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CISC 2016

第12届中国智能系统会议

The 12th Chinese Intelligent Systems Conference

程序册

Program Guide

主办：中国人工智能学会
协办：中国人工智能学会智能空天系统专业委员会
承办：国防科技大学
厦门市军民融合协同创新研究院
北京航空航天大学

2016年10月21-23日 中国·厦门

中国智能系统会议往届会议信息

2015年 扬州

张天平 教授
扬州大学

2014年 北京

贾英民 教授
北京航空航天大学

2013年 焦作

王福忠 教授
河南理工大学

2012年 上海

王朝立 教授
上海理工大学

2011年 烟台

杨洪勇 教授
鲁东大学

2010年 北京

刘载文 教授
北京工商大学

2009年 重庆

柴毅 教授
重庆大学

目 录

会议简介

中国智能系统会议是每年举办一次的全国性学术会议，其宗旨是为智能系统领域的专家学者、研究生以及工程技术人员提供一个学术交流的平台，以推动我国智能系统相关的控制理论及应用技术的发展。第 12 届中国智能系统会议（CISC'2016）将于 2016 年 10 月 22-23 日在风光迤逦，经济与科技实力雄厚的厦门市召开。

本届会议由中国人工智能学会主办，中国人工智能学会智能空天系统专业委员会协办，国防科技大学、厦门市军民融合协同创新研究院与北京航空航天大学共同承办，是纪念世界人工智能诞生 60 周年系列活动之一。会议得到了北京邮电大学、南开大学、北京大学、重庆大学、北京控制工程研究所、东南大学、扬州大学、中山大学、北京理工大学、上海理工大学、河南理工大学、北京科技大学、清华大学、哈尔滨工业大学、北京工商大学、中国民航大学、上海应用技术学院 等多家兄弟单位的大力支持。

经程序委员会的认真评审，最终有 115 篇论文被录用并收入会议论文集。会议论文集由 Springer 出版社“Lecture Notes in Electrical Engineering”分上下两卷结集出版。

会议将邀请我国智能系统及其空天控制领域的著名专家、学者做大会报告，就近年来智能系统相关的理论与应用方面的成果与进展进行广泛的交流；会议分组报告论文作者将围绕相关专题进行研讨。

我们热忱欢迎各位同仁莅临本届年会！

组织机构

主办单位

中国人工智能学会

协办单位

中国人工智能学会智能空天系统专业委员会

承办单位

国防科技大学

厦门市军民融合协同创新研究院

北京航空航天大学

支持单位

北京邮电大学	南开大学
北京大学	北京工商大学
东南大学	上海理工大学
扬州大学	上海应用技术学院
北京控制工程研究所	北京理工大学
清华大学	中山大学
哈尔滨工业大学	上海大学
中国民航大学	燕山大学
重庆大学	北京科技大学

大会顾问

吴宏鑫 院士 (北京控制工程研究所)

房建成 院士 (北京航空航天大学)

孙增圻 教授（清华大学）

大会主席

贾英民 (北京航空航天大学)　　刘衡竹　(国防科技大学)

程序委员会主席

杜军平 (北京邮电大学)　　楚天广 (北京大学)

费树岷 (东南大学)　　张天平 (扬州大学)

组织委员会主席

王大轶 (北京控制工程研究所)　　戴琼海 (清华大学)

邹　云 (南京理工大学)　　孙青林 (南开大学)

邀请委员会主席

段广仁 (哈尔滨工业大学)　　苏宏业 (浙江大学)

郭　雷 (西北工业大学)　　王朝立 (上海理工大学)

评奖委员会主席

陈增强 (南开大学)　　张　霖 (北京航空航天大学)

柴　毅 (重庆大学)　　王国利 (中山大学)

财务委员会主席

孔令富 (燕山大学)　　蔡　强 (北京工商大学)

刘忠信 (南开大学)　　王福忠 (河南理工大学)

出版委员会主席

杨洪勇 (鲁东大学)　　李海生 (北京工商大学)

张　青 (中国民航大学)　　李晓斌 (上海应用技术学院)

区域主席

任雪梅 (北京理工大学)　　宗　群 (天津大学)

周　进 (上海大学)　　尹鸿鹏 (重庆大学)

会议秘书长

陈　敬 (厦门市军民融合协同创新研究院)　　张维存 (北京科技大学)

李洪波 (清华大学)　　李明星 (北京航空航天大学)

重要信息

- 会议时间：2016 年 10 月 22-23 日
- 会议地点：厦门海旅温德姆至尊酒店
- 会议日程：2016 年 10 月 21 日 会议报到
  2016 年 10 月 22 日 大会报告
  2016 年 10 月 23 日 会议考察
- 会议语言：中文

会议报到：

- 报到时间：2016 年 10 月 21 日 8:00-22:00
- 报到地点：厦门海旅温德姆至尊酒店
- 联 系 人：陈　敬（130-3089-8366）
  李明星（138-1174-4175）
  杨　亮（150-1118-9383）

会务组联系方式：

- 联 系 人：陈　敬（130-3089-8366）
  李明星（138-1174-4175）
- 电子信箱：cisc2016@126.com
- 会议网址：http://sias.buaa.edu.cn/

交通方式

1、厦门高崎机场—厦门海旅温德姆至尊酒店

◆ 打车：全程约19.4公里，费用约55元

◆ 空港快线：T3\T4候机楼乘坐“海沧快线”，全程约40分钟票价10元，厦门海旅直达温德姆酒店

2、 厦门火车站—厦门海旅温德姆至尊酒店

◆ 打车：全程约14.8公里，费用约41元

◆ 公交：842路，梧村汽车站—嵩屿公交场站下车

3、厦门北站—厦门海旅温德姆至尊酒店

◆ 打车：全程约30.5公里，费用约88元

◆ 公交：898路，厦门北站-海湾大厦站

4、厦门海旅温德姆至尊酒店—教师酒店

◆ 根据会议指示牌步行距离约780米

酒店预订：

1、厦门海旅温德姆至尊酒店：

会议会场酒店

地　　址：厦门市海沧区嵩屿东路88号

酒店电话：0592-6885555

入住时间：10月21日

房间价格：标　　间 500元/间/天（包含早餐）

标间合住 330元/间/天（包含早餐）

2、厦门教师酒店：

距离会场780米

地　　址：厦门海沧区嵩屿南一里232号

酒店电话：0592-6881999

房间价格：标　　间 260元/间/天（包含早餐）

标间合住 130元/间/天（包含早餐）

3、房间预订方式：

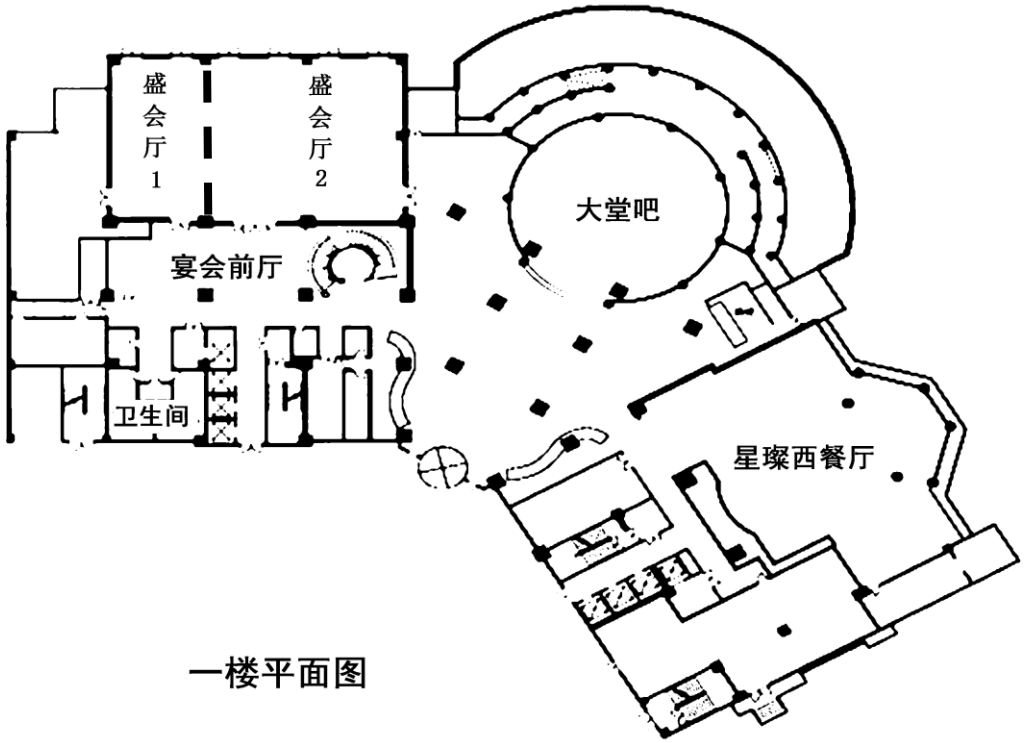
采用回执预订方式，完成住宿预订者方能得到入住保障。请注意：不同标准的房间先订者先得，如某一标准的房间被预订完，请预订其他标准的房间，预订确认后不接受更改。

4、附近其他宾馆：

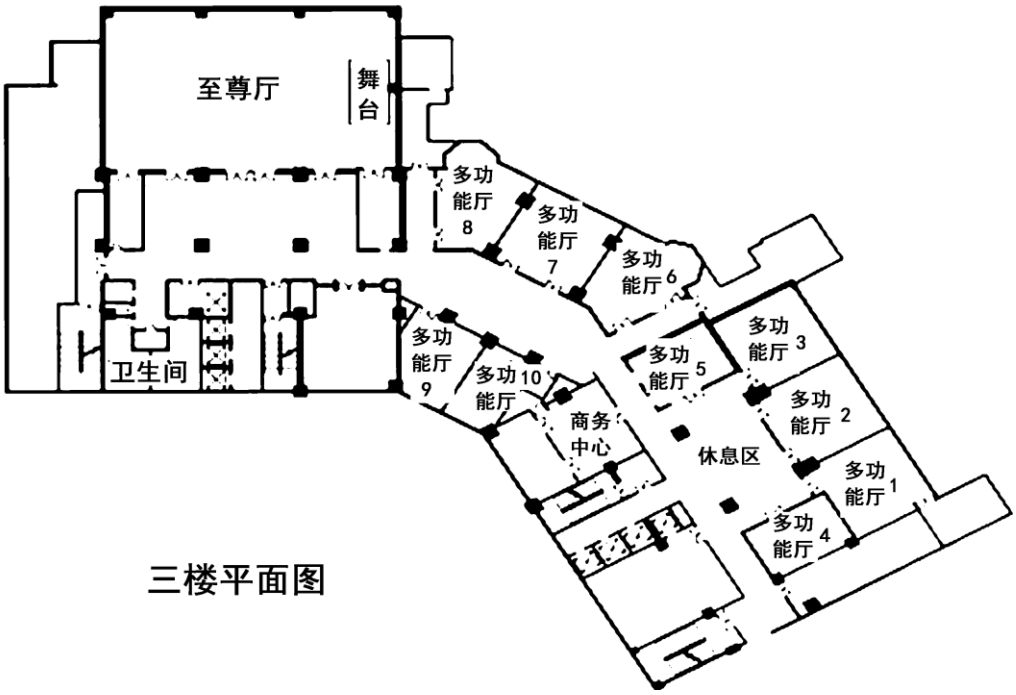
参会人员自行预订

会场平面图

会场：厦门海旅温德姆至尊酒店



一楼平面图



三楼平面图

酒店地图 1


食鼎记
绿韵茗茶庄
鑫源弘烟酒行
嵩屿中路
嵩屿中路
嵩屿中路
嵩屿中路
航运大厦
海峡文创中心
福建省特级教
师协会厦门分会
厦门海旅温
德姆至尊酒店
海旅集团
厦门外国语学校
嵩屿路
嵩屿街道办事处
海沧区教
师进修学校
海沧区嵩屿街道
社区卫生服务中心
厦门海事局
厦门海联综合楼
嵩屿南二路
嵩屿南二路
稻花香里
汇景佳园
中国工商银行
清香茗茶
六六之家
济保生堂
起
终
豪景海岸

酒店地图 2

会议时间表

10 月 21 日（星期五）		
8:00-22:00	**会议注册** 联系人：陈　敬（130-3089-8366） 李明星（138-1174-4175） 杨　亮（150-1118-9383）	厦门海旅温德姆至尊酒店大堂吧
20:00-22:00	**中国人工智能学会智能空天系统专业委员会会议** 主持人：贾英民（北京航空航天大学） 刘衡竹（国防科技大学） 杜军平（北京邮电大学） 李海生（北京工商大学） 任雪梅（北京理工大学） 王朝立（上海理工大学） 张维存（北京科技大学）	厦门海旅温德姆至尊酒店一楼盛会厅
10 月 22 日（星期六）		
8:30-9:00	**开幕式** 主持人：刘衡竹（国防科技大学）	厦门海旅温德姆至尊酒店三楼至尊厅
9:00-9:20	**集体照相** 主持人：陈　敬（厦门市军民融合协同创新研究院） 王继强（南京航空航天大学）	
9:20-10:00	**大会报告 1：** 报告人：贾利民（北京交通大学） 主持人：杜军平（北京邮电大学）	
10:00-10:40	**大会报告 2：** 报告人：吴　敏（中国地质大学） 主持人：柴　毅（重庆大学）	
10:40-10:50	**茶歇**	
10:50-11:30	**大会报告 3：** 报告人：胡忠志（南京航空航天大学） 主持人：陈增强（南开大学）	
11:30-12:10	**大会报告 4：** 报告人：李小俚（北京师范大学） 主持人：巩敦卫（中国矿业大学）	

12:10-14:00	**午餐**	厦门海旅温德姆至尊酒店一楼盛会厅 2
14:30-15:30	**专题讨论 1** 智能系统：理论与应用的结合 嘉宾：楚天广，陈增强，柴毅，张天平，席在荣	厦门海旅温德姆至尊酒店三楼至尊厅
15:30-16:30	**专题讨论 2** 智能系统：我最想研究的问题 嘉宾：杨洪勇，陈谋，程龙，张亚，陈杨杨	
16:30-16:40	**休息**	
16:40-18:50	**分组报告 1**：多智能体与网络控制 论文编号：C-3、C-6、C-8、G-1、G-8 主持人：宋运忠，杨正全	厦门海旅温德姆至尊酒店三楼多功能厅 1
	分组报告 2：航空航天中的控制 论文编号：E-1、E-2、E-5、E-9、E-12 主持人：王继强，熊凯	
	分组报告 3：鲁棒、自适应及智能控制 论文编号：A-8、B-2、D-4、D-5、J-5 主持人：刘忠信，张可	厦门海旅温德姆至尊酒店三楼多功能厅 3
	分组报告 4：目标识别、辨识及图像处理 论文编号：B-5、F-10、H-4、H-6、H-11 主持人：杨月全，魏伟	
19:00-20:30	**晚宴** 主持人：李洪波（清华大学） 王朝立（上海理工大学） **颁发优秀论文奖** 颁奖人：孙青林（南开大学） 王国利（中山大学） 周　进（上海大学） 蔡　强（北京工商工大学） 张　青（中国民航大学） 李晓斌（上海应用技术大学）	厦门海旅温德姆至尊酒店一楼盛会厅 2
10 月 23 日（星期日）		
9:00-15:00	**会议考察**	环岛路 院前社 慈济东宫

大会报告

报告 1

轨道交通科技现状及未来发展中国路径

贾利民

北京交通大学

摘要：本报告回顾和总结轨道交通技术发展及现状，描述了轨道交通技术发展面临的挑战与主要趋势，给出了轨道交通技术的发展路径，定义了面向未来的关键技术集合，介绍了“十三五”国家科技计划对若干重大项目和重大科技工程的总体安排。

报告人简介：贾利民，1963 年 1 月出生，1991 年获得博士学位，1994 年晋升教授。现任北京交通大学教授，轨道交通控制与安全国家重点实验室首席教授，国家轨道交通安全协同创新中心首席科学家。

历任《中国高速列车自主创新联合行动计划》总体专家组副组长、《国家高速列车科技发展“十二五”重点专项》专家组组长、《国家技术预测》交通领域专家组组长、《“十三五”国家科技发展规划》交通领域专家组副组长，“十三五”国家重点研发计划《先进轨道交通重点专项》专家组组长。兼任 CES 常务理事和轨道交通电气技术专委会主任、CAA 智能自动化专委会副主任、ITS China 常务理事和轨道智能运输系统专委会主任、中国高速铁路产业技术创新联盟常务副理事长。

长期从事高速铁路、智能交通、智能自动化等领域教学、科研和政府咨询工作。参与组织实施了“中国高速列车关键技术研究及装备研制”、“智能高速列车系统关键技术研究及样车研制”、“城市轨道列车在途监测与安全预警关键技术”和“新一代城市轨道交通列车系统关键技术与装备研制”等多项国家科技计划重大项目；共获国家和省部级科技进步奖 19 次。出版专著 14 部，高等学校教材 5 部，发表 SCI/EI 检索论文 300 余篇；已获授权专利 40 余项。

报告 2

平面欠驱动系统与协作式多智能体系统控制

吴敏

中国地质大学

摘要：平面欠驱动系统是一类输入个数少于自由度个数、无重力约束的非线性系统，可用于太空、深海等微重力环境中；协作式多智能体系统通过智能体间的协商和协调来完成复杂的控制与决策任务，广泛应用于航天、智能电网、网络管理和群体决策等领域。本报告针对多连杆欠驱动系统，研究系统末端位置的稳定控制方法，包括运动状态约束关系，基于群智能优化的目标角度计算方法，非完整系统转化为完整系统的模型降阶方法以及位置稳定控制器设计等；针对多智能体系统一致性问题及策略自学习中的维数灾、行为探索和动作尝试的盲目性问题，研究设计一致性协议及解决维数灾、泛化、搜索与利用平衡问题的方法，包括分布式有限时间一致性控制方法，分布式同时学习与协同策略搜索算法，基于高斯回归的双阶段值迭代方法，参考模型自适应动态规划方法等，并进行了协作式多智能体系统在机器人足球、分布式发电微网控制领域的应用探讨。

报告人简介：吴敏，国家杰出青年科学基金获得者，教育部长江学者奖励计划特聘教授，新世纪百千万人才工程国家级人选，国务院政府特殊津贴专家。中国地质大学（武汉）学术委员会副主任，自动化学院院长，湖北省自然科学基金创新群体学术带头人，复杂系统先进控制与智能自动化湖北省重点实验室主任，教育部自动化类专业教学指导委员会委员，中国自动化学会控制理论专业委员会委员、过程控制专业委员会委员，IEEE 高级会员，《International Journal of Automation and Computing》、《控制理论与应用》和《信息与控制》编委，汤森路透全球高被引科学家和爱思唯尔中国高被引学者。获国家自然科学二等奖 1 项，国家科技进步二等奖 1 项，省部级科学技术奖 11 项、教学成果奖 2 项。获国际自动控制联合会（IFAC）控制工程实践优秀论文奖、中国过程控制学术贡献奖。发表 SCI 收录论文 183 篇，出版中外专著 6 部、教材 2 部、译著 2 部，授权国家发明专利 27 项，登记软件著作权 19 项。

报告 3

智能航空发动机

胡忠志

南京航空航天大学

摘要：航空发动机是高度复杂和精密的热力机械系统，用来为飞机飞行提供动力，直接影响飞机的性能和飞机的安全性、可靠性、经济性及环保性。客户要求、市场竞争以及适航法规不断推动着技术创新，数字化、信息化、互联网以及大数据技术的应用不但缩短了航空发动机的研发周期，而且提升了产品全生命周期的质量和降低了产品研发和运营成本。本报告将基于现役商用航空发动机产品现状及市场和客户要求，讨论引入智能化的概念到航空发动机的原因，定义智能航空发动机的特点，梳理实现智能化的技术挑战，并探讨智能化可能的实施途径。

报告人简介：胡忠志，国家“千人计划”特聘专家，南京航空航天大学特聘教授，博士生导师。北京理工大学本科，The University of British Columbia 博士。曾任职于美国通用电气公司（GE）15 年，先后参与并领导了多种型号的航空发动机控制系统的研发，包括设计、制造、试验和适航认证等活动。在 GE 国际研发中心曾任高级研究员和实验室经理，在 GE 航空集团曾任主管工程师，主任工程师，GEnx 发动机智能控制和健康管理项目经理，和中国区航空系统集团工程部总经理。在控制系统技术方面，拥有 5 项美国专利；在控制理论及应用、航空发动机控制及健康管理、高安全高可靠电子硬件及软件、系统集成及验证等领域，发表论文 40 余篇，合译《燃气涡轮发动机性能》一书由上海交大出版社出版。

报告 4

脑刺激-脑成像技术及发展

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摘要：经过过去二十多年的技术发展，脑刺激-脑成像已经被成功用于神经生理学和脑与认知科学的研究，包括神经兴奋性、神经抑制性及神经可塑性、认知基本规律等，尤其正成为功能性脑疾病如精神分裂症、抑郁、癫痫、睡眠障碍、孤独症、老年痴呆、中风康复等的新治疗和康复技术。本报告总结了目前的脑刺激-脑成像技术存在的需要和研究现状；以 TMS-EEG 为例子重点介绍，脑刺激-脑成像融合给我们带来的一些新发现和成果的案例，同时，也报告了我们的一些研究进展，包括技术创新和应用，尤其报告在植物人的诊断和康复方面的应用，指出 TMS-EEG 技术的融合不仅是研究大脑功能和大脑活动的重要工具，也是将来临床上的功能性脑病治疗新手段；但是，脑刺激-脑成像的结合并不是简单的技术堆叠，而是需要克服很多技术难题，才能保证脑刺激-脑成像的最大效能，因此，本报告进一步探讨了脑刺激-脑成像中的闭环控制等前沿问题。

报告人简介：李小俚，洪堡学者，国家杰出青年科学基金获得者，教育部新世纪优秀人才，民盟盟员。现任北京师范大学认知神经科学与学习国家重点实验室副主任和北京师范大学脑调控与认知增强研究中心主任。1998.4-2009.6，先后在香港城市大学、德国汉诺威大学、香港中文大学和英国伯明翰大学从事科研工作。2009-2011 年，担任燕山大学自动化系主任和河北省计算机工业控制重点实验室主任。主要从事神经信息与工程、自动化智能状态监控、微弱信号检测与信号处理等研究。至今在国际期刊上发表 SCI 论文 180 多篇，专利 50 多项，出版中文专著 2 部，成果获教育部提名国家自然科学一等奖 1 项，省部级自然科学二等奖 3、三等奖 1 项。

论文摘要

A 机器学习算法及其应用

A-1

Transformer Internal Insulation Fault Diagnosis Based on RBF Neural Network Evolved by Immune Particle Swarm Optimization

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Abstract The reliability of the power transformer operation is directly related to the security of power system and the reliability of power supply. In order to improve the diagnosis accuracy of internal insulation fault in transformer, this paper proposes an algorithm of transformer internal insulation fault diagnosis which is based on RBF neural network evolved by immune particle swarm optimization by analyzing the internal insulation fault type of transformer and the content of dissolved gas in transformer oil composition. The paper focuses on the composition principle of transformer fault diagnosis based on RBF neural network. The method of determining the number of hidden layer of network center and the initial position based on artificial immune network algorithm is given. The method of network weight optimization based on particle swarm optimization algorithm is developed. And the simulation experiment is also given. The simulation results show that the proposed algorithm can effectively diagnose the transformer fault types and the diagnosis accuracy can reach above 90 %.

A-2

Implementation of Intelligent Dynamic Tracking Monitoring System for Vehicle Transportation-in Hazardous Goods

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Abstract In order to put an end to malignant accident caused by leakage, loss, explosion, etc., of hazardous goods of vehicle in transportation process, this paper explores a kind of remote real-time dynamic track monitoring system. In the paper, it makes the anatomy of the reason resulted in malignant accidents, discusses the system architecture aimed at the conditions and trigger factors of malignant accidents caused, based on the combination between GPS positioning and GPRS communication, it designs the transceiver terminal of vehicle data acquisition and the functional modules such as communication, electronic map loading, database, monitoring alarm,

etc., in monitoring center, and realizes a prototype of real-time dynamic track monitoring system. The preliminary test demonstrated that it could complete the remote dynamic tracking and monitoring function of transportation-in hazardous goods in vehicle. Research shows that it can provide effective technical support for security of transportation-in hazardous goods of vehicle.

A-3

Sensor Fault Diagnosis Using Ensemble Empirical Mode Decomposition and Extreme Learning Machine

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Abstract An algorithm using Ensemble Empirical Mode Decomposition (EEMD) and Extreme Learning Machine (ELM) for the detection and classification of sensor fault is presented in this paper. Under this method, the standardized sensor signal is decomposed through EEMD into the original signal, several Intrinsic Mode Functions (IMFs), and residual signal. Then, the variance, reduction ratio and normalized total energy of each IMF and residual are calculated as the sensor fault features. Subsequently, the feature vectors are input into the Extreme Learning Machine (ELM), which is utilized as the classifier for the detection and identification of sensor faults. The fault diagnosis simulation result of the carbon dioxide sensor indicates that this method can not only be effectively applied to the fault diagnosis of carbon dioxide sensors but also provide reference for the fault diagnosis of other sensors.

A-4

A New Quantum-Behaved PSO: Based on Double δ-Potential Wells Model

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Abstract In this paper, a new QPSO based on double δ-potential wells model (QPSO-DPW) is proposed. The algorithm contains three components: the global best position, the particle position relative to the mean individual best positions, and the particle position relative to global best position. This strategy restrains the particle premature convergence and fall into local convergence. Several classical nonlinear functions are employed to test the effectiveness of QPSO-DPW. The results demonstrate good performance in convergence speed and the global searching ability when compared with other recent variants of the PSO.

A-5

An Improved Kernel K-means Clustering Algorithm

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Abstract Kernel K-means is an extended method of K-means, which identifies nonlinearly separable clusters. However it still exits limitations, the one is which repeatedly sets different initial positions to find better local minima, the other is that it can only for linear separable data clustering. In order to overcome this issue, in this paper we propose an improved global kernel k-means. The proposed algorithm adds one cluster at every stage and generates the next centric point at next stage to avoid the unnecessary calculation. Experimental result shows that the proposed algorithm does not depend on initialization which identifies nonlinearly separable cluster, meanwhile, because of the incremental nature and search procedure, the poor local minima is avoided. Moreover, an improvement is put forward to decrease the computational complexity that does not significantly affect the accuracy of classification.

A-6

The Transformer Fault Diagnosis Based on AdaBoost Least Square Support Vector Machine

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Abstract Least square support vector machine integrated with adaptive boost algorithm was applied to the transformer fault diagnosis. In order to obtain the training sample, characteristic gases dissolved in the faulty transformer oil were collected and normalized, then a number of different classifiers are to be constructed though adaptive boost algorithm on the same training set. Subsequently, least squares support vector machine is used as the base classifier, which was fast in calculation and was improved by iteration in classification ability. The fault diagnosis results show that the method was simple and flexible, it has high accuracy rate of fault diagnosis. To a certain extent, this method makes up for the deficiencies of three-ratio method, such as code missing and boundary absolute.

A-7

Adaptive Neural Output Feedback Control for Flexible-Joint Robotic Manipulators

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Abstract In this chapter, an adaptive neural output feedback control scheme is proposed for flexible-joint robotic manipulators. First, the mathematical model of a robotic manipulator is built with considering flexible joints. Then, a Luenberger state observer is employed to estimate the unknown states such that the constriction that all the states should be available for measurements can be relaxed. In order to achieve a satisfactory tracking performance, an adaptive controller is designed by combining neural network control and dynamic surface control techniques to avoid the so-called "explosion of complexity" problem. With the proposed scheme, the tracking error can be guaranteed to converge to a small neighborhood around zero, and simulation results show the effectiveness of the developed method.

A-8

Adaptive Neural Network Control for a Class of Nonlinear Systems

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Abstract An adaptive neural network control scheme is developed for perturbed nonlinear systems with unknown functions. To avoid the curse of dimensionality, dynamic surface-control (DSC) technique is introduced in the progress of controller design. Moreover, the problem of singularity is solved in estimation of the unknown functions by designing a novel strategy of estimation. It is shown that the DSC-based controller can ensure semi-global uniform ultimate bounded of the closed-loop system, and the tracking error can be arbitrarily small with appropriate design parameters. A simulation example is used to demonstrate the validness of the proposed algorithm.

A-9

An Intelligent Surveillance System for Crowed Abnormal Detection

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Abstract In this paper, an intelligent surveillance system for emergency detection is designed for campus. The framework of the system includes following steps. First, the foreground extraction is used with background difference and three frame-difference methods to get the moving objects. Second, based on canny operator, an edge detection is employed to eliminate the effect of brightness. Third, to enhance the accuracy of the results at non-vertical visual angle, the image is divided into limited layers to detect separately after edge detection, based on pixel features. In this

way, the crowd density information can be obtained. Experimental results show the effectiveness of the designed system.

A-10

The Structure Shaping of ITAE Optimal Control System Base on PSO

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Abstract A method, structure shaping, based on the standard form of ITAE optimal control, is presented in the paper. First, structure shaping is related to adjusting the factors of local feedback and open-loop amplification; second, the PSO is used to obtain the optimal result of structure shaping. The results show that after structure shaping, tracking response, stability and robustness have been greatly improved, which possess a high practical value in engineering.

A-11

Dynamical Behaviors in Coupled FitzHugh-Nagumo Neural Systems with Time Delays

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Abstract It is observed that neuron encodes and integrates information employing a variety of complex dynamical behavior, such as spiking, bursting, periodicity, quasiperiodicity, and chaos. Time delay is an inevitable factor in the signal transmission between neurons, and neural system may lose its stability even for very small delay. In this paper, a model of coupled FitzHugh-Nagumo (FHN) neural system with two different delays is formulated, and its nonlinear dynamic behaviors such as stability, bifurcations, and chaos are then studied. It is shown that time delays can affect the stability of equilibrium states, and thereby lead to Hopf bifurcation and oscillation behavior. Moreover, some complex dynamics including quasi-periodic solutions and chaos are numerically demonstrated. Subsequently, numerical examples illustrate the effectiveness and feasibility of the theoretical results.

A-12

A Novel Safety Assessment Approach Based on Evolutionary Clustering Learning

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Abstract The safety risk assessment is a structured and systematic methodology aiming at enhancing the complex engineering system safety. It has been gradually and broadly used in the industrial process control system nowadays around the world. In this paper, a novel safety assessment approach based on evolutionary dictionary learning and fault tree analysis for the complex engineering system is proposed. First, historical signals are utilized to conduct the clustering learning dictionaries by norm similarity matching model and patch-based evolutionary dictionary learning algorithm. Second, the support vector machine method is employed to identify and reflect the normal and fault operating states. Third, an improved safety risks method is proposed to reflect the probable hazards of different faults on the basis of the fault tree analysis. Finally, this processing on online signals is to offer an effective safety assessment index and update the evolutionary dictionaries and safety routing metrics. The related experiments are constructed to demonstrate that our proposed approach can achieve high performance.

A-13

Short-Term Solar Irradiance Forecasting Using Neural Network and Genetic Algorithm

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Abstract Solar irradiance is a vital factor for a solar plant because the inaccurate prediction can increase the risk and the cost of operation. To reach a high-prediction accuracy, a model for short-term direct normal irradiance prediction is proposed in this paper. First, the inputs of the model were discussed and included historical data, such as direct normal irradiance, air temperature, pressure, and the wind velocity. Then, the model was constructed and optimized by genetic algorithm. Model validation was conducted using data from the National Renewable Energy Laboratory's India Solar Resource Data. The result shows that the forecast skill of the proposed model improved 80 % over the persistence model and also better than that of some published models.

B 机器人控制

B-1

Modeling and Control of a Rail-Type Mobile Robotic Work Platform

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Abstract The longitudinal displacement of a rail-type mobile robotic work platform based on semi-active suspension system is modeled, and the unknown disturbance noise in the model is separated. As for the control method, we use the state feedback control of linear quadratic regulator and add the filter of H∞ minimum error state estimation to filter the unknown process and measurement noise. Besides, the difference between Kalman filter and H∞ filter is analyzed based on the power spectral density. Eventually, the anti-interference performance of two filters is compared by means of simulation.

B-2

Robust Tracking Control of Wheeled Mobile Robots with Parameter Uncertainties and only Target's Position Measurement

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Abstract Robust tracking control of wheeled mobile robots (WMRs) is studied in this work. Considering the dynamic model of WMRs with unknown parameters, a robust sliding-mode state feedback controller is proposed, guaranteeing the tracking errors converge to zero asymptotically. Later, combining robust exact differentiators with the proposed state feedback control law leads to a tracking controller, in which only the position of reference robot is included and the tracking errors are driven to the origin asymptotically too. Numerical simulation is carried out to verify the effectiveness of proposed controller.

B-3

Path Following Control for Nonholonomic Mobile Robots with a Distance Between the Mass Center and the Geometrical Center

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Abstract Currently, some path following control problems have been proposed for nonholonomic wheeled mobile robot (WMR) with driven wheels under the condition that there is a distance between the mass center and the geometrical center. However, there is lack of the relevant experiment verification except for several simulations. In this paper, the mathematical model of WMR kinematics is analyzed. In polar coordinates a new kinematics tracking error model is put

forward based on the WMR, whose mass center does not coincide with its geometrical center. In view of the grid map model composed of discrete path point path, on the principle of point stabilization, a new dynamic feedback tracking controller is designed. The stability of the closed-loop system is rigorously proved. Simulation and experiment results are provided to illustrate the performance of the control law.

B-4

Looking After the House Using the Mobile Phone to Control the Robot Remotely on the Internet

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Abstract In this chapter, we can use our mobile phone to remotely control our mobile robot on the Internet basing on the TCP/IP protocol. We make an app installed in our mobile phone based on Android. We can see the real-time video translated from the camera fixed on the robot. The robot can translate the real-time video of the environment the robot stays to our mobile phone. The mobile phone can display the real-time video directly. When we control the robot, we can see how the mobile robot moves at the same time. When the robot meets the obstacles using the ultrasonic sensors, the robot can stop and translate this warning to the mobile phone. When we finish the control work, we can control our robot to move to the destination to get the electric charge. We can use our robot to see the rooms of our house, when we have left our house for a long time. It is very convenient for us to look after our house.

B-5

Autonomous Control of Mobile Robots for Opening Doors Based on Multi-sensor Fusion

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Abstract This paper presents a method of opening doors by mobile robots autonomously. Considering that the existing fingerprint lock will collapse when finger injures, the use of robot shows its durability and convenience, and it avoids carrying even losing keys trouble, and incarnates people’s awareness of intelligent robot era. In this robot opening door system, a mobile phone is applied to send open-door command, the robot receives the command via Wi-Fi, then plans path based on laser sensor and encoder sensors to move to the door position, and aims at the door handle based on visual servo, and finally opens the door. Experiments have proved the validity and feasibility of the presented method. Meanwhile, we are discussing other applications of this method.

B-6

Output Feedback Stabilization of Stochastic Non-holonomic Mobile Robots

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Abstract We discussed the output feedback stabilization of stochastic nonholonomic mobile robots. Output feedback controllers are given with backstepping method. So, the original closed-loop system can be stabilized in probability based on provided switching control strategy. In the end, we give an example to explain these results.

B-7

Research on Grasp Force Control of Apple-Picking Robot Based on Improved Impedance Control

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Abstract In order to solve the problem during the force control process of apple-picking robot the control effects are affected by robot dynamic parameters, contact environment uncertainties, and the noise interference of force sensors. This paper presents an improved impedance control algorithm. The algorithm only considers the direction of grasping apples, avoiding the complexity of multi-DOF manipulator impedance control; meanwhile impedance parameters are adjusted by RLS on time to improve the real-time control and the robustness to the force interference. Simulation results show the control algorithm is effective in force tracking and the output of force is steady; it can reduce the grasp damage remarkably. The research can provide a reference for the apple-picking robot compliant grasp.

B-8

The Design and Application of a Manipulator's Motion Controller for Changing CNC Machine Tools

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Abstract Computer numerical control (CNC) machine is one of the most important processing means in the manufacturing industry right now. The paper presents and designs a motion controller of manipulator which is used to change the tools for the CNC machine. First, the paper describes the necessity and significance of automatic tools change for CNC machine. Then the details about the hardware and function of the motion controller of manipulator for tools change are introduced. In the end, the paper analyses the data clearly about the whole system when the manipulator is working.

B-9

Globally Exponentially Stable Triangle Formation Control of Multi-robot Systems

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Abstract In this paper, the problem of formation control for nonholonomic robots is investigated. Based on the negative gradient method and the Lyapunov direct method, a globally and exponentially stable control scheme for multi-robot formation control system is designed. The proposed control law using the adaptive perturbation method can guarantee the globally exponential stability of the desired triangle and line formation, and the equilibrium set of the overall system is unique, which is exactly the desired formation set. Finally, some simulations illustrate the effectiveness and correctness of the proposed controllers.

B-10

Distributed Finite-Time Formation Control for Multiple Nonholonomic Mobile Robots

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Abstract In this paper, the finite-time formation control problem for a group of nonholonomic mobile robots is considered. A distributed finite-time estimator is proposed to estimate leader's state in finite time. Then, based on the estimated values of estimator, a distributed finite-time formation control law is designed. With the help of finite-time Lyapunov theory and graph theory, rigorous proof shows that the group of mobile robots can converge to desired formation pattern and its centroid can converge to the desired trajectory in finite time. Simulations are given to verify the effectiveness of the method.

B-11

Adaptive Tracking Control for Differential-Drive Mobile Robots with Multi Constraint Conditions

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Abstract To solve the trajectory tracking problem, we propose an adaptive controller with input constraint for the differential-drive mobile robots containing uncertain parameters. Two inequalities guarantee the satisfaction of input constraints, and the adaptive control method can adjust the uncertain parameters of the kinematic model on line. The system stability is proved by the Lyapunov stability theory. Simulation results verified the effectiveness of the former proposed method.

B-12

A Visual Feedback Model-Free Design for Robust Tracking of Nonholonomic Mobile Robots

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Abstract This paper considers the problem of designing a visual feedback control law for robust tracking of nonholonomic mobile robots. The control approach developed in this work with uncalibrated visual parameters, unknown control directions, and external disturbances. Using incomplete information of the moving objects to be tracked to propose a model-free, self-support control algorithm to ensure the tracking error can be driven into a prespecified neighborhood of zero. Global stability of the corresponding closed-loop system of tracking error is proved by the Lyapunov stability theory. Finally, the simulation results demonstrate the effectiveness of the proposed controller design method.

C 多智能体控制

C-1

Adaptive Finite-Time Bipartite Consensus for Nonlinear Coopetition Multi-agent Systems with Unknown External Disturbances

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Abstract This paper studies the adaptive finite-time bipartite consensus problem for second-order nonlinear coopetition multi-agent systems subject to external disturbances. The novel continuous distributed adaptive protocols with update laws are proposed. By using the finite-time Lyapunov stable theory, the rigorous finite-time stable proofs and accurate expression of convergent regions of bipartite steady-state errors are given. An example is given to demonstrate the effectiveness of the presented method.

C-2

Finite-Time Consensus Tracking for Second-Order Multi-agent Systems Without Relative Velocity Measurements

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Abstract This paper considers the finite-time consensus tracking problem in directed networks of second-order multi-agent systems. Based on auxiliary system approach, a distributed control protocol is proposed for each follower, which only relies on the relative position measurements among the neighboring agents. Then, using homogeneous theory, sufficient conditions are derived to ensure that the states of the followers can track that of the leader in finite time under fixed topology. Moreover, the case under switching topology is also studied. Finally, numerical simulations are given to illustrate our theoretical results.

C-3

Consensus Control for Multi-agent Networks with Mixed Undirected Interactions

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Abstract This paper is concerned with the average consensus problem on multiagent networks with undirected interactions which can be either static or dynamic. Notably, the multi-agent networks involving static and dynamic interactions are represented by graphs with edge weights in the form of real numbers and transfer functions. We propose a distributed consensus control algorithm based on the nearest neighbor rule. It is shown that the connectivity topology condition

supplies a necessary and sufficient condition for all agents to achieve average consensus. Numerical simulations are provided to verify the effectiveness of the obtained results.

C-4

Containment Consensus of Multi-agent Systems with Communication Noises

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Abstract Containment control of multi-agent systems with switching topologies and communication noises is studied. In order to attenuate the effect of noises, containment control algorithm with multiple leaders is presented, where a positive time-varying gain is employed in the protocol. The stability of control algorithm is studied with the assumption that communication topology is jointly connected. Some constraint conditions of multi-agent systems are derived with the aid of modern control theory and stochastic analysis. Simulation results are provided to verify the correctness and effectiveness of the conclusion.

C-5

Leader-Following Consensus Problem of Fractional-Order Multi-agent Systems with Perturbation

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Abstract In this paper, the consensus problem of fractional-order multi-agent systems (FOMAS) with perturbation is considered. Both undirected and directed communication topologies are considered for FOMAS, where the fractional order $0 < a < 2$. By using the fractional-order stability theory and the inequality techniques, some consensus criteria are obtained. Besides, an example is given for illustration.

C-6

Observer-Based Event-Triggered Consensus Tracking Control of Multi-agent Systems

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Abstract The leader-following consensus problem of multi-agent systems with general linear dynamics is investigated in this paper. Only one leader is considered and the communication

topology among the followers is undirected. A novel consensus protocol based on observer and event-triggered mechanism is proposed. Based on the protocol, a sufficient condition is obtained by using common Lyapunov function method. This condition can guarantee that each follower agent can track the leader. Finally, a numerical example is given to demonstrate the effectiveness of the proposed scheme.

C-7

Robust $H\infty$ Consensus of the Second-Order Multi-agent Systems with Random Time-Delays

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Abstract This paper investigates the consensus problem for directed networks of agents with external disturbances and random time-delays. Both networks under the fixed and switching topologies are taken into consideration. Based on Lyapunov stability theory, sufficient conditions for all agents achieving stability with the directed $H\infty$ performance are given in the forms of liner matrix inequality (LMI). Finally, the simulation results show the correctness and effectiveness of the designed protocols.

C-8

Evolution and Spread of Public Opinion in Structured Multi-agent Systems

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Abstract This paper investigates the evolution and spread of public opinion by the aid of evolutionary game theory. Moreover, we employ the complex networks to model the interactions between the members of the multi-agent systems. For one specific opinion, we assume that three roles exist in the population: supporter, objector, and neutral. And, the supports and objectors will try to persuade the neural to adopt their strategies, in the form of game theory. The supports and objectors will make strategy updating according to the payoff-based updating rules. The findings on complex networks (BA scale-free networks) reveal that the initial distribution of the opinions and the adoption probability of the neutral players would be two important factors for the spread and evolution of opinions.

C-9

Consensus of Linear Multi-agent Systems with Persistent Disturbances

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Abstract This paper focuses on the consensus problem of continuous-time multiagent systems with persistent disturbances. A distributed protocol is designed, which consists of two parts, one is the traditional control protocol, the other one is the estimation of disturbances. Then, using the method of matrix analysis, the sufficient conditions for achieving consensus of the closed-loop systems are found out. Finally, simulations are provided to demonstrate the effectiveness of the proposed algorithm.

C-10

Event-Triggered Consensus Control of Nonlinear Multi-agent Systems with External Disturbance

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Abstract This paper investigates the consensus problem for a leader-following nonlinear multi-agent system with external disturbance by using the event-triggered control strategy. First, in order to transform the consensus control problem of disturbed system into the H∞ problem, a controlled output function is defined. Then a distributed event-triggered protocol is designed, and a sufficient condition is given to ensure that the nonlinear multi-agent system can reach consensus with the desired disturbance attenuation ability.

D 鲁棒与智能控制

D-1

Robust Control of Piecewise Linear Switched System with Constrained Input and Ellipsoid

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Abstract This paper deals with the uncertain linear discrete-time switched systems with constrained control input and ellipsoid. The piecewise linear systems is described as ellipsoid

which can be characterized by a set of vector inequalities, thereby the constraint of LMIs (linear matrix inequalities) is released. In terms of LMIs, the perturbed impulsive switched system with constrained control input can be robust stabilized in Lyapunov theory. The simulation results verify the effectiveness of the proposed method.

D-2

Composite DOBC and $H\infty$ Control for Stochastic Systems with Disturbances

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Abstract Composite disturbance observer-based control (DOBC) and $H\infty$ control scheme is proposed for a class of stochastic systems with nonlinear dynamics and multiple disturbances. The stochastic disturbance observer based on pole placement is constructed to estimate disturbance which is generated by an exogenous system. Then, composite DOBC and $H\infty$ controller is designed to ensure that the composite system is mean-square stable and its $H\infty$ performance satisfies a prescribed level. A numerical example validates the feasibility and effectiveness of the approach.

D-3

Estimation for a Class of Unknown Frequency Disturbance Using Two-Step Nonlinear Disturbance Observer

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Abstract This paper proposes an estimation strategy of two-step disturbance observer to unknown frequency disturbance existing in a class of nonlinear systems. Two-step disturbance observer is designed to estimate the disturbance and guarantee the disturbance estimation error system is asymptotically stable. A number simulation example is given to demonstrate the correctness and effectiveness of the presented method.

D-4

Adaptive Dynamic Surface Control for Dual-Motor Driving System with $H\infty$ Performance

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Abstract In this paper, a novel adaptive tracking control method is proposed for the dual-motor driving system (DDS) with parameter uncertainties and external disturbances. The DDS is a multi-variable, nonlinear and strong-coupling system which increases the difficulty of the

controller design. To handle this problem, a set of alternative state variables is introduced to transform the DDS into a strict feedback form. Based on the transformed system, an adaptive controller is constructed by integrating the H ∞ technique into the dynamic surface control to guarantee that the output tracking error satisfies the H ∞ performance. More importantly, the designed controller cannot only attenuate the influences of external disturbances on the system output, but also have a strong robustness for system parameter variations. Simulation results are conducted to validate the effectiveness of the proposed method.

D-5

Stabilization of a Class of Uncertain Nonlinear System via Fractional Sliding Mode Controller

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Abstract In this paper, a novel fractional sliding mode control scheme is suggested to stabilize a second-order uncertain nonlinear system. The proposed sliding manifolds, which will converge to the origin in finite time by utilizing a classical quadratic Lyapunov function, ensures the reduction of the chattering phenomenon during the control process. Based on Lyapunov's stability theorem, the closed-loop system can be stabilized to the origin in the future time. Some results about the control and stabilization of such nonlinear systems, when the fractional sliding mode controller is used, are illustrated in this paper. Finally, an example with numerical simulations is provided to show the validity and feasibility of the proposed method.

D-6

An Augmented Multiple-Model Adaptive Estimation for Time-Varying Uncertain Systems

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Abstract An augmented multiple-model adaptive estimation (MMAE) algorithm is presented for a time-varying system, where the model uncertainty may occur occasionally. Generally, it is difficult for a single filter to achieve superior performance for both the certain system and the uncertain system. An algorithm that is designed for an uncertain system may yield suboptimal performance in the situation, where the model uncertainty does not occur. To cope with this problem, we propose to use two filters in parallel in a multiple-model framework. One of the filters, an augmented Kalman filter (AKF), provides estimates of uncertain parameters when the model uncertainties occur, whereas the second filter, a Kalman filter (KF), yields high precision in the absence of the uncertainties. A practical example is given in simulation to show the potential application of the presented algorithm. It indicates that the augmented MMAE is efficient to deal with the occasional model uncertainty.

D-7

Robust $H\infty$-optimal Output Feedback Actuator Placement with a Class of Actuator Constraints

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Abstract This paper investigates the actuator placement of uncertain linear systems. The designed actuator locations are subject to a class of nonlinear equality constraints, and a dynamic output feedback controller should also be derived based on measured outputs. To minimize $H\infty$ norm of the closed-loop systems, the actuator placement problem is formulated as an uncertain non-convex optimization problem. A series of transformations are developed to convert this problem into a deterministic successive convex problem. Correspondingly, an optimization algorithm is derived based on prediction-correction procedure.

D-8

Linear Active Disturbance Rejection Control Approach for Load Frequency Control Problem Using Diminishing Step Fruit Fly Algorithm

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Abstract The diminishing step fruit fly optimization algorithm (DS-FOA) is employed to optimize the performance of the load frequency control (LFC) problem by employing the linear active disturbance rejection control (LADRC) approach. First of all, the LFC problem taking into account the case of a single generator supplying power to a single service area is presented. Second, the general LADRC solution to the problem is given, where the diminishing step fruit fly optimization algorithm (DS-FOA) is employed to optimize the performance of the system with the approach. Third, the performances of the system with the following three control approaches are compared, including the traditional PID control approach, the normal LADRC approach, and the DS-FOA optimized LADRC approach. With the proposed LADRC approach, the system performance is much better than that of the traditional PID controller, and a much better performance is achieved with the proposed DS-FOA optimized LADRC approach. The performance superiority of the proposed approach is also validated by the frequency domain analysis results given.

D-9

Design and Control of the Upright Controllable Force Sub-system for the Suspended Gravity Compensation System

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Abstract This paper introduces the design and control of the suspended gravity compensation system's upright controllable force subsystem. The upright subsystem consists of the transmission compensation module, the buffer module, and the control part. The transmission compensation module includes the transmission components. The buffer module includes the compression spring and its fittings. The control part contains servo motor, tension sensor, and relative displacement sensor. The subsystem can follow the object upright motion actively and provide constant force to compensate the gravity of the object.

D-10

Further Analysis on Observability of Stochastic Periodic Systems with Application to Robust Control

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Abstract This paper is concerned with a class of discrete-time stochastic systems with periodic coefficients and multiplicative noise. Above all, observability is studied by analyzing the unobservable subspace of concern dynamics. Further, invariantsubspace approach is applied to derive an operator-spectral criterion of observability, which improves the observability test presented by Ma et al. (Proceedings of 2016 American control conference, to appear) [1]. Based on the proposed observability criterion, an infinite-horizon stochastic periodic *H2*/*H*∞ control is obtained in the presence of (*x, u, v*)-dependent noise.

D-11

Stabilization of Perturbed Linear Systems by an Event-Triggered Robust *H*∞ Controller

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Abstract Event-triggered control systems have been increasingly studied as an alternative to the time-triggered sample-data system, mainly for its advantage of reducing the resource utilization. In this paper, we propose a robust $H\infty$ controller for a linear perturbed model and implement it in an event-triggered feedback scheme, to achieve the L_2 stability of the system. A sufficient condition guaranteeing the L_2 stability of the system is provided in the form of matrix inequality. The optimization of this inequality condition is settled by eliminating the nonlinear components, and an adjustable parameter is brought in to reduce the conservatism. Illustrative examples are given to show this controller's ability at enlarging sample time and disturbance attenuation.

D-12

The Active Disturbance Rejection Control with a Square-Root Amplifier for Non-minimum Phase System

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Abstract This paper adopts the active disturbance rejection control (ADRC) technology to control the non-minimum phase system (NMP). A new amplifier called square-root amplifier (SQF) is added in the ADRC to reduce the undershoot and the settling times of the step response. Simulation results are given to verify the effectiveness of the proposed scheme.

D-13

Adaptive Terminal Sliding Mode Control for Servo Systems with Nonlinear Compensation

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Abstract To achieve high accurate position tracking of servo systems with backlash and friction nonlinearity, a terminal sliding mode controller with adaptive compensation is proposed in this paper. The nonlinear backlash model is converted into the linear expression in order to simplify the system for control-oriented design. The presented controller consists two parts, which are position tracking controller and nonlinear compensator. A novel terminal sliding mode controller is proposed by adopting a terminal sliding mode manifold, while making sure the control system

could reach the sliding surface and converge to equilibrium point in finite time. The adaptive compensator is used to compensate the error caused by linearization and friction including static friction and viscous dissipation. Simulation results verify the reliability and effectiveness of the proposed method.

D-14

Sensorless Vector Control of PMSM Based on Improved Sliding Mode Observer

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Abstract This paper proposes a sensorless control algorithm for the permanent magnet synchronous motor (PMSM) based on a new sliding mode observer (SMO), which substitutes a sigmoid function for the signum function. The stability of proposed SMO is analyzed using the Lyapunov stability theorem. Adaptive law of switching gain is regulated with the rotor speed to expand the functional range of SMO. A back-electromotive force (back-EMF) observer is designed to eliminate the high frequency components of estimated back-EMF. An input-normalized phase-locked loop (PLL) is adopted to extract the rotor position and speed for compensating the phase lag resulted from the filter. The simulation results illustrate the validity of the analytical approach and the efficiency of the new sensorless control algorithm for PMSM based on the new SMO.

D-15

Research on Sliding-Mode Control Technology of High-Performance LED Lighting Circuit

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Abstract In order to adapt to the dimming characteristics of load led lamp, and to solve the shortcomings of slow dynamic response and poor dynamic performance on control parameter of the traditional PI control, a sliding-mode controller based on half-bridge LLC resonant converter with current negative feedback is studied in his paper. Two fixed frequencies are set according to the constant current characteristic of the LED lamp, and the switching of the working state under the two operating frequencies of the LLC converter is realized by sliding-mode control. The LED lamp dimming can be realized when the reference current is changed. In this paper, the large-signal model of LLC resonant converter is derived based on the extended description function method, and the sliding surface equations and control parameters of the system are deduced according to the model of the system. Then, the simulation circuit of 240 W LLC resonant converter with PI control and sliding-mode control is built. According to the simulation results, when the load current jumps, the response speed of sliding-mode control is faster than that of PI control, the dynamic performance of sliding-mode control is higher, and the system is more robust.

D-16

Nonlinear Servo Motion Control Based on Unknown Input Observer

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Abstract This paper presents an alternative control method based on a new unknown input observer (UIO) for servo motor systems with unknown time-varying nonlinear dynamics and disturbances. By defining auxiliary filtered variables, an invariant manifold is derived and used to design the estimation of unknown dynamics. The new observer has only one scalar to be set, and thus can be easily incorporated into the control design to achieve precise output tracking. The convergence of the proposed estimator is compared with other three well-known schemes. Comparative simulation results show the satisfactory estimation and control performance.

D-17

H∞ Filtering for a Class of Discrete-Time Markovian Jump Systems with Missing Measurements

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Abstract This paper is concerned with the *H*∞ filtering problem for a class of discrete-time Markovian jump system with missing measurements. The measurement missing assumed to occur in random way and the missing probability for each sensor is governed by an individual random variable satisfying a certain probabilistic distribution over the interval [0 1]. Our attention is focused on the design of a filter such that, for the admissible random measurements, missing the error of filtering process is stochastically stable. Using the Lyapunov function combined with projection Lemma is established that the filtering error system is stochastically stable and a guaranteed *H*∞ performance constraint is achieved. A numerical example is given to illustrate the feasibility and effectiveness of proposed filter.

E 飞行器与航天器控制

E-1

Virtual Actuators for Attitude Control Based on Variable-Speed Control Moment Gyros

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Abstract A steering law avoiding singularity by virtual actuators for variable-speed control moment gyros (VSCMGs) is proposed in this paper. Using virtual actuator to extend VSCMGs Jacobian matrix, this method can guarantee the pseudo-inverse solution of VSCMGs steering law always exists. At the same time, the null motion of VSCMGs is adopted to make sure that the VSCMGs gimbal angles always get away from the singularity and the VSCMGs rotor velocities tend towards to expect speed. The proposed steering law is demonstrated through numerical simulation for large angle attitude maneuver control.

E-2

Distributed Control for Formation Switch of Fixed Wing MAVs

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Abstract We propose a distributed control approach for formation switch of fixed wing micro aerial vehicles (MAVs). First, a multilayer system framework is designed for distributed formation control of fixed wing MAVs. Then, a specific control algorithm is proposed for on-the-fly formation switch. During the entire formation switching process, constraints such as a safe inter-MAV distance can be satisfied, by applying position-based dynamics on the conceptual centers around which the MAVs circle. The effectiveness of the proposed approach is demonstrated by comparative experiments in a realistic robot simulator.

E-3

Research of Variable Cycle Engine Modeling Technologies

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Abstract A component level mathematical model of double bypass variable cycle engine (VCE) was built with a reference to the modeling method of two-spool-turbofan engine. The model of fan was developed with separated characteristic of fan tip and hub sections. The model of core drive fan stage (CDFS) model was built to work under single bypass mode and double bypass mode. The model was able to run as steady mode and transient mode. During the calculating process of the dynamic co-working equations, the method of volume dynamics was used in order to avoid the iterative calculations. In single bypass mode, it represents higher thrust and smaller bypass ratio,

which is fit for the high-speed flight. In double bypass mode, it shows lower thrust and bigger bypass ratio, which is fit for the low-speed flight.

E-4

Multi-sensor Fault Diagnosis of Aircraft Engine Based on Kalman Filter Group

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Abstract For the problem of Multi-sensor Fault Diagnosis in aircraft engine, according to the theory of Kalman filter, this paper proposed a novel fault diagnosis method based on Kalman filter group. Author used the engine model nonlinear system based on the least square fitting method, and the linear discrete system model of engine was obtained by discrete treatment. On this basis, further considering the effect of engine sensor fault and interferences, successively for single sensor and multi-sensor faults condition, we put forward the aircraft engine sensor fault diagnosis method based on Kalman filter group. The simulation results show that this method can quickly diagnose and have a good diagnostic accuracy for multiple sensor faults and gradual failure of the engine.

E-5

Development of a Simulation Platform for Spacecraft Omni-directional Rendezvous

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Abstract A novel semi-physical simulation platform that can be used for verification on spacecraft omni-directional rendezvous is presented. The platform is comprised of a 6-DOFs motion module and a 3-DOFs motion module, which provides the capability for reconstructing the motion of spacecraft rendezvous on the ground. The mechanical structure and the dynamics model of the platform are given at first. Then the reference trajectory for the platform's motion module is developed based on the similarity theory and a tracking controller is designed. Finally, the effectiveness of the simulation platform is demonstrated by the numerical simulation of flying-by rendezvous.

E-6

Robust Coupling-Observer-Based Linear Quadratic Regulator for Air-Breathing Hypersonic Vehicles with Flexible Dynamics and Parameter Uncertainties

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Abstract This paper studies the anti-disturbance control problem for air-breathing hypersonic vehicles (AHVs) with flexible dynamics and parameter uncertainties. A novel anti-disturbance control method is presented, which includes a robust coupling observer (RCO) and a linear quadratic regulator (LQR). The compensator is designed to reject the disturbance generated by rigid-flexible couplings (RFCs). The LQR is presented to track desired trajectories. Finally, simulation results show that the control performance can be improved by using the RCO-based LQR compared with the traditional linear quadratic regulator.

E-7

Robust Tracking Control for Flexible Space End Effector

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Abstract In this paper, a robust tracking control strategy is proposed for flexible space end effector. First, a flexible end effector is designed for the purpose of decreasing the rigid collision caused by the contact between space manipulator with the target. Permanent magnet spherical motor (PMSM) combining yaw, pitch, and roll motions in a single joint is employed to track the trajectory of the end effector. Then, the dynamic model of PMSM rotor is built according to the second Lagrange equation and the Cardan angle coordinate transformation. Finally, based on computed torque method, a robust control strategy is presented to reject the external disturbance. The simulation results illustrate the strong robustness of proposed control scheme.

E-8

Robust Control for Elliptical Orbit Spacecraft Rendezvous Using Implicit Lyapunov Function

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Abstract In this paper, a robust control scheme using implicit Lyapunov function is proposed to solve the elliptical orbit spacecraft rendezvous problem in the presence of parameter uncertainties and external disturbances. First, an implicit Lyapunov function is constructed that is to be used in

control design, and the finite-time convergence is guaranteed by some linear matrix inequalities depending on variable parameter and the implicit Lyapunov function. Then, an analytical feasible solution of these inequalities is provided for practical implementation. Simulation example is given to illustrate the effectiveness of the proposed method.

E-9

Integrated Design of Fault Diagnosis and Reconfiguration for Satellite Control System

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Abstract An integrated design of fault diagnosis and reconfiguration method is studied for actuator failures of satellite control system. First, the effectiveness factor and the controller gain are taken as a whole to design the combined control law, which is obtained by placing the closed-loop system poles according to the theory of regional pole assignment. And this paper uses perturbation linearization method to solve the generating bilinear matrix inequalities (BMI). Then the effectiveness factor is obtained with a two-stage Kalman filter and thus the control law can be solved. Finally, the effectiveness of the provided method is illustrated by a simulation.

E-10

Decoupled Tracking Control for a Flexible Multi-body Satellite with Solar Panels and Manipulator

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Abstract This paper studies the tracking control of a robotic manipulator mounted on a rigid satellite with flexible solar panels. By designing a decoupled feedback controller, the manipulator can track planned paths in the presence of the disturbances from the flexural modes of the panels, and meanwhile, the attitude dynamics of the satellite are stabilized. Stability analysis is proposed based on the Floquet theory for periodic linear systems. Finally, numerical simulations are carried out to validate the controller for the nonlinear model.

E-11

Autonomous Navigation for Spacecraft Around Mars Based on Information Fusion with Cross-Correlation Noise

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Abstract This paper presents an innovative autonomous navigation scheme based on information fusion for spacecraft orbiting Mars using observations of Phobos and Deimos. The optimal fusion (OF) algorithm and the covariance intersection (CI) fusion algorithm are then applied to solve the information fusion problem of multiple subsystems which are all cross-correlation. Simulation results demonstrate the superiority that the OF algorithm and the CI fusion algorithm have in handling the fusion problem with cross-correlation noise compared with Federated Filter.

E-12

Modeling and Simulation of Parafoil Systems in Wind Fields

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Abstract Parafoil systems are a kind of flexible wing vehicle. In view that the vehicle flying at low altitude is more susceptible to wind fields, and considering that the parafoil canopy and the payload are regarded as rigid connection, a six degrees of freedom (DOF) dynamic model is established according to the Kirchhoff motion equation, which consists of three DOF for translational motion and three DOF for rotational motion. Moreover, the effects of wind fields on its flight performances are also discussed. The motion characteristics of parafoil systems under the horizontal constant wind field are studied by numerical simulation. Simulation results demonstrate that the established model can accurately characterize dynamic performances of parafoil systems in wind fields, which is high valuable in engineering applications.

F 检测、识别与跟踪技术

F-1

Determination of the Vehicle Relocation Triggering Threshold in Electric Car-Sharing System

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Abstract The electric car-sharing system is an arising and promising urban transportation mode.

Vehicle unbalance usually occurs in multi-station electric car-sharing systems. Threshold triggering method is the most practicable approach for vehicle relocation, while determination of thresholds is the key problem. This paper presents a method for the thresholds determination. First, a prototype of two-stage method is proposed to illustrate the function of upper and lower thresholds. Subsequently, an optimization-based model is derived to determine the thresholds under the objective of minimizing the out-of-service rate and number of moving vehicles. Order data of EVCard system in Shanghai, China was employed to test the method. The results indicate that the proposed calculative method lead to relative better service rate and less moving times.

F-2

Inland Moving Ships Detection via Compressive Sensing and Saliency Detection

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Abstract This paper presents an effective inland moving ships' detection method fused with compressive sensing and saliency detection to attack the challenge: when the ships detected suffer serious cavities due to their large size, relatively low speed, and uniform color. The background is composed of a K-SVD dictionary and a mean set of K-SVD coefficients associated to each pixel. To address the problem that the background and difference image are corrupted by the movement traces when ships sail into the first frame, the logical bitwise AND is performed between difference image and saliency map to get the exact result. Due to the use of K-SVD coefficients, the background is blurry. Then background update strategy is put forward to eliminate the movement traces and make the background more clearly. Finally, both qualitative and quantitative evaluations on several challenging inland video sequences demonstrate that the proposed algorithm outperforms several state-of-the-art methods in terms of efficiency and accuracy.

F-3

Prediction of Air Target Intention Utilizing Incomplete Information

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Abstract This paper focuses on the application of UAVs (unmanned aerial vehicles) on the information battlefield, and an intention prediction method for air targets is studied. Four factors of the enemy UAVs including velocity, angle, offense, and detection are analyzed and predicted by Grey Markov chain. Then, by combining the predicted factors with the rules provided by rough set,

the enemy UAVs' intention in the following short time can be deduced. The prediction method is studied utilizing incomplete information, and the feasibility of the developed prediction method is proved by the simulation results.

F-4

Proposal Generating Method Using Geometrical Features for Vehicle Detection

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Abstract Region proposal methods have been widespreadly applied in object detection, which aim to use less bounding boxes to cover the potential objects. In this paper, we propose to use geometrical features of the proposals to improve the performance of vehicle detection. Two kinds of method are exploited to the geometrical features: (1) regression analysis technique is used to estimate each proposal's score, where the higher score indicates higher possibility of the proposal containing an object; (2) geometrical constraints are applied on these features to improve the recall with less proposals. Experiments are conducted on the KITTI dataset for vehicle detection. The results show that our method achieves a recall of 98% at IoU of 0.5 with only 1000 proposals, which outperforms the state-of-the-art algorithms.

F-5

Abnormal Event Detection Based on Crowd Density Distribution and Social Force Model

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Abstract In this study, we proposed a new method for the detection of abnormal event based on the social force model (SFM), combined with the local density information of the crowd. The method extracts the local density of the people based on the feature point clustering algorithm. The Latent Dirichlet Allocation (LDA) model is established based on the bag of words method combined with the temporal and spatial features of visual words, then identify the abnormal event using the maximum likelihood function.

F-6

Fading Unscented–Extended Kalman Filter for Multiple Targets Tracking with Symmetric Equations of Nonlinear Measurements

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Abstract This paper is devoted to the problem of multiple targets tracking based on symmetric equations of nonlinear measurements. We develop a nonlinear stochastic model with unknown random bias to provide a unified structure for the tracking systems with different types of symmetric measurement equations. Moreover, the fading unscented–extended Kalman filter (FUEF) is designed to deal with the strong nonlinearities by embedding the unscented transform into the extended Kalman filter and to conduct the effect of unknown bias by inserting the fading factor. The performance of the novel filter paired with two of symmetric measurement equations are illustrated and compared by the Monte Carlo simulation results.

F-7

RSS-Based Target Tracking with Unknown Path Loss Exponent

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Abstract This paper studies the problem of target tracking by using the received signal strength (RSS) with unknown path loss exponent. The path loss exponent is estimated by using the least square approach and the unscented Kalman filter is used to address the nonlinear filtering problem. A numerical example and an experiment involving localization of a mobile robot are provided to demonstrate the effectiveness of the proposed algorithm.

F-8

Adaptive Blocks-Based Target Tracking Method Fusing Color Histogram and SURF Features

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Abstract In order to solve the object tracking problem under occlusion, this paper proposes an adaptive weighted tracking algorithm based on color features. The target is divided into pieces

according to the features of color in this algorithm. SURF features are used to regulate the existing tracking results to improve tracking accuracy. In the tracking process, we can judge the occlusion by the degree of matching, and adaptively adjust the weight of each block to achieve accurately tracking. Simulation results show the effectiveness of the proposed algorithm.

F-9

Vehicle Queue Detection Method Based on Aerial Video Image Processing

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Abstract Vehicle queue length is one of the important traffic parameters in intelligent traffic management system. High-altitude video monitoring avoids environmental object barrier and has advantages of dynamic video monitoring like larger view range, multi-angle and high precision, at the same time, it provides technical support for the vehicle queue length detection at the intersection. In order to detect the vehicle queue length in real time and apply it to the management of intelligent traffic system, a new algorithm based on video vehicle queue length detection is proposed in this paper. First, the frame difference method is used to construct the background of the image so that the background modeling error of moving objects could be reduced. On this basis, relief operation is taken to the image background and the current frame image in order to avoid the impact of light changes on the algorithm. Finally, the two-value image is analyzed to obtain the real queue length. The experimental results show that the improved method is simple to achieve and it can obtain a more accurate queue length.

F-10

Two-Stage Recursive Least Squares Parameter Identification for Cascade Systems with Dead Zone

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Abstract In this paper, two-stage recursive least squares algorithm (TS-RLS) is investigated for parameter identification of cascade systems with dead zone. In order to estimate the slopes and endpoints of the dead zone, switching functions are presented to reconstruct the expression of dead zone. All the parameters of linear subsystems and dead zone are separated by using the key term separation principle, which is applied to convert the cascade systems into a quasilinear model.

The proposed identification algorithm not only estimates all the parameters of the cascade systems, but also reduces the computation cost of identification process. The result of the simulation illustrates the flexibility and efficiency of proposed identification algorithm.

F-11

Tracking Control of a Nonminimum Phase Inverted Pendulum

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Abstract Three methods are investigated for the tracking problem of the famous cart–pole system (a kind of planar inverted pendulum). The output is required to track a sinusoid signal. Control design is based on the linearized model. First, we show that using output error and states feedback, approximate tracking can be achieved with bounded tracking error. Then exact tracking via output regulation is investigated. By constructing a regulator equation, the equivalent input and equivalent states which are needed to maintain output at the reference trajectory can be calculated. We show that the tracking problem is equivalent to the stabilizing problem in the states error coordinate. Finally, we study exact tracking via stable system center method. Because of the nonminimum phase property, a bounded solution for the internal dynamics is required and is estimated by stable system center method. Then the tracking problem can also be transformed into a stabilizing problem. Simulations are made for each method.

F-12

Salient Object Detection Based on RGBD Images

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Abstract Salient object detection is very important in many image and vision-related applications. We add the depth clue into the detection method to extract salient objects. In low-level feature extract part, we extract the depth edge and corner clue, combining with color image features to form a 55 dimensions' vector. In the high-level prior part, the depth prior is used to predict the probability together with the other three priors. The experiment result showed that with the depth clue, the salient detection result is improved.

G 复杂系统与网络控制

G-1

An Asynchronous Linear-Threshold Innovation Diffusion Model

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Abstract We consider a linear-threshold innovation diffusion model in asynchronous networks, wherein the *positive* vertices hold supporting attitude towards the innovation and accelerate the diffusion whereas the *negative* vertices oppose it and obstruct the diffusion. A more realistic assumption made in this work is that the attitudes of the vertices (i.e. positive or negative) are changeable. The diffusion begins from a small subset of active nodes and propagates towards the whole network through random transmitting delays along each edge. The vertices outside of the initial active set would be activated and keep forever in active status once the difference of the positive and negative signals they receive from their neighbors exceed a certain threshold. The attitudes of these active nodes would change if the difference of the received positive and negative signals reaches given thresholds. Under these assumptions, our model can exhibit an interesting phenomenon: whenever the initial active set surpasses a certain size, the diffusion process propagates to a specific proportion instead of all the vertices. Experiments on Erdős-Rényi networks verify that the theoretical estimations match closely with the experimental results.

G-2

Deconvolution Estimation Problem for Measurement-Delay Systems with Packet Dropping

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Abstract This paper addresses the optimal deconvolution estimation problem for measurement-delay systems over a network subject to random packet dropout, which is modeled by independent and identically distributed Bernoulli processes. First, the state estimator problem is solved by utilizing the reorganized innovation analysis approach, which is given in the linear minimum mean square error sense (LMMSE). Then, the noise estimator is obtained based on the state estimator and the projection formula. Last, we provide a numerical example to declare that our proposed estimation approach is effective.

G-3

Passive Control of Lorenz Chaos System with Nonlinear Virtual Contraction Analysis

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Abstract In order to pave the way for the exploration of Lorenz chaos system control, one kind of observer which was based upon nonlinear virtual contraction analysis was suggested, and on account of that, states of the Lorenz chaos system can be made available via just the single variable output. And thereafter, passive control of Lorenz chaos system was made possible under auspices of the available observed states of the Lorenz chaos system. Results demonstrated that, the expected phase points as well as the origin targeting in helps of passive control can be made possible, and the expected phase point targeting was not like that reported in the already published literature. In comparison with the Lorenz chaos system control with full states, our assumption is much more near the reality, and when compared with the other state observer, the nonlinear virtual contraction analysis method suggested here is much more simple, and from the view point of the fusion of passive control, nonlinear virtual contraction analysis observer, the configuration of the control action is also different from the already existing results, so the specified phase points targeting can also be new, thus, the targeting phase zone can be flexible, which is promising for the potential usage of chaos systems.

G-4

Adaptive Synchronization of Networked Mechanical Systems with Communication Delays

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Abstract This paper addresses the adaptive synchronization problem of networked mechanical systems in task space with time-varying communication delays, where both kinematic and dynamic uncertainties are considered and the information flow in the networks is represented by a directed graph. Based on a novel coordination auxiliary system, we extend existing feedback architecture to achieve synchronization of networked mechanical systems in task space. The control scheme is established with time-domain approaches by using Lyapunov–Krasovskii functions. Simulation results are provided to demonstrate the effectiveness of the proposed control schemes.

G-5

Community Detection Based on Local Similarity Index in Chinese Aviation Network

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Abstract This paper proposes a fast and efficient method based on local similarity index for detecting community structure in Chinese aviation network, and compares the partition accuracies of seven similarity measures. Simulation results on Chinese aviation network show that the algorithm proposed by us can perform better than the other six pre-existing methods. It can achieve better accuracy in community detection with low algorithm complexity for the reason of requiring only the local information of the network.

G-6

Study on the Leakage Current and Neutral-Point Potential Balance in TL-Boost Photovoltaic System

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Abstract In this paper, TL-Boost is adopted as a front-end converter in the non-isolated photovoltaic grid-connected system, the common-mode leakage current equivalent circuit of TL-Boost circuit is established, and the calculation formula of leakage current of the system is derived. On this basis, a conclusion that the common-mode leakage current of the system can be reduced using the synchronous modulation strategy is obtained. Aiming at the problem of unbalanced neutral-point potential in the process of starting up when DC bus voltage is building up, a fuzzy control strategy based on pre-TL-Boost circuit is proposed, thus realizing the balance of two capacitors' voltage on the DC side. And the experimental results verify the theoretical analysis.

G-7

Cluster Synchronization in Complex Dynamical Networks with Linear Generalized Synchronization in Each Community

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Abstract This paper concentrates on the cluster synchronization such that each community achieves linear-generalized synchronization in complex networks. Here two control schemes are introduced to realize cluster synchronization. One is to adjust the coupling strength of edges which connect different groups automatically, and to use the pinning control simultaneously. The other scheme is to adjust the coupling strength of edges in each group and to select only one node in each group to control. Finally, we present some simulations to demonstrate the correction of our conclusion.

G-8

An Improved Algorithm for Siphons and Minimal Siphons in Petri Nets Based on Semi-tensor Product of Matrices

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Abstract This paper proposes an improved algorithm for enumerating siphons and minimal siphons of Petri nets (PNs) in the framework of [18]. First, the logical equation of each transition is converted into a matrix equation by using the semi-tensor product (STP) of matrices, and then the matrix equation group of the PNs is obtained. Second, an improved algorithm is proposed to calculate the siphons and minimal siphons, respectively. Finally, two illustrative examples are presented to show the efficiency and application of the improved algorithm.

G-9

Distributed Optimization Over Weight-Balanced Digraphs with Event-Triggered Communication

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Abstract This paper extends the event-triggered communication in consensus problems of multi-agent systems to the case of distributed continuous-time convex optimization over weight-balanced digraphs. We address problems whose global objective functions are a sum of local functions associated to each agent. We utilize the event-triggered communication technique to reduce the communication load and avoid Zeno behavior meanwhile. Based on Lyapunov approach, we prove that the Zero-Gradient-Sum (ZGS) algorithm combined with the event-triggered communication makes all agents' states converge to the optimal solution of the global objective function exponentially fast.

G-10

FPGA Design of MB-OFDM UWB Baseband System Based on Parallel Structure

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Abstract A design method of multiband orthogonal frequency division multiplexing ultra wideband (MB-OFDM UWB) baseband system using parallel structure is proposed. FPGA is used to design the transmitter and the receiver. The input of digital to analog conversion (DAC) module, the output of the analog to digital conversion (ADC) module, the synchronization module, the carrier frequency offset (CFO) estimation, and compensation module are all made up of four-channel parallel structures. The simulation results prove that, when the CFO and the sampling frequency offset (SFO) are up to ± 20 ppm, in additive white Gaussian noise (AWGN) channel, CM1 or CM2 channel, the scheme ensures the low bit error rate (BER). It is suitable for high-speed MB-OFDM UWB system.

G-11

The Study of Voice Coil Motor Position Control System Based on Fuzzy Nonlinear PID

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Abstract In view of the requirement of modern industry for voice coil motor (VCM) position control system's quickness and accuracy, on the basis of the classical PID control, this chapter which based on the working principle and mathematical model of VCM, combined with fuzzy control method and nonlinear PID control method, realized the rapid and precise control of position, and all these are based on the classic control to PID. Through designing the nonlinear PID controller in detail, and combining with the fuzzy control, it realized the parameter setting and position control system for quick response and high precision. The simulation and experimental results show that the fuzzy nonlinear PID controller can get following advantages: better position control system dynamic performance of VCM, faster response, and higher accuracy.

H 图像处理及视觉伺服系统

H-1

Salient Region Detection Using Multilevel Image Features

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Abstract In this paper, we propose a novel salient region detection approach. First, segment the original image into a set of superpixels to extract patch level features using low-level features in the patch. Next, global level features like element uniqueness and color contrast are created by previous patch level features. And then both patch level and global level features are gathered to a region to create region level features. Finally, all three level features are utilized to train support vector machines (SVM) classifier, and the trained SVM classifier is used to compute saliency map. The experiment results on the datasets show that the approach we propose performs outstanding in several state-of-the-art approaches.

H-2

3D Velocity Measurement of High-Speed Rotating Sphere Based on the Monocular Vision Servo System

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Abstract The information processed by monocular vision is a target object that projects from 3D to 2D. So restoring the depth information has a significant influence on the prediction of target trajectory and subsequent control decision. This paper proposes an algorithm based on monocular vision, which can be used to calculate 3D velocity of high-speed rotating sphere, this will be applied to vision recognition of table tennis robot, and play an important role in robots' motion plan and decision control. The experimental results of the proposed algorithm are verified with little error, which proves the feasibility of the proposed method.

H-3

B-SIFT: A Simple and Effective SIFT for Real-Time Application

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Abstract SIFT is the one of the most famous algorithm in image matching for its robustness of scale changes, rotation changes, view changes and light changes. However, it is too complex to compute and match. This paper introduces a binary descriptor which can be computed using a simple intensity difference of relatively few bits, and proposes an efficient and effective algorithm named B-SIFT. Compared to complex 128-vector descriptors in SIFT, the binary descriptor is used as the local invariant features which is easy to compute and match. Experimental results based on open datasets demonstrate that B-SIFT obtains 1–2 orders of magnitude speed-up while preserving competitive discriminant ability.

H-4

Non-negative Matrix Semi-tensor Factorization for Image Feature Extraction and Clustering

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Abstract Non-negative Matrix Factorization (NMF) has been frequently applied to image feature extraction and clustering. Especially in image clustering tasks, it can achieve the similar or better performance than most of the matrix factorization algorithms due to its parts-based representations in the brain. However, the features extracted by NMF are not sparse and localized enough and the error of factorization is not small enough. Semi-tensor product of matrices (STP) is a novel operation of matrix multiplication, it is a generalization of the conventional matrix product for allowing the dimensions of factor matrices to be unequal. STP can manage the data hierarchically and the inverse process of STP can separate the data hierarchically. Based on this character of STP, we propose the Non-Negative Matrix Semi-Tensor Factorization (NMSTF). In this algorithm, we use the inverse process of Semi-Tensor Product of matrices for non-negative matrix factorization. This algorithm effectively optimizes the above two problems in NMF. While achieving similar even better performance on image clustering tasks, the size of features extracted by STNMF is at least 50 % smaller than the ones' extracted by NMF and the error of factorization reduces 30 % in average.

H-5

Multi-exposure Dynamic Image Fusion Based on PatchMatch and Illumination Estimation

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Abstract In this study, we present a novel image fusion algorithm for multi-exposure dynamic images based on PatchMatch and illumination estimation. To eliminate the ghosting artifacts which often occur in the fusion results of existing exposure fusion methods when there are moving objects in the scenes, the fusion process of our proposed algorithm is as follows. First, we take advantage of the PatchMatch method to align the selected reference image with the other input images and then we fuse these images together based on illumination estimation to obtain the final fusion image. Experimental results demonstrate that our proposed method performs better than the existing fusion methods both in visual effect and objective indicators.

H-6

Fast Moving Crowd Counting for Unconstrained Videos

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Abstract It is important to estimate the number of people in fast moving crowd scenarios for the surveillance systems. Regression-based techniques achieved promising results for counting the number of people in crowded scenes. However, appearance features used in the most existing techniques are not able to mirror the motion state of crowds. The motion state of crowds is important to solve the counting problem of fast moving crowds, since it is decided by the amount of people. In this study, we propose a novel method to address this problem from three perspectives: (1) train a crowd counting estimation model suited to all of the crowded scenes; (2) combine motion states with multiappearance features for crowd counting; and (3) count fast moving crowds in unconstrained videos. These ideas are implemented in a fast object segment framework, which can segment fast moving crowds in the unconstrained videos. Extensive experiments validate the effectiveness of our proposed method.

H-7

Tourism Activity Recognition and Discovery Based on Improved LDA Model

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Abstract More and more tourist travels can be found on the Internet, these travels include travel activity, time, and space information. Using machine learning methods to identify and discover tourism activities has become a hot spot in the present study. In this paper, considering the particularity of tourism travel journey, we improve the original latent Dirichlet distribution model, and put forward a model of tourism activity recognition and discovery based on activity-topic latent Dirichlet allocation. This model extends the latent Dirichlet allocation model with tourist activities, aiming to obtain the probability of tourism activities that belongs to a certain topic. From the relationship between travel text–topic–vocabulary–tourism, we can efficiently identify and discover the purpose of tourism activities.

H-8

Local Zernike Moment and Multiscale Patch-Based LPQ for Face Recognition

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Abstract In this paper, a novel feature extraction method combining Zernike moment with multiscale patch-based local phase quantization is introduced, which can deal with the problem of uncontrolled image conditions in face recognition, such as expressions, blur, occlusion, and illumination changes (EBOI). First, the Zernike moments are computed around each pixel other than the whole image and then double moment images are, respectively, constructed from the real and imaginary parts. Subsequently, multiscale patch-based local phase quantization descriptor is utilized for the non-overlapping patches of moment images to obtain the texture information. Afterward, the support vector machine (SVM) is employed for classification. Experimental results performed on ORL, JAFFE, and AR databases clearly show that the LZM-MPLPQ method outperforms the state-of-the-art methods and achieves better robustness against severe conditions abovementioned.

H-9

Human Action Recognition Based on Multifeature Fusion

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Abstract A human action recognition method based on histogram of oriented gradient (HOG) of motion history image (MHI) and Speeded Up Robust Features (SURF) is presented in this paper.

The method overcomes the shortcomings of the algorithm based only on HOG of motion history image. The experiment results show that the new method improves recognition rate and has a promising performance.

H-10

Study on Camera Calibration for Binocular Stereovision Based on Matlab

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Abstract Camera calibration is designed to build a 3D word coordinates and the corresponding relationship between the 2D image coordinates. It is the foundation of binocular stereo measurement system, and the calibration precision also affects the measuring precision of whole system eventually. This paper proposes an improved plane calibration method based on studies of existing calibration method. First of all, the method used camera pinhole model for calculating initial interior and exterior parameters, then the radial and tangent distortion were introduced, and the nonlinear optimizing method was used to solve distortion coefficients. Finally, a simulation example is provided to prove the effectiveness of the conclusion.

H-11

Point Cloud Segmentation Based on FPFH Features

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Abstract Point cloud segmentation is a key part of geometric processing. In this paper, a point cloud segmentation method based on the Fast Point Feature Histograms (FPFH) is proposed. Fast Point Feature Histograms (FPFH) is used to extract features of point clouds, and then Gaussian Mixture Model (GMM) is employed to cluster the point clouds. Experimental results on SHREC2014 dataset show the effectiveness of the proposed method. It can avoid both under-segmentation and over-segmentation.

H-12

Quantified Living Habits Using RTI Based Target Footprint Data

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Abstract Providing personalized healthcare for elders is more and more necessary in aging society. It is the premise to quantify their living habits properly. In this paper, a classification algorithm is used to transform footprints of elder into daily activities by combining point of interest. A concept of activity matrix and vector is proposed to quantify daily life, and then a clustering algorithm based on similarity is put forward to realize abnormal behaviors recognition. Finally, a experiment is given to illustrate the effectiveness of the proposed methods.

H-13

The CUDA-Based Multi-frame Images Parallel Fast Processing Method

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Abstract This paper purposes a fast parallel processing method for multi-frame images based on CUDA by Nvidia employing the Sobel edge detection operator as example. To utilize the CUDA's high parallel computing capability of dense numeric calculation, the paper optimizes the data structure of multi-frame images, combines the multi-frame images into "one image" which reduces the complexity of method. And the experiment result shows that the average running time of the method based on CUDA, which is 499.7 ms, is about 15 % as much as that based on CPU when processing the 64 frames of 512 ×512 pixels images with 8-digit grayscale. The method can utilize the CUDA's computing capability greatly.

I 电子电力系统及其控制

I-1

Fault Diagnosis Method of Wind Turbine Generators Based on Principal Component Feature Extraction

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Abstract The operation process of the wind turbine generator is complex, the running state variables are many, and the variables are related to each other. It is difficult to achieve the expected results if the traditional fault diagnosis method is used. The fault diagnosis method based

on principal component analysis (PCA) of the feature extraction of wind turbine generator is presented in this paper. The principal component model is established based on the normal working condition history data at first, and the control limits of Hotelling *T*2 and SPE two statistics are obtained. The condition monitoring and fault location of generating sets are realized by comparing the statistics of real-time operation and the size of the threshold. The experimental simulation results of the operation data of the wind turbine generator show the effectiveness of the method.

I-2

Design on Embedded System in Parameter Measurement for Electric Power System

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Abstract In order to avoid out of whack in large-scale complex power system caused by the influence of artificial or natural factors, this paper explores the application of embedded system in electric power system measurement of electrical parameters. In the paper, it researches the related algorithm of the characteristic parameters in power system, takes the microcomputer line protection system of a 110 kV substation as an example, constructs the software and hardware platform of electric power parameter state monitoring system based on embedded microprocessor, and designs the hardware circuit and software control program. The system commissioning results demonstrates that the designed system can determine whether the fault of the related equipment, sends correctly the trip command to make the isolation between the fault equipment and the power system so as to protect the system from being damaged. The experiment results show that it is effective and available to electrical parameter test of the embedded system based on integrated testing method in the power system for guaranteeing the safe and stable operation of power system.

I-3

Reactive Power Predictive Compensation Strategy for Heavy DC Hoist

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Abstract To deal with reactive power disturbances in power grid introduced by speed and load changes of heavy DC hoist in operation, a reactive power predictive compensation strategy is proposed. After analysis of reactive power absorbed by the DC hoist in different operation stages, the work principle and the reactive power compensation flowchart and modification module are presented with reactive power compensation regulation based on fuzzy control. Finally, experiment results are given to demonstrate the effectiveness and robustness of the proposed strategy in reducing external and internal disturbances, with the power factor ranging from 0.95 to 0.98.

I-4

A Novel MPPT Control Algorithm Based on Peak Current

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Abstract Aiming at the MPPT (maximum power point tracking) control of the fly-back type grid-connected microinverter, a novel maximum power point tracking control algorithm based on peak current sampling is studied, and a current sampling circuit composed of blocking diode and bias diode is proposed. Compared with maximum power point tracking methods of the conventional MPPT, the method in this paper does not need to calculate the actual power by multiplying the input voltage and the corresponding input current of the photovoltaic components. And the maximum power point of PV modules can be obtained according to comparing the detected sampling peak current of the switch tube. Therefore, the input voltage sampling circuit, the cost and the resources of the control chip are saved, and the complexity of the computation on maximum power point is simplified, thus ultimately achieving the MPPT fast control algorithm. The method in this paper has no need of sampling resistance or current Holzer, which improves the efficiency of grid-connected microinverter. The experimental results verify the correctness of the method studied in this paper.

I-5

Cascade STATCOM Power Factor Automatic Compensation System

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Abstract Cascaded H bridge inverter is the key component of the static synchronous compensator (STATCOM). It is widely used in power factor compensation, for its fast response, high reliability, and safety. In this paper, we introduce a sampling system of phase-sensitive circuit into the model cascade STATCOM switch, and propose a grid power factor automatic compensation system. Model of the system operation is then presented. We also analyze the cascade STATCOM switch in normal working condition by applying the switching function of double Fourier transform technique. A simulation platform is constructed to verify the feasibility, correctness, and reliability of the system.

I-6

Voltage-Balanced Control for a Cascaded 3H-Bridge Rectifier

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Abstract This paper studies the CHBR (Cascaded H-Bridge Rectifier)'s DC side capacitor voltage balance control algorithm, introduces single-phase DQ coordinate transformation, deduces the

mathematical model in this coordinate. This uses feed-forward decoupled control strategy to keep voltage and current of AC side in the same phase, puts forward an improved algorithm to balance DC capacitor voltage even if the loads of CHBR are imbalanced. Finally, establishes a simulation model of three cells' CHBR. The simulation results indicate that this improved algorithm can reduce the switching frequency effectively, and balance the DC voltage of every module much better.

J 其他

J-1

New Decoupling Conditions for Arbitrary Systems Based on Transcale Coupling to the Time-Derivative Order

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Abstract This paper proposes new coupling concepts: transcale coupling to the time-derivative order to give new decoupling conditions for a general system described by (*A, B, C, D*) quadruples. Based on these new coupling concepts, novel conditions for the diagonal/diagonal block decoupling and triangular/triangular block decoupling are obtained in the time domain.

J-2

Modeling and Control of Rail Type Suspended Conveyor for Electrolytic Aluminum Anode Casting

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Abstract The dynamic equation of rail type suspended conveyor for electrolytic aluminum anode casting is established as controlled plant. Besides, hierarchical sliding mode control (HSMC) is utilized to track the displacement of conveyor driving unit for anode casting and, meanwhile, realize the smooth control for swing angle of loading hook and ferrophosphorus ladle container without extra force on them. Simulation studies the control of conveyor for electrolytic aluminum anode casting in various conditions and cycle operation test of factory production process, indicating that the anode casting process of conveying can be stably, effectively, and smoothly controlled and has good robustness.

J-3

Bearing Fault Diagnosis Based on Hilbert Marginal Spectrum and Supervised Locally Linear Embedding

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Abstract A bearing vibration signal is nonlinear and nonstationary, with multiple components and multifractal properties. A bearing fault diagnosis method based on Hilbert marginal spectrum (HMS) and supervised locally linear embedding (SLLE) is proposed for the first time in this paper. HMS is introduced for feature extraction from faulty bearing vibration signals. Then SLLE is proposed for the dimensionality reduction of high-dimensional fault feature, which is more effective than other reducing dimension methods, such as principle component analysis (PCA), multidimensional scaling (MDS), and locally linear embedding (LLE). Finally, the support vector machine (SVM) is applied to achieve the bearing fault diagnosis according to the extracted feature vector. The results show that the proposed method improves the fault diagnostic and classification performance significantly.

J-4

Metal Magnetic Memory Signal Denoising for Stress Concentration Zone

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Abstract The method of metal magnetic memory (MMM) was developed for early fault diagnosing of ferromagnetic materials. MMM signal is a weak-field detect signal, where the Earth's magnetic field acts as the stimulus instead of an artificial magnetic field, and can be easily affected by the various factors such as environment interference and electronic noise. This paper is aimed to denoise metal magnetic memory signal and extract the feature of stress concentration zone. An efficient algorithm is proposed for detection of stress concentration zone based on wavelet and teager energy operator (TEO). This algorithm employs wavelet transform, to decompose the MMM signal into sub-band signal. In each of the critical sub-band signals, the mask construction is obtained by smoothing the TEO of corresponding wavelet coefficients that is applied to enhance the discriminability of signal components against those of noise. The multiscale related feature is extracted for the low signal-to-noise ratio signals that accurately determines the stress concentration. Finally, the proposed method is proved to be effective through the experimental data.

J-5

Parabola-Based Flue Gas Temperature Modeling and Its Application in BTP Control of a Sintering Process

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Abstract It is very important to predict the accurate position of the burning through point (BTP) in the sintering process. When BTP is controlled accurately, the energy consumption in the sintering process can be reduced greatly. Although BTP cannot be measured directly, we can measure the flue gas temperature to predict BTP. When the flue gas temperature of the twenty-third bellow is controlled at 600 ℃, BTP will be controlled on the center of the twenty-third bellow. In this case, the sinter mix can be converted into the sinter ore with the maximum conversion rate. A method of modeling the flue gas temperature based on parabola is discussed in the paper. By means of the least square method (LSM), the relationship between the flue gas temperature and the negative pressure is modeled. The position of the burning through point (BTP) can be controlled by adjusting the negative pressure of the motor which can be controlled by adjusting the duty cycle. By comparing the measured flue gas temperature with the set temperature and comparing the measured negative pressure with the set negative pressure, the fuzzy controller with 81 rules can output the appropriate duty cycle which can control the motor properly. The flue gas temperature of the twenty-third bellow is checked so that the real position of the burning through point can be obtained. Simulations show that the position of the burning through point in the sintering process can be controlled exactly.

J-6

A Method of Virtual Test Based on Model Checking and a Case Study

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Abstract In this paper a virtual test method, which is a fusion approach on the combination of automata-based model checking theory and systems engineering theory, is proposed. An automaton of Window Tree Model (WTM) based on multi-tree to describe the system behavior as a system model is used on one hand, and a State Transition Graph (STG) based on Büchi automaton to describe design correctness as a specification is used on the other hand. An automaton-based model checking mechanism is designed to build the foundation of the virtual test method. Moreover, the two main aspects of the method, which are the design correctness verification and the interface test, are defined. A case study is followed to illustrate the modeling and verification process. Finally, a Virtual Test Platform (VTP), which implements the method, is

introduced to unfold the virtual test configuration, virtual test execution as well as the virtual test evaluation features.

J-7

ST Segment Deviation Parameter Statistic Based on Spectrogram

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Abstract The aim of this work is to detect the existence of ST segment deviation episodes in electrocardiogram (ECG) signals using spectrogram. Spectrogram is one kind of time–frequency distribution (TFD) which provides good aggregation property. Downloaded from MIT-BIH database, the experimental samples of ECG signals include 60 records without ST segment deviation and 60 records with ST segment deviation. We compare smoothed pseudo-Wigner–Ville distribution (SPWVD) with spectrogram of ECG signals. Spectrogram is used to statistic ST segment deviation in order to find out sensitive parameters. Fisher linear discriminate analysis is used to identify ST segment deviation episodes. The recognition rate of this method is up to 91.4 %. The investigation lays a basis for promoting the accuracy of ST segment deviation recognition.

J-8

Blind Source Separation Based on Mixed Integer Programming

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Abstract The underdetermined blind source separation problem is a common problem in our daily life, but it is difficult to solve because of its underdetermined. In the literature, sparse component analysis which exploits the sparsity of sources in a predefined sparse dictionary has been proposed to solve it. Usually, sparse component analysis uses a two-stage approach. The first stage is to estimate the mixing matrix and the second stage is to reconstruct sources. In fact, the second stage is a sparse optimization problem. In this paper, we model the problem of reconstructing sources as a bi-objective optimization problem. We take the error and sparsity as the two optimization objectives, and propose an iterative algorithm based on mixed integer programming to solve the bi-objective source reconstructing problem. Experimental results show the accuracy and effectiveness of our proposed algorithm.

J-9

A Novel Algorithm Based on Avoid Determining Noise Threshold in DENCLUE

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Abstract This paper focuses on density-based clustering analysis. The determination of noise threshold set in DENCLUE is studied via analyzing several typical density-based clustering methods. An improved algorithm which does not use the noise threshold in DENCLUE is proposed based on the estimation of points in inner cluster. Compared to the original DENCLUE, smaller silhouette coefficients can be obtained from the proposed algorithm via experimental verification. Meanwhile, the noise in data sets can also be verified well in our method, which can be viewed as an improvement for applicability and performance of DENCLUE.

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