进行一次核酸检测(未按要求完成核酸检测者，其“随申码”将被赋黄码)。

如有以下任一情形，禁止参会：

(1) 在参会前 7 天内，有境内中高风险地区(以国务院客户端疫情风险等级为准)、港澳台地区、国外旅居史；

(2) 被判定为新型冠状病毒感染者(确诊病例或无症状感染者)、疑似病例的密切接触者；

(3) 已治愈出院的确诊病例或已解除隔离医学观察的无症状感染者，尚在随访或医学观察期内者；

(4) 有发热、寒战、咳嗽、咳痰、咽痛、打喷嚏、流涕、鼻塞、头痛、乏力、肌肉酸痛、关节酸痛、气促、呼吸困难、胸闷、结膜充血、恶心、呕吐、腹泻、腹痛、皮疹、黄疸、嗅觉或味觉减退等症状，未排除传染病者；

(5) 在参会前 7 天内，有境内中高风险地区所在地及其他国内本土疫情(尚未划定疫情风险区或采取区域静态管理等措施的)地区所在县(市、区、旗)旅居史。

二、会议期间防疫安排

(1) 参会人员入场前请配合扫描“数字哨兵”及“场所码”；

(2) 出示随申码(绿码)、大数据行程卡及 48 小时内核酸检测阴性证明；

(3) 测量体温(低于 37.3℃)；

(4) 新冠抗原检测；

(5) 刷身份证入场；

(6) 参会期间需全程规范佩戴口罩。

三、健康管理要求

(1) 所有人员参会期间需全程做好个人防护，保持安全社交距离；

(2) 为方便参会人员，会务组将在会场每天固定时段为参会人员核酸采样(具体时间、地点另行通知)；

(3) 参会人员每日做好自主健康监测，如出现体温≥37.3℃或有咳嗽、咽痛等新冠肺炎疑似症状，应立即主动联系大会现场工作人员，配合接受流行病学调查和相应安排。在没有明确诊断结果前，不再进入会场。