第13届中国智能系统会议

The 13th Chinese Intelligent Systems Conference

程 序 册

Program Guide

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：牡丹江师范学院

北京航空航天大学

牡丹江世茂假日酒店

2017年10月14-15日

中国智能系统会议往届会议信息

CISC

2016
厦门
国防科技大学
刘衡竹

2015
扬州
扬州大学
张天平

2014
北京
北京航空航天大学
贾英民

2013
焦作
河南理工大学
王福忠

2012
上海
上海理工大学
王朝立

2011
烟台
鲁东大学
杨洪勇

2010
北京
北京工商大学
刘载文

2009
重庆
重庆大学
柴　毅

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、研究生和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 13 届中国智能系统会议（CISC'2017）将于 2017 年 10 月 14-15 日在黑龙江省牡丹江市召开。

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，牡丹江师范学院以及北京航空航天大学共同承办。会议得到了北京科技大学、河南理工大学、南开大学、北京工商大学、重庆大学、上海理工大学、北京邮电大学、鲁东大学、北京理工大学、苏州大学、扬州大学、东南大学、西南交通大学、山东科技大学、牡丹江师范学院、燕山大学、上海应用技术大学、国防科技大学、北京控制工程研究所、中山大学、贵州大学、哈尔滨工程大学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 144 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、学者作大会报告，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

牡丹江师范学院

北京航空航天大学

支持单位

北京科技大学
南开大学
重庆大学
北京邮电大学
北京理工大学
扬州大学
西南交通大学
牡丹江师范学院
上海应用技术大学
北京控制工程研究所
贵州大学
河南理工大学
北京工商大学
上海理工大学
鲁东大学
苏州大学
东南大学
山东科技大学
燕山大学
国防科技大学
中山大学
哈尔滨工程大学

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) 吕桂军 (牡丹江师范学院)

程序委员会主席

杜军平 (北京邮电大学) 楚天广 (北京大学)

邓志东 (清华大学) 王国利 (中山大学)

组织委员会主席

张 岩 (牡丹江师范学院) 张 霖 (北京航空航天大学)

刘衡竹 (国防科技大学) 费树岷 (东南大学)

邀请委员会主席

段广仁 (哈尔滨工业大学) 孙青林 (南开大学)

张天平 (扬州大学) 王朝立 (上海理工大学)

评奖委员会主席

陈增强 (南开大学) 柴 毅 (重庆大学)

蔡 强 (北京工商大学) 杨洪勇 (鲁东大学)

财务委员会主席

孔令富 (燕山大学)　　张　青 (中国民航大学)

周武能 (东华大学)　　王福忠 (河南理工大学)

出版委员会主席

李海生 (北京工商大学)　　李洪波 (清华大学)

巩敦卫 (中国矿业大学)　　李晓斌 (上海应用技术大学)

区域主席

任雪梅 (北京理工大学)　　刘忠信 (南开大学)

周　进 (上海大学)　　尹宏鹏 (重庆大学)

会议秘书长

张维存 (北京科技大学)　　周　鹏 (牡丹江师范学院)

肖　楠 (牡丹江师范学院)　　裴文靖 (北京航空航天大学)

重要信息

- 会议时间：2017 年 10 月 14-15 日
- 会议地点：牡丹江世茂假日酒店
- 会议日程：2017 年 10 月 13 日 会议报到
  2017 年 10 月 14 日 大会报告
  2017 年 10 月 15 日 会议考察
- 会议语言：中文

会议报到

- 报到时间：2017 年 10 月 13 日全天
- 报到地点：牡丹江世茂假日酒店
- 联 系 人：张 岩（13836301123/18346331616）
  周 鹏（13704533606）
  裴文靖（17701026616）

会务组联系方式

- 联 系 人：张 岩（13836301123/18346331616）
  周 鹏（13704533606）
  裴文靖（17701026616）

- 电子信箱：cisc2017@126.com
- 会议网址：http://sias.buaa.edu.cn/

酒店预订

1、牡丹江世茂假日酒店：

会议会场酒店

地　　址：牡丹江市爱民区西地明街 1 号(北山公园旁)

酒店电话：0453-8293288　　传真：0453-8293299

入住时间：10 月 13 日

房间价格：标间合住：169 元/间/人（含早餐、健身）

标 准 间：338 元/间（含早餐、健身）

大 床 房：338 元/间（含早餐、健身）

注 1：标间合住每人每天 169 元，发票开取需两人协商，提前去酒店前台说明办理；

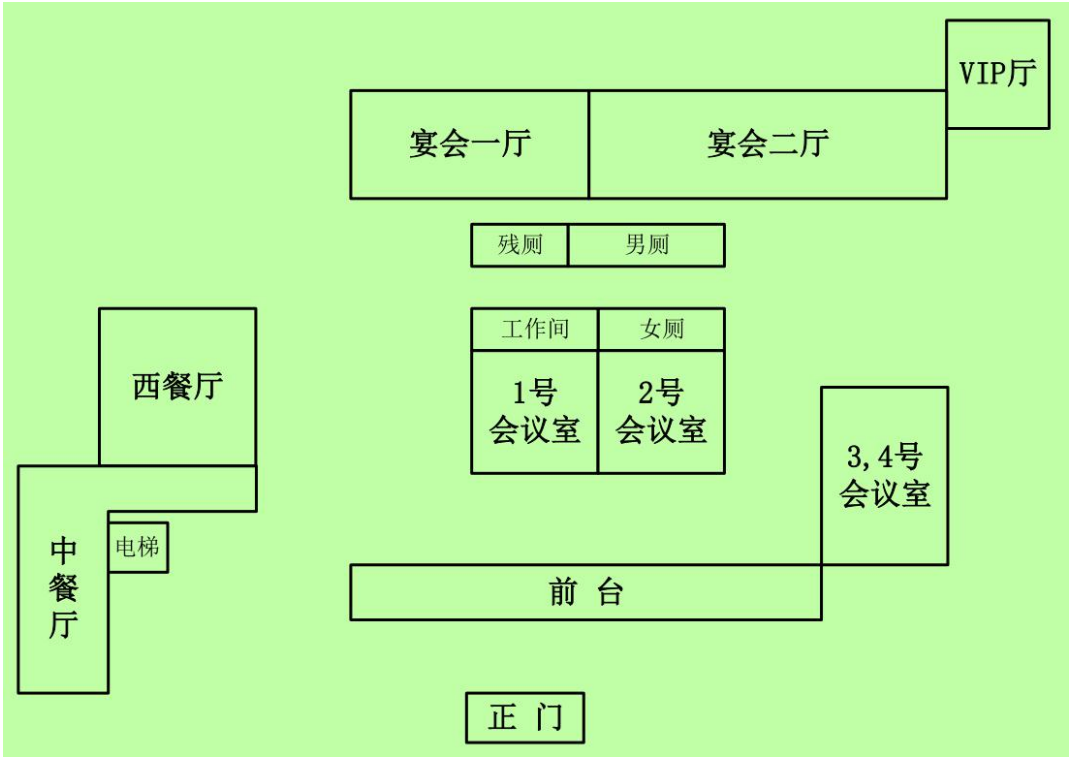
注 2：预定标准间与大床房的参会人员也请预先向酒店前台说明办理发票的要求。

2、房间预订方式：

采用回执预订方式，提前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。

3、附近其他宾馆：

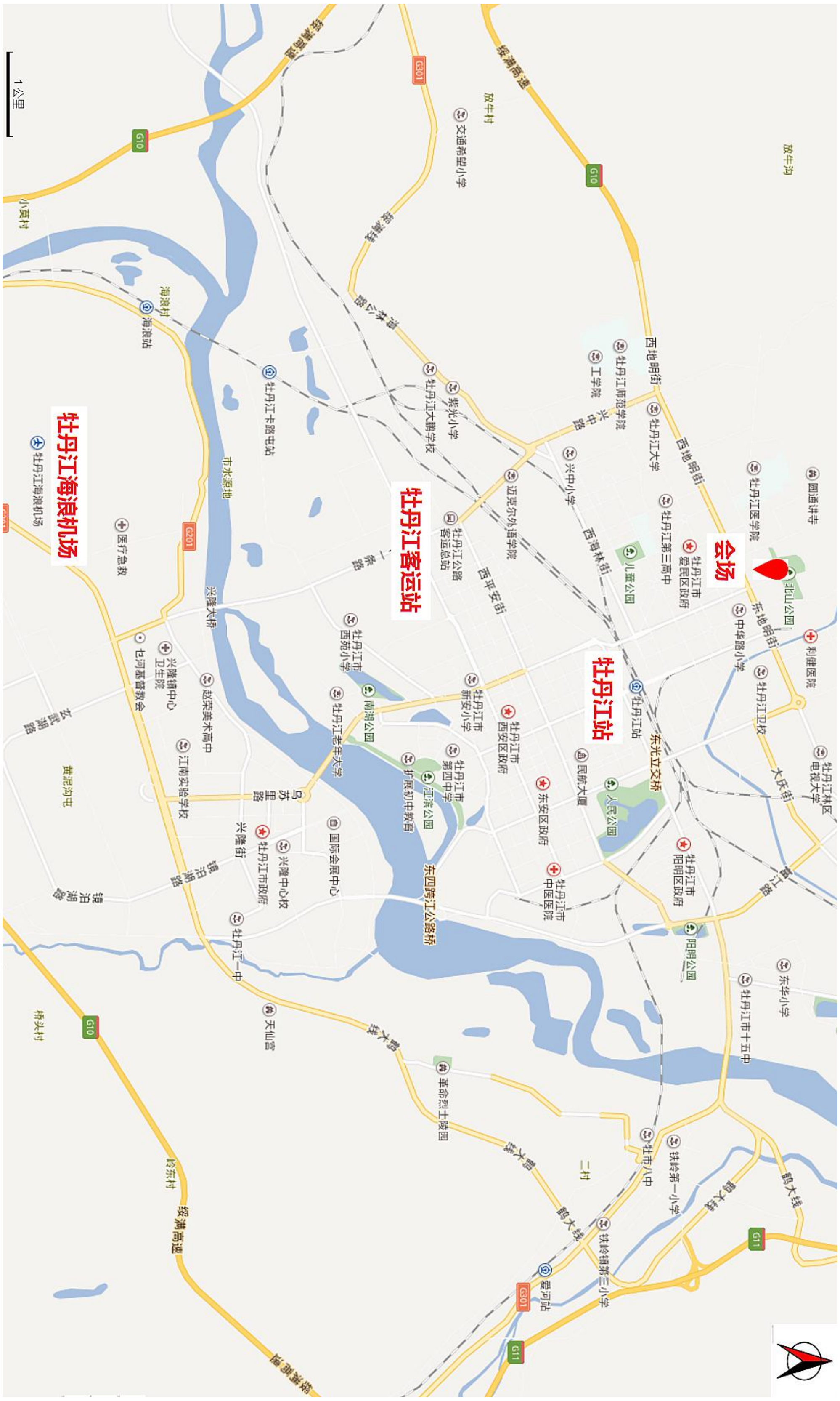
参会人员自行预订。



酒店平面示意图

酒店周边地图

牡丹江市地图



交通信息

1、牡丹江海浪机场 - 牡丹江世茂假日酒店

乘坐出租车需约 22 分钟（约 10.2 公里），费用约 20 元

乘坐公交车需约 1 小时 15 分钟，票价 3 元

乘坐 21 路（公交场站方向），在西二条路下车

同站换乘 9 路（火车站东方向），在新荣小区站下车，步行 50 米到新荣小区

换乘 14 路（北山宾馆站方向），在北山宾馆站下车，步行 450 米到世茂假日酒店。

2、牡丹江火车站（建设中，火车正常运行）- 牡丹江世茂假日酒店

乘坐出租车需约 8 分钟（约 2.6 公里），费用约 8 元

乘坐公交车需约 29 分钟，票价 1 元

乘坐 99 路（龙凤公墓方向），在祥伦街民安路口站下车，步行 750 米到世茂假日酒店。

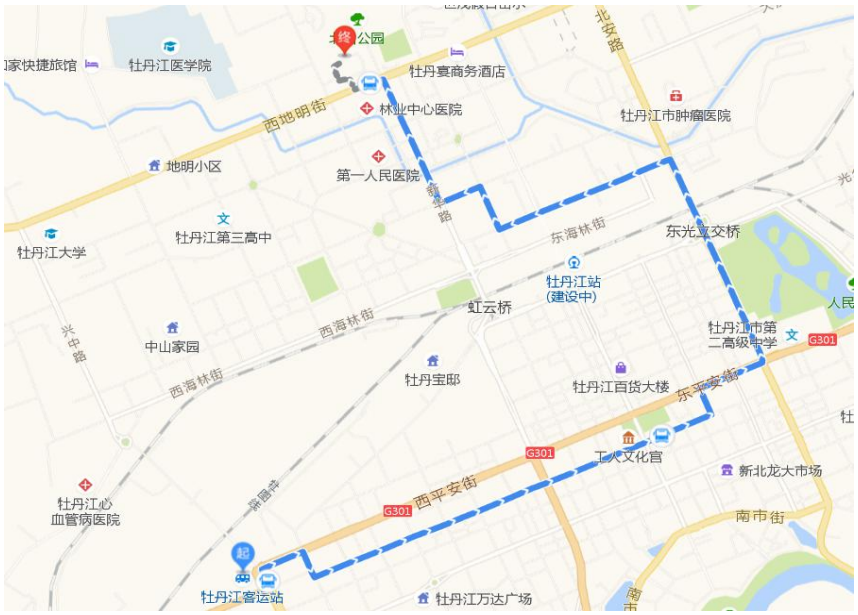
3、牡丹江客运站 - 牡丹江世茂假日酒店

乘出租车需约 16 分钟（约 5.8 公里），费用约 12 元

乘坐公交车需约 59 分钟，票价 2 元

乘坐 **4 路**（阳明区政府方向），在劝业场下车

同站换乘 **14 路**（北山宾馆方向），在北山宾馆站下车步行 450 米到世茂假日酒店。



会议日程

10 月 13 日（星期五）		
全天	**会议注册** **联系人：**张　岩　13836301123/18346331616 裴文靖　17701026616	牡丹江世茂假日酒店大堂
18:00-20:00	**晚餐**	西餐厅
22:00-23:30	**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） 吕桂军（牡丹江师范学院） 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）	3, 4 号会议室
10 月 14 日（星期六）		
8:30-9:00	**开幕式** **主持人：**张　岩（牡丹江师范学院）	宴会二厅
9:00-9:20	**集体照相** **主持人：**周　鹏、肖　楠（牡丹江师范学院）	
9:20-10:00	**大会报告 1：** **报告人：**楚天广（北京大学） **主持人：**付永领（北京航空航天大学）	
10:00-10:40	**大会报告 2：** **报告人：**王国利（中山大学） **主持人：**张天平（扬州大学）	
10:40-10:50	**茶歇**	
10:50-11:30	**大会报告 3：** **报告人：**陈增强（南开大学） **主持人：**关治洪（华中科技大学）	
11:30-12:10	**大会报告 4：** **报告人：**任雪梅（北京理工大学） **主持人：**巩敦卫（中国矿业大学）	
12:10-14:00	**午餐**	西餐厅

14:30-15:20	**专题讨论 1** **题目：**新形势下智能系统研究的机遇与挑战 **嘉宾：**王朝立、陈增强、张天平、李晓斌、关治洪、柴毅	宴会二厅
15:20-16:10	**专题讨论 2** **题目：**互联网+时代，我关注的智能系统问题 **嘉宾：**杨洪勇，刘忠信，李海生，李文玲	
16:10-16:25	**特约嘉宾报告：** **报告人：**刘东升(北京航天宏图信息技术股份有限公司副总) **主持人：**张岩	
16:25-16:35	**休息**	
16:35-18:20	**分组报告 1：**滤波估计与智能优化 **论文编号：A-4、A-8、H-7、A-2、B-9** **主持人：**王继强，杨正全	3 号会议室
	分组报告 2：航空航天中的控制问题 **论文编号： C-8、C-13、C-14、K-8、C-5** **主持人：**陈杨杨，马保离	1 号会议室
	分组报告 3：机器学习与图像处理 **论文编号： B-7、E-5、E-6、E-8、G-12** **主持人：**刘忠信，张可	VIP 厅
	分组报告 4：复杂网络与机器人 **论文编号：D-5、G-3、I-6、J-2、J-6** **主持人：**孟德元，魏伟	2 号会议室
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）　宋运忠（河南理工大学） 林　岩（北京航空航天大学） 李晓斌（上海应用技术大学）	宴会二厅
10 月 15 日（星期日）		
9:00-15:00	**会议考察** 牡丹江八女投江群雕 百年俄式风情小镇横道河子镇	

大会报告

报告 1

空间合作运动建模与控制研究中的一些问题

楚天广

北京大学工学院

摘要：空间合作任务中轨道运动和姿态运动及合作目标间相对运动在（时间和空间）数量级上存在显著差异，相应的多关联运动体的跨尺度运动建模、分析与控制问题充满困难和挑战性，长期以来得到大量的研究并取得不断的进展。我们以航天器交会对接任务和航天器机械臂运动控制为背景，讨论空间多关联运动体姿轨跨尺度运动以及空间多体系统在物理守恒约束条件下的动力学建模、分析与控制研究中的一些基本问题和有效方法。

报告人简介：楚天广，1993 年毕业于清华大学工程力学系一般力学（动力学与控制）专业，获得工学博士学位；1989、1984 年分别在哈尔滨工业大学和河南大学获得理学硕士、学士学位。1993 至 1995 年在北京大学作博士后研究，后留校任教。2001 至 2003 年在墨尔本大学作访问研究。现为北京大学工学院教授、一般力学（动力学与控制）专业博士生导师。研究兴趣包括运动稳定性理论与应用、非线性系统动力学与控制、网络化与多智能体系统、学习与进化方法等复杂系统动力学与控制问题。承担和参加过多项国家自然科学基金项目、国家"973"和"863"等课题，研究工作曾经获得"国家科学技术进步奖"、"国家教委科学技术进步奖"等奖励。目前担任中国自动化学会控制理论专业委员会委员、中国人工智能学会空天智能系统专业委员会委员、中国控制会议张贴论文奖评委，以及《宇航学报》、Artificial Intelligence and Applications、 ISRN Applied Mathematics、 Journal of Nonlinear Analysis and Applied Mathematics 等学术刊物编委。

报告 2

实现周边智能化的设备无关位置感知

王国利

中山大学数据科学与计算机学院

摘要：报告从信息技术发展的趋势，阐释周边智能感知作为新一代智能化支撑技术的客观必然性，总结周边智能化在智能系统构建中的新应用，分析设备无关位置感知在实现周边智能化中的不可或缺性。

报告将介绍中山大学围绕周边智能化在设备无关位置感知方面所做的若干探索性研究工作，主要包括窄带射频网络和光纤传感阵列实现设备无关定位的理论方法、实现技术和案例讨论，以及在辅助居家养老等应用中的思考。

报告人简介：王国利，在南开大学计算机系先后获学士、硕士和博士学位。1992 年 7 月至 2000 年 3 月受聘汕头大学工学院计算机系。2003 年 11 月起受聘中山大学信息科学与技术学院。2000 年 3 月至 2003 年 11 月期间作为德国洪堡研究基金获得者分别在德国波鸿鲁尔大学及斯图加特大学进行学术研究工作。现任中山大学数据科学与计算机学院教授，机器智能与先进计算教育部重点实验室主任、智能科学与技术研究所所长。研究方向是信息获取与信息处理，重点研究压缩感知支配的新型计算成像方法和周边智能化技术。相关研究成果分别获得 2000 年教育部科学奖励自然科学二等奖及 2004 年广东省科学奖励自然科学二等奖。

报告 3

逻辑动态系统代数状态空间方法在复杂系统中的应用研究

陈增强

南开大学计算机与控制工程学院

摘要：逻辑动态系统的代数状态空间方法是近年发展起来的一种有效建模与分析方法，它以矩阵半张量积（STP）为主要工具，在布尔网络、逻辑电路网络、演化博弈等许多领域取得了成功应用。此次报告将汇报我们近年来在该领域的一些新的研究进展。一方面针对一些典型的逻辑系统，例如，有限状态自动机、Petri 网等系统采用这种代数状态空间方法对其动态行为进行建模、分析与综合；另一方面针对与逻辑系统相关而没有得到完善解决的问题，例如，Type-2 模糊逻辑关系方程的求解问题、搜索图的控制集与内稳定集问题，利用这种新的逻辑系统分析与综合工具进行进一步研究。

报告人简介：陈增强，本硕博均就读于南开大学，1990 年留校任教至今，1999 年被聘为教授、博导。曾任自动化系主任，现任机器人与信息自动化研究所副所长。获上海宝钢教育奖（教师一等奖）及教育部优秀教师奖，入选教育部青年骨干教师计划和新世纪优秀人才支持计划。研究兴趣为复杂网络建模与分析、多智能体控制、混沌理论及应用、模型预测控制、自抗扰控制、飞行器制导优化与控制及智能优化计算与智能信息处理等。曾承担国家 863 计划、国家自然基金及省部级课题、国防和企业合作课题 20 余项；获教育部和天津市科技奖 4 次，其中研究成果"智能预测自适应控制理论与应用"获天津市自然科学二等奖。发表 SCI 和 EI 刊物论文 200 多篇，SCI 他引 2000 余次。现为中国仿真学会理事、中国人工智能学会智能空天专业委员会副主任、中国自动化学会过程控制专业委员会常务委员、中国自动化学会控制理论专业委员会委员以及中国自动化学会数据驱动控制、学习与优化专业委员会委员以及中国工业与应用数学学会复杂网络与复杂系统专业委员会委员；现任及曾任《控制理论与应用》、《控制工程》及 Nonlinear Dynamics、Journal of Control Science and Engineering 等刊物编委。

报告 4

大惯量多驱动系统的非线性控制

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摘要：伺服系统因具有高精度、强适应性以及稳定性等优点被广泛应用于工业、军事以及航空航天等各个领域。但随着工业的快速发展和机械自动化程度的不断提高，许多大惯量、大功率系统的出现对伺服系统的性能提出了更高的要求，而传统的单电机驱动由于功率的限制已经不能满足这种需求。因此，采用多个电机代替单一电机来驱动负载已经成为现今伺服系统的研究重点和难点之一。由于多个电机相连并通过传动环节驱动负载，造成负载跟踪与电机同步的耦合、摩擦和齿隙非线性以及系统谐振等问题，从而影响系统的性能和控制精度。本次报告主要介绍多电机驱动控制系统的研究工作：包括多电机的同步控制，偏置力矩的设计，齿隙与摩擦等非线性的补偿，电机之间的同步与负载跟踪问题，机械谐振抑制等方面。

报告人简介：任雪梅，教授、博士生导师。研究方向为多驱动系统的控制、复杂系统辨识、伺服系统、神经网络与自适应控制、智能信息处理等，多次到香港理工大学、University of Texas at Arlington、University of Florida 和 University of Bristol 访问。主持国家自然基金重点项目、面上项目、国家自然科学基金和英国皇家学会联合项目、高等学校博士学科点专项科研基金、兵器预研基金和横向课题等项目研究。任雪梅教授在国内外期刊和会议上发表论文 100 多篇，被 SCI 收录的有近 50 篇。中国人工智能学会理事，中国人工智能学会智能空天系统专业委员会委员，中国人工智能学会智能服务专业委员会委员。获得北京市科学技术二等奖和三等奖、中国兵器工业集团公司科学技术二等奖和三等奖等奖项。

论文摘要

A. 观测、估计与滤波

A-1

Adaptive Observer Design for Quasi-one-sided Lipschitz Nonlinear Systems

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Abstract This paper deals with the adaptive observer design problem for quasi one-sided Lipschitz nonlinear systems. First, some useful assumptions are presented for the observer design purpose. Then, under the assumptions, an adaptive observer is constructed for the nonlinear system. Finally, a numerical example is given to illustrate the effectiveness of the proposed method.

A-2

Data Missing Process by Extended Kalman Filter with Equality Constraints

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Abstract In this paper, the extended Kalman filter (EKF) is used to estimate the position of the feature points when data missing occurs, taking the feature extraction of plane moving robot ceiling-based positioning as background and the coordinates of the feature points in the image plane as objects. Firstly, the acceleration model of the feature points in the image plane is established as the motion equation, and the motion information of the feature points is extracted by filter. Then, the equality constraints of the feature points are added to the filter scheme to increase the measurement information. In the case where there is a loss of data, that is, the feature points are lost partly, and the predicted values of the lost points are estimated as the true value. By comparing the filtering results, it shows that the addition of equality constraints can not only

enhance the filtering effect, but also can estimate the loss points more effectively. Finally, the validity of the filtering scheme is verified by a numerical example.

A-3

A Real Strong Tracking Filter with Application to Frequency Estimation

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Abstract This paper proposes a real strong tracking filter (RSTF) and apply it for frequency estimation of distorted signals in power systems with mutation. In this method, the robustness is improved due to the smoothing ability of three sampling sine wave relational model, as well as the adaptive ability of strong tracking filter (STF). By analyzing the experiments, it is validated that the RSTF algorithm can track frequency in the presence of mutation rapidly and accurately, in addition to guaranteeing the real-time and effectiveness for online application.

A-4

A Method of Trajectory Prediction Based on Kalman Filtering Algorithm and Support Vector Machine Algorithm

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Abstract A trajectory prediction method based on Kalman filter algorithm (KF) and support vector machine algorithm (SVM) is proposed to predict the trajectory prediction of fast flight ping-pong in the research of ping-pong robot. This method combines the real-time performance of KF and the stability of SVM. By comparing the correlation coefficient between the predicted value and the measured value, the method intelligently selects an appropriate algorithm for the trajectory prediction of ping-pong. Finally, the result of simulation experiment of fast flight ping-pong shows that the method has good stability to the trajectory prediction of ping-pong, and the prediction accuracy is obviously improved compared with the single algorithm.

A-5

Optimization of Mobility Pattern for Underwater Wireless Sensor Networks g

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Abstract Due to the fluidity of water and limitations of nodes, it is challenging to update node's location and movement at all times. The paper proposes optimization of mobility pattern for underwater wireless sensor networks. Based on the ocean current model, Gauss radial basis function is utilized as spatial function to construct the mobility pattern for underwater nodes. Considering centers and coefficients changing with node's location and movement, the cost function of average dissimilarity is selected to choose centers to increase accuracy. The extended Kalman algorithm is used to update coefficients when movements changing. According to the real-time mobility pattern, nodes can estimate future location. Results show that the optimal mobility pattern is more accurate and suitable for underwater wireless sensor networks in the seashore environment.

A-6

A Location Estimation Method on Man and Vehicle in Coke Oven

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Abstract In this paper, a moving target localization method in ultra wide band (UWB) technology from time difference of arrival (TDOA) and angle of arrival (AOA) measurements is proposed. This method provides much higher precise estimate of target position than the single measure method. The UWB radar system which can be used with advantage of tracking of persons or vehicle moving behind obstacles. Simulation studies are given to confirm the approximate efficiency. A Field measurement is conducted in order to verify the accurately approximating impact on a person walking outdoors, which provides a great experiment result.

A-7

Adaptive Maximum a Posteriori Filtering for Relative Attitude and Position Estimation

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Abstract In the presented algorithm, the Gaussian maximum a posteriori (MAP) filter and the traditional extended Kalman filter (EKF) are implemented in parallel to obtain the adaptive ability. One of the elemental filters, the EKF yields high precision in the scenario with low process noise, whereas the other elemental filter, the Gaussian MAP filter is adopted to utilize the measurement maximally in the presence of high process noise. The state estimates of the parallel filters are combined automatically based on the confidence for the underlying situation, such that the presented algorithm can adapt to different operation scenarios. The presented algorithm can provide precise relative attitude and position knowledge between two spacecrafts. It is applicable for many space missions, such as spacecraft formation flying, autonomous rendezvous docking and failed satellite removal. This is the first paper that presents the adaptive MAP estimator based on parallel multiple filters for spacecraft relative navigation.

A-8

A Fourth-order Current Adaptive Model for Online Denoising by Kalman Filter

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Abstract Dealing with noisy time series is a significant task in many data-driven real-time applications. In order to improve the performance of time series data, an important pre-processing step is the online denoising of data before performing any action. In this paper, a novel method was proposed to dispose the noisy time series data based on a fourth-order current adaptive model (FCAM), which can capture the feature of high unstable time series data. The proposed model consists of two parts. The first one is to estimate the system state within FCAM. The second one is

to update the adaptive parameter in the FCAM based on the Yule-Walker algorithm. Finally, the favorable denoising effectiveness of the method was verified by the simulation experiment.

A-9

Apnea Detection with Microbend Fiber-Optic Sensor

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Abstract As a common chronic disease, sleep apnea syndrome (SAS) seriously threatens patients' health, so it is imperative to find an effective way of apnea detection. In this paper, we present a new method that explores of using the high sensitivity characteristic of the micro-bending effect of the gradient multimode fiber to detect human breathing movement, and thereby collecting the respiratory signals. With characterizing central apnea, 8 different features in time-domain and frequency-domain are extracted from the respiratory signals, which are used to train the classifiers. In the feature modeling, we present a peak calculation method based on moving average curve (MAC) to increase the accuracy of estimating the respiratory frequency and amplitude. In our experimental studies, the forward sequence selection method (SFS) is employed to combine these features for training SVM classifier, and our approach can reach an accuracy rate of 94.6% in apnea discrimination.

A-10

Research on Rotor Flux Observer for Extended Complex Kalman Filter of Asynchronous Motor

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Abstract In order to improve the observation accuracy of the rotor flux of the asynchronous motor, a flux observation method based on the extended complex Kalman filter is proposed and applied to the vector control of the asynchronous motor. The complex mathematical model of asynchronous motor is established by choosing the state variables appropriately. On this basis, a rotor flux observer based on the extended complex Kalman filter algorithm is designed to realize the accurate estimation of the rotor flux. The results show that the method can simplify the motor state equation effectively and reduce the order of the mathematical model of the asynchronous motor, it can also reduce the amount of calculation. Simulation results verify the effectiveness and feasibility of the proposed method.

A-11

Fusion Filter for Wireless Transmission with Random Data Packet Dropouts and Delays

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Abstract This paper extends the fusion filter with random packet dropouts and random delays in the wireless transmission systems. Considering the uncertain dynamics of the factual system, a transmission output model is proposed by assuming the possible transmission delays and pockets dropouts. According to the method of the minimum cross-covariance, we derive the optimum fusion filter and the cross-covariance matrices. A simulation example is given to verify the effectiveness of the system.

B. 机器学习及其应用

B-1

A Feature Selection Method Based on Information Gain and BP Neural Network

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Abstract Data mining and machine learning fields are facing with a great challenge of mass data with high dimensionality. Feature selection can contribute a lot to address this issue with the concept of reducing the number of features by eliminating the redundant and irrelevant ones while preserving the information of original features maximally. This paper analyzes and compares two common feature selection methods, then puts forward a novel method for feature selection based on information gain and BP neural network (IGBP). The experimental result shows that IGBP method can reduce the time cost and improve the accuracy of the model at the meantime. The scientificity and superiority of IGBP are demonstrated in this paper, making it an efficient approach to deal with high-dimensional data.

B-2

Research on CO Poisoning Risk Classification Evaluation Based SOM-AHP Method

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Abstract For the risk of CO poisoning risk problems in heating quarter rental housing of northern China, a risk assessment model on CO poisoning based on SOM-AHP method is proposed in this paper. On the basis of designing the index system of poisoning risk assessment, self—organizing

neural network (SOM) is used to determine the division of the risk classification, and used Analytic Hierarchy Process (AHP) to obtain the relative weight of each risk index, then according to the classification rule of the hierarchical order and warning level, the risk classification of carbon monoxide poisoning has been realized. The model is applied to the risk assessment of carbon monoxide poisoning in rented houses in Chaoyang District of Beijing, and the results showed the feasibility of the model.

B-3

Fault Diagnosis of Rolling Bearing Based on Wavelet Packet and Extreme Learning Machine

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Abstract The paper presents a new method using wavelet packet analysis and Extreme Learning Machine (ELM) with the following steps. First, the signal is decomposed by wavelet packet, and the root-mean-square (RMS) and energy of the decomposed subband component signals are extracted. Secondly, the fault classification model of rolling bearing is established based on the Extreme Learning Machine (ELM). Finally, the eigenvector composed of the characteristic parameters of the decomposed sub-signals is used as the model input to diagnose the fault of the rolling bearing. The results indicate that this method will be effectively applied to fault diagnosis of rolling bearings.

B-4

Visual Based Abnormal Target Annotation with Recurrent Neural Networks

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Abstract Most traffic accidents are caused by abnormal driving behaviors. Timely annotate the abnormal targets could effectively reduce the accident risk. This paper has proposed a system used

on autopilot vehicles, to evaluate the targets' caution level. The target with high caution level will be treated as being abnormally driven so attract more attention from the autopilot algorithm. In this paper, a learning based relative position prediction algorithm is proposed by applying CW-RNN method on digital video data. And by modeling the vehicle dynamics and the camera parameters, a position-caution level mapping is built. The system is demonstrated in experiment with the data from Caltech Pedestrian Dataset. An analysis is done to explore the relation between the caution level and the parameters of the vehicle.

B-5

Microblog Query Expansion Based on Ontology Expansion and Borda Count Rank

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Abstract Most of the traditional microblog query methods based on keywords matching lead to low query efficiency. It is difficult for users to get the real information they want without using the semantic expansion. With the study of microblog query expansion algorithm based on ontology and local query feedback, in this paper, we propose a microblog query expansion algorithm based on ontology expansion and Borda count rank. We use the semantic connection provided by ontology knowledge base to expand the initial query words, combine the local query feedback to filter the final query expansion words, and use Borda count method to rearrange the query results. The experimental results show that Microblog query expansion algorithm based on ontology expansion and Borda count rank has better recall and precision rate than keyword-based query expansion algorithm, ontology-based query expansion algorithm and query expansion algorithm based on ontology and local query feedback.

B-6

Microblogging Event Search Based on LSTM Model

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Abstract With the rapid development of the online social media, microblogging events surveillance has become a major research topic. Traditional search method does not consider the characteristics of the events, the search algorithm has its limitations. To solve this problem, we proposed a microblogging event search method based on Long Short Term Memory (LSTM) networks called MESL. Using training corpus to extract the common characteristics of microblogging events. The establishment of event search model effectively improves the microblogging event search quality. Experimental results on the real microblogging datasets show that MESL model is better than the traditional methods for microblogging event search.

B-7

Microblog Search Method Based on Neural Network Language Model

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Abstract Deep neural network language model has gained significant development among natural language processing (NLP) in recent years. In this paper, we focused on using neural language model (NNLM) to enhance microblog search. This paper proposed a microblog search method based on neural network language model (NBSM). Firstly, we train neural network language model based on microblog data, so as to get the distributed representation of words which may contain internal express model of microblog. Then, we use the distributed representation of words to get the expanding words of users' searching words. Finally, we re-rank microblog search results combining deep sematic text similarity and social signal features. The method we proposed can effectively obtain microblog express model, and its search result can re flect the social hot-topics of the topic related to users searching words. Experiment results show that the proposed method yields significant improvements over state-of-arts methods and significantly improves the user's search experience.

B-8

Scenic Negative Comment Clustering Based on Balance Weighted Comment Topic Model

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Abstract The scenic comment information from visitors often hidden the different aspects of the recommendations and expectations of the attractions, the extraction of these key information will help the spot managers find their own shortcomings and improve themselves. In this paper, we improved the author topic model and proposed a model of clustering the negative comments of the scenic spots. There are two improvements from our proposed model. Firstly, we added the importance of the comment category to the text clustering. Secondly, in order to prevent the stop words accumulating in the sampling process, we introduced the balance weight to the proposed model. Experiments showed that the model could not only effectively cluster these data, but also could extract the rich information related to different comment categories from the clustering results, which could help the managers of the scenic spots to better manage the attractions and attract tourists.

B-9

Scale Adaptive Kernelized Correlation Filter with Scale-Invariant Feature Transform

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Abstract In order to solve the problem of scale variation in Kernelized Correlation Filter (KCF)

tracker, a scale adaptive tracking method based on Scale-Invariant Feature Transform (SIFT) is proposed. Firstly, it uses SIFT to extract and match keypoints between two successive frames to estimate the new scale of the target. Secondly, it utilizes keypoints information to resist strong disturbance of complex scenes, so that the method this paper proposes can be more robust. The method is tested in standard tracking library and compared with original tracking method in center location error and the overlap rate. These results illustrate that our tracking method with SIFT scale compensation improves the performance effectively.

B-10

The Admissions Big Data Mining Research based on Real Data from a Normal University

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Abstract In this paper, a Normal University's 2011–2016 real admissions data are analyzed by the Apriori, K-MEANS and KNN algorithm. The result shows that the university's normal students are more likely to choose other normal majors than to choose other non-normal majors related the normal majors and the overall situation of the Normal University's student enrollment is relatively stable. Liberal arts college is the most popular college. Chinese language and Literature (normal) and English (normal) are more popular in the Normal University. The result reveals the internal connection between the various majors and has a guiding role for specialties setup in the university.

B-11

Clustering Personalized 3D Printing Models with Multiple Modal CNN

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Abstract Clustering personalized 3D printing models is very useful for a cloud manufacturing management system, but it is difficult to cluster directly because of the complexity and abstraction of the 3D print model input. In this paper we use the convolution neural networks (CNNs) to learn the similarities of 3D print model pairs in different input modes and integrate these similarities by multi-channel spectral clustering. The three-dimensional CNN and the view-based CNN are used for different input modes. Our experiments show that the accuracy of the clustering can be improved by merging training results of different input modes.

B-12

Handwritten Digit Recognition Based on Improved BP Neural Network

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Abstract Due to the different writing habits, it is difficult to achieve the recognition of handwritten numbers. The artificial neural network has been widely used in character recognition because of its strong self-learning ability, adaptive ability, classification ability, fault tolerance and fast recognition. BP neural network is used to identify handwritten numerals in this paper. In order to obtain a higher correct rate, this paper improves the traditional BP neural network and experiments with the MNIST data set on the MATLAB simulation platform. The experimental results show that the improved network converge faster and the classification is more accurate.

B-13

Research on Gait Recognition and Step Rate Detection Based on SVM and Auto-correlation Analysis

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Abstract In order to monitor the motion state of human body, wearable system is studied. The system can identify gait and detect step rate. By data acquisition system with acceleration sensor, acceleration data are collected under various moving states, and immediately transmitted via

blue-tooth. After signals have been analyzed by pre-processing and relevant feature extraction, gait patterns are recognized through support vector machine (SVM) classifier. Compared with back propagation neural network (BPNN) classifier, results indicate that SVM classifier has advantages of simple design and high accuracy for the same data set. So SVM classifier is more suitable. According to crest-detection, auto-correlation analysis algorithm is proposed and tested. Research findings show that auto-correlation analysis can greatly improve the accuracy and adaptability of step rate measurement.

B-14

Object Detection from Images Based on MFF-RPN and Multi-scale CNN

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Abstract In this paper, an object detection model based on MFF-RPN and Multi-scale CNN is proposed. Firstly, the region proposal network based on multi-level feature fusion (MFF-RPN) is presented to extract the candidate proposals. Secondly, a convolutional neural network (CNN) with different scale convolution kernels is conducted to extract features adaptively. Finally, multi-task loss is employed to establish a complex mapping between image object features and object detection mode. The experimental results prove that the proposed algorithm gets better classification performance and higher detection accuracy.

B-15

Dual Radio Tomographic Imaging with Bayesian Compressive Sensing

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Abstract A common difficulty in device-free localization (DFL) using received signal strength (RSS) is that the uninformative and redundant RSS data in wireless sensor network (WSN) usually degrades the localization performance. This paper develops a dual radio tomographic imaging (RTI) to keep data efficiency in sparse signal recovery as well as eliminating the redundant measurements. In addition to Tikhonov regularization, we also utilize a robust loss function in sparse Bayesian learning for RTI to handle with the outlier data. Moreover, by taking advantage of proposed spatial continuous filter in position estimation, our dual RTI achieves lower localization errors in DFL system.

B-16

View-based 3D Model Retrieval via Convolutional Neural Networks

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Abstract In this paper, we propose a multi-view fusion 3D model retrieval using convolutional neural network to solve the problem of the local perception in feature descriptor. By view pooling, we combine information from multiple views of a 3D model to eliminate the position correlation caused by the viewing angle of camera. In addition, integrating pre-processed RGB view-feature with Binary view-feature in the same model is used to generate a single model descriptor. Experiments on ETH dataset demonstrate the superiority of the proposed method.

B-17

Extreme Learning Machine based Location-Aware Activity Recognition

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Abstract According to the recent government reports, China has gradually entered an aging

society. Pension problem is a vital problem to face. Therefore, it will be very useful to monitor the health status of elderly people who live alone at home. To evaluate the abilities of elderly people in daily life, the activities of daily living (ADL) is used. In this work, we propose a novel machine learning approach for ADL recognitions by considering the location context information of the elder. With the popularity of smart phones, motion recognition can be done by the embedded sensors such as acceleration sensors and. However different ADL models possibly have the same movement to a certain degree, which will affect the classification performance. We append the location information as an additional feature to detect ADL. Furthermore, we propose a hierarchical Extreme Learning Machine (ELM) to classify the ADL. With the experiment and test, the algorithm described in this paper can achieve obvious performance in ADL recognition.

B-18

Infrared Image Temperature Measurement Based on FCN and Residual Network

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Abstract The key to electrolytic aluminum infrared temperature measurement system is to establish a certain mapping relationship between the gray image of the electrolyte and the temperature on the basis of the infrared thermal imaging system. Image segmentation techniques is use to get the extraction of the electrolyte region. Based on this, this paper combined the FCN network architecture, improved the VGG19 network with relatively good performance at present. In view of the network depth deepening, this paper also incorporates the residual thought, which solves the problem of network degradation caused by the deepening of the network. The new framework model proposed in this paper can meet the requirements of industrial temperature measurement.

C. 运动系统的位置姿态控制

C-1

Attitude Control of a Quad-rotor Based on LADRC

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Abstract In this paper, the structure of the linear active disturbance rejection control (LADRC) is described in detail, including linear tracking differentiator, linear extended state observer and linear feedback control law. Typical algorithms of the each part are given as well. In order to control the attitude of the quad-rotor robot as we expected, we designed a LADRC scheme. Simulations are carried out based on Simulink. After parameters adjustment and simulating with different disturbances, the simulation results show that the LADRC can satisfy the need of control precision and speed of response. It also indicates that the LADRC has strong robustness and anti-disturbance performance, which can control the nonlinear time-varying coupling system effectively.

C-2

Robust $H\infty$ Control of Non-cooperative Rendezvous Based on $\theta - D$ Method

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Abstract This paper mainly investigates the space non-cooperative rendezvous control problem by robust $H\infty$ method which is an effective approach to attenuate the influence of parametric uncertainties and external interference in system. First of all, the 6-DOF coupling translation-rotation model established in line-of-sight (LOS) coordinate system is developed. And it is proved that when a Hamilton-Jacobi-Inequality (HJI) is satisfied, non-cooperative rendezvous system is asymptotic stable at origin with a desired $H\infty$ performance. Subsequently, the $H\infty$

controller is proposed using the solutions to the HJI. To get an approximate solution of the HJI effectively, the modified $\theta - D$ method is introduced. Finally, the numerical simulations prove the availability of the proposed control scheme.

C-3

Dynamic Modeling and Analysis of the Micro-spacecraft Ejection Separation System

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Abstract Separation velocity and angular velocity are two key factors affecting the success of space ejection separation. In this paper, a coupled dynamic model of micro-spacecraft ejection separation mechanism is built based on the Newton-Euler method. With this model as the research object, the influences of different system parameters on the separation velocity and the angular velocity of the ejection separation mechanism are simulated and analyzed. The results indicate that the physical parameters of separating springs and the installation position of space ejection separation mechanism are the main factors affecting the separation velocity and angular velocity respectively.

C-4

Coordinated Control of Multi-satellites Formation Flying for Pulsar Observation

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Abstract X-ray pulsar navigation is a critical and frontier technology for spacecraft's autonomous navigation in future. Now an effective database of pulsars angle position with high precision has not been developed. The precision of pulsar angle position measurement could be greatly improved by observing a pulsar jointly at the same time with several satellites. While observing

the same pulsar the satellites have to set their attitude and orbit coordinately. There should be a constraint of tasks, spatial graphs, agreements and time in the observing process. In paper a plan of observing a pulsar at the same time by several satellites is put forward, a method of multi-satellites coordinated control is presented, and a digital experiment is carried out for simulating the proposed scheme. As results, the plan is feasible, the controller of the satellites orbit position and attitude is stable, the plan and control method is especially suitable for X-ray pulsar interferometry so that the accuracy of pulsar angle position can be improved by observation with multi-satellites formation.

C-5

The Intelligent Flight Control of Quadrotor in Tunnel Based on Simple Sensors

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Abstract This paper studies the automation flight control problem of a quadrotor in the tunnel. The LED lamp belt is installed in the tunnel and two moving points are the tracking target of the quadrotor. The velocity-control-mode is first well done before the tracking control algorithm is considered. A control law is then designed to achieve tracking task in the straight tunnel. When the parameter is properly designed, the quadrotor still can perform tracking task for the moving points even in the bent tunnel. Moreover, we prove that the collision between the quadrotor and the tunnel can be avoided by using the proposed control law. The validity of the proposed control algorithm is also demonstrated through numerical simulations.

C-6

Longitudinal Control of Unmanned Powered Parafoil with Precise Control Gain

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Abstract Unmanned powered parafoil is a complex nonlinear system. In this paper, a novel approach based on active disturbance rejection control (ADRC) with precise control gain is constructed for unmanned powered parafoil to reach the precise reference altitude. We first outline the dynamic model of unmanned powered parafoil. Moreover, the longitudinal altitude controller

is introduced, where the extended state observer (ESO) estimates the total disturbances involving model uncertainties, internal coupling and external wind disturbance. Furthermore, the highlight of paper, is that the control gain is directly obtained from the system model rather than a trial value, which can optimize the state error feedback (SEF) and enhance the stability and disturbance-rejection of the controller. After that, the introduction of semiphysical platform is presented and the experimental results are analyzed. The experiment results verify the efficiency of this control approach.

C-7

Attitude Control of a Class of Quad-Rotor Based on LADRC

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Abstract Based on the analysis of the working principle and dynamic characteristics of quad-rotor, its dynamic model is established. And the simulation platform of quad-rotor control system is developed in Matlab/Simulink environment. Considering the characteristics of nonlinear, strong coupling, under-actuated, and uncertain of the quad-rotor aircraft, the most widely used cascade PID controller is adopted in the simulation of the quad-rotor control system. To deal with the aircraft parameter uncertainties and external interferences, this paper designed a linear active disturbance rejection controller (LADRC), which realizes the real-time estimation and compensation of internal disturbances and external disturbances by using the extended state observer (ESO) to overcome the strong coupling, model uncertainties and external disturbances of the quad-rotor aircraft. Simulation results on attitude tracking and height control of the LADRC system are analyzed on the simulation platform and compared with the cascade PID control system. The simulation results show that the LADRC is superior to the cascade PID controller in terms of disturbance rejection.

C-8

Tracking Control of Quad-Rotor Based on Non-regular Feedback Linearization

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Abstract This paper addresses the tracking control problem of quad-rotor moving in three-dimensional space. The tracking controller is based upon the use of suitable input transformation and non-regular feedback linearization technique. Two steps are involved in control design. In the first step, two control inputs are respectively designed for height and yaw angle, guaranteeing their tracking errors asymptotically converge to zero. In the second step, the control inputs for roll and pitch angles are employed to govern the rest two position tracking errors by substituting designed height and yaw control inputs into the remaining position tracking errors, with the remaining position tracking errors holding a feedback linearized form in their fourth derivatives. Finally, simulations are provided to validate the proposed control scheme.

C-9

The Path Tracking Control Method Based on LOS Algorithm for Surface Self-Propelled Model

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Abstract Aiming at the surface self-propulsion model system, the paper design a path tracking control method based on the LOS (Line of sight) algorithm to achieve automatic path tracking control purposes. The algorithm uses a simple principle to obtain the desired heading angle, and through the PID control, which makes the ship closer to the expected course, finally sailing at heading, complete path tracking control. Simulation and experiment results for a Surface Self-Propulsion Vessel are provided to validate our method.

C-10

Global Tracking Control of Underactuated Surface Vessels with Non-Diagonal Matrices

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Abstract In this paper, two control laws are proposed to solve the tracking control problem of underactuated surface vessels with non-diagonal inertia and damping matrices. Based on the inherent cascaded structure of dynamics, the original tacking control problem of vessels is converted to stabilization control problem of two subsystems. Then, two tracking control laws are designed respectively for known and unknown model parameters. The first surge control law is simple without any model parameter, and hence is possible to be extended to the case of unknown model parameters. Stability analysis indicates that both the two control laws realize global *K*-exponential tracking under persistently exciting condition. Effectiveness of the proposed controllers is demonstrated by numerical simulations.

C-11

Cooperative Path Planning for Intelligent Vehicle Using Unmanned Air and Ground Vehicles

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Abstract This paper focus on the intelligent vehicle path planning issue using cooperation between Unmanned aerial vehicle (UAV) and Unmanned ground vehicle (UGV). For the UGV's path planning problem in the cooperative system, the theory of traditional Artificial Potential Field (APF) was analyzed, and an algorithm for the intelligent vehicle was presented. The proposed algorithm allows the intelligent vehicle to navigate through obstacles, and finding a path which can reach the target without collision. The novelty of the algorithm is that directly establish the function model of repulsive and attractive force, and redefine the local minimum point to solve the problem of local minimum point. The proposed algorithm was illustrated with MATLAB, as a result, a safe and feasible path can be generated which can ensure the intelligent vehicle reach the target smoothly.

C-12

Path Tracking Control for Four-Wheel Steering Vehicles by Hyperbolic Projection-Based Feedback Dominance Back stepping Method

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Abstract The path tracking problem is studied for four-wheel steering vehicles in this paper. A path tracing controller with decoupling performance between lateral velocity and yaw rate is designed by using the hyperbolic projection-based feedback dominance backstepping method to achieve the tracking goal. Simulations are shown that the lateral offset converges to zeros and the vehicle heading angle converges to the actual road direction of the desired path. These results conclude the new designing controller is very effective.

C-13

Singularity-free Path Following Control for Miniature Unmanned Helicopters

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Abstract A singularity-free nonlinear controller is presented for the miniature unmanned helicopter to follow a reference path described by implicit expressions. Based on the time-scale separation principle, the controller is designed with hierarchical inner-outer loop structure. The outer-loop position controller is constructed with hyperbolic tangent function, and temporary-path generation method is developed to keep the control matrix invertible and obviate large control energy. The desired command attitude can be derived from position controller without singularity by choosing appropriate controller parameters. The inner-loop attitude controller is designed with the unit-quaternion attitude representation and backstepping technique to achieve attitude tracking. Numerical simulation is provided to verify the theoretical results.

C-14

Stabilizing Quadrotor Helicopter Based on Controlled Lagrangians

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Abstract A stabilization controller for the quadrotor helicopter is designed based on controlled Lagrangians method in this paper. Firstly, the dynamical model of quadrotor helicopter is simplified by input transformations. With linearization at the desired equilibrium and invertible state transformations, the model can be divided to four subsystems. Then controlled Lagrangians method is applied to stabilize the two subsystems with one under-actuation degree, and the other two subsystem are stabilized by PD control laws. Finally, local asymptotic stability of the closed-loop system is proved theoretically and verified by simulation results. Different from common-used controllers, the controller presented in this paper does not depend on the outer/inner loop structure and the time-scale separate principle, which always hinder rigorous stability analysis of the controlled system and complicate control algorithm.

D. 复杂系统与网络

D-1

Recursive State Estimation for Discrete-time Nonlinear Complex Networks

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Abstract This paper studies the state estimation problem for a class of discrete-time nonlinear complex networks. The purpose is to design a recursive state estimator by using the variance-constrained approach such that the variance of the estimation error is not more than the prescribed upper bound. By adopting the structure of the extended Kalman filter (EKF), the gain matrix is determined by minimizing the trace of the prescribed upper bound matrix. It is shown that the estimator can be developed by solving two Riccati-like difference equations. A numerical example is provided to illustrate the effectiveness of the proposed estimator.

D-2

Quasi-synchronization of Chaotic Systems with Parameter Mismatches Via Aperiodically Intermittent Control

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Abstract This paper focuses on the problem of quasi-synchronization of chaotic systems, which will be dealt by aperiodically intermittent control. Different from previous results which investigated quasi-synchronization via periodically intermittent control, the method of aperiodically intermittent control removes the limit that every work time is the same and all rest time are equal. A novel sufficient condition for quasi-synchronization is established under a small error bound via using a piecewise switching time-dependent Lyapunov function, which is monotonically decreasing with respect to time. The effectiveness of the proposed approach is shown by taking Chua's circuit.

D-3

The Immune System Model Based on B Method

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Abstract Due to the lack of understanding of immunology, the immune theory is still controversial, which causes the difficulty in the immune system simulation. Based on the strict mathematics, the formal B method which is combined with the immune system as an example to transform the Unified Modeling Language class diagram into B formal specification in this paper. Through its strict verification technology, the model reliability is proved. Then the transformed class diagram will be transformed into the JAVA model of immune system, and some basic rules of immune system will be obtained.

D-4

Graphic Modelling Approach as a Support for Event-B Modelling

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Abstract Event-B method, as an evolution of B-method, is a formal method for system-level modelling and analysis based on extended first order logic and set theory, which provides flexible approaches of refinement and decomposition to construct large systems gradually with some successful applications in their formal verifications. However, it is hard to manipulate and grasp this method for many researchers because of its highly abstraction. In order to reduce the burden of developers' work and the complexity of Event-B model, a graphic modeling approach, called Event-B graph, is introduced in this paper, which is used as an alternative way to clearly describe the state flow of the model and provide a graphic way of system-level modelling to bridge the real problem and the Event-B model construction. After introducing some new concepts and structure of Event-B graph, the transformation algorithm from Event-B graph to Event-B model is provided and the equivalence of the transformation is then proved. An example is finally provided to illustrate the procedure of Event-B graph construction.

D-5

Link Prediction from Partial Observation in Scale-free Networks

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Abstract We study the link prediction problem in scale-free networks by using node similarity measure method to estimate the probabilities of potential links from a partial observation of links. Specifically, we give estimates of scaling parameter of the power-law distribution based on the observed node degrees and approximate solutions to a transcendental equation with Hurwitz-zeta function, whereby to obtain a local sub-network similarity measure of node pairs that do not have available observation information. Experiments on synthetic scale-free networks verify the effectiveness of our method.

D-6

The Civil Aviation Crew Recovery Time-Space Network Model Based on a Tabu Search Algorithm

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Abstract In order to reduce cost of airlines when disruption of crew scheduling happens, a mathematical programming model of crew scheduling recovery is constructed under the usage of airline crew. In the proposed model, the objective is to minimize the usage of airline crew,moreover, the estimated delay costs are considered as chance constraints. To solve the model, a tabu search algorithm is adopted. Finally, a numerical example is carried out to illustrate the efficiency of the model and algorithm. The computed results show that the tabu search algorithm designed in this paper to solve the crew scheduling recovery problem not only achieves good optimization results, but also has a higher computational efficiency, a faster convergence rate and a more stable computing result. By this, the airlines cost waste can be better avoided.

D-7

A Visualization Method for Hierarchical Structure Information of the Food Inspection Data Based on Force-Directed Model

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Abstract Food safety supervision and management departments have accumulated a large number of food sampling data, and the data shows hierarchical and high-dimensional characteristics. Because of the lack of appropriate visualization methods, it is difficult to carry out efficient analysis. In this paper, we extracted a hierarchical and high-dimensional dataset from the food inspection data for visualization, and proposed a method based on the force-directed model. Besides, we applied an optimized method to design the interactive mode. Through the visual interaction, the information can be displayed much more efficiently and thus facilitate the understanding of information.

E. 图像处理与人机交互

E-1

Interactive Touch Control Method Based on Image Denoising Technology

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Abstract In this paper, an interactive touch control method based on image filter technology is proposed to solve the problem of noise interference in the image transmission of interactive system. Firstly, an interactive touch control system based on Kinect sensor is constructed. The intelligent interaction area is created by projection technique and dynamic capture method, and the image of Kinect is processed by Kalman filtering. Finally, the infrared operation pen is employed to simulate the mouse to achieve human-computer interaction. The experimental results show that the interaction effect of the human-computer interaction system can be well obtained.

E-2

A Wall Interactive System Based on Infrared Electronic Pen

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Abstract In this paper, a new method of interactive system based on infrared electronic pen is proposed to achieve accurate tracking of the target trajectory with anti-jamming ability. Projection technology, infrared sensor, dynamic capture, image processing and other technologies are synthesized in this system. The interactive area is created intelligently and the touch event is determined, and the Improved Mean Shift algorithm is utilized for image information tracking. The simulation of the mouse function can make any wall into a touch screen. With the integration of whiteboard technology, a good human-computer interaction effect can be achieved.

E-3

Hand-Eye Calibration of IMU and Camera Without External Equ ipments

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Abstract To relate measurements made by visual and inertial sensors, we must solve the hand-eye calibration (HEC) equation AX = XB, where X denotes an unknown rotation and translation between camera and inertial measurement unit (IMU), and A and B respectively represent the calculated movement transformations related with the camera and IMU. This paper introduces a systematic framework to jointly calibrate IMU and relative transformations X with a linear decomposition algorithm which is composed by Kronecker product and singular value decomposition. Without the requirements of external equipments including Robot Operating System or specific hardware and of the A and B featured the identical rotation angle, it enables the extension to the arbitrary set-up and the noise in rotation. The details of our framework are given, together with a validity of A and B movements followed by results of real experiments, showing that the enough precision and more robustness can be achieved.

E-4

Feature Extraction for Target Spacecraft in the Final Approaching Phase of Rendezvous and Docking

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Abstract The rendezvous and docking technology is the key issue to accomplish the spacecraft maintenance in-orbit, space station supply, and astronauts visiting. The technology of the vision measurement for spacecraft directly determines that its results are successful or fail in the final

approaching phase of rendezvous and docking. Feature extraction for target spacecraft includes edges, lines, circles, and especially motion information. In this paper, image smoothing based on 2-Dimensional Adaptive Wiener Filtering is introduced, then Canny Edge Detector is used for edge detection, finally using Standard Hough Transform to extract lines and the characteristic circle. Experimental results show that the computation is obviously improved, meanwhile, the precision of detection is also improved. What' s more, lines and circles detection as the fundamental step of extracting motion information, even the vision measurement for spacecraft position and attitude determination, is absolutely necessary.

E-5

Dual Color Image Blind Watermarking Algorithm Based on Compressive Sensing

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Abstract As a new information processing theory, Compressive Sensing (CS) should be further researched on the applications of digital watermarking. This paper presents a novel blind digital watermarking scheme embedding a color watermark into a color host image. By using Compressive Sensing theory, Gaussian random matrix is carried out to observe the sparse image and watermark is embedded in compressed observation domain. Finally a smooth norm algorithm is used to reconstruct watermarked image. The watermark extraction process is the blind extraction. The experimental results indicate that the algorithm meets the requirements of the watermark invisibility, robustness and security.

E-6

Ground Moving Target Indication Based on Doppler Spectrum in Synthetic Aperture Radar Images

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Abstract Two moving target detection methods in a given synthetic aperture radar (SAR) imagery are proposed based on the theory of SAR imaging. The methods are performed by using the phase information of the image patch by patch. First, an average Doppler spectrum is achieved from the stationary parts in the image and used as a standard one in the successive computations. Then an average Doppler spectrum of a selected image is computed and used to detect moving targets with random directions by correlation and normalized difference computation. Finally, the effectiveness and practicability are validated by theoretical and field data.

E-7

Spherical Panorama Stitching Based on Feature Matching and Optical Flow

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Abstract In recent years, 360° spherical panorama images and videos have seen huge adoption in virtual reality research. Image mosaic is the main technology to stitch the little scale images to a large scale panoramic image. Because of the gross distortion in the edge of fisheye lens, the misregistration on the corrected images leads to obvious ghosting after stitched. In this paper, we use pyramid LK optical flow algorithm to reduce the misregistration areas by remapping with interpolation algorithm. Additionally, we use sample point algorithm to adjust the brightness of images for minimize visual seams. Experiments show convincing evidence that the effect of our spherical panorama stitching improves significantly.

E-8

Facial Expression Recognition Using Histogram Sequence of Local Gabor Gradient Code-Horizontal Diagonal and Oriented Gradient Descriptor

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Abstract This paper present an original method for facial expression recognition, which fused with the Gabor filter and Local Gradient Code-Horizontal Diagonal (LGC-HD) as well as Histogram of Oriented Gradient (HOG). This approach firstly is used Viola-Jones algorithm to

resize the facial expression image and convolve the facial expression image with Gabor filters to extract the Gabor Coefficients Maps (GCM). Then, we obtain Average Gabor Maps (AGM) by folding GCM of four orientations in each scale to reduce dimensions. The LGC-HD and HOG is applied on each AGM to obtain the LGGC-HD-HOG descriptor. At last, the Support Vector Machine (SVM) is adopted as classifier. We conclude that the method in this paper is better in recognition rate than other similar methods by analyzing the experimental result.

E-9

Nonlinear Tracking Control for Image-Based Visual Servoing with Uncalibrated Stereo Cameras

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Abstract This paper considers the problem of uncertain camera pose and camera parameters for a 3-degree-of-freedom (DOF) robot manipulator in nonlinear visual servoing tracking control. To solve this problem, the typical Kalman filter (KF) algorithm is designed to estimate the image Jacobian matrix online, which can reduce the system noises to improve the robustness of the control system. Visual optimal feedback controller is developed to precisely track the desired position of the robot manipulator. In addition, stereo cameras are incorporated into the robot manipulator system such that the tracking errors in both camera image frame and robot base frame can simultaneously converge to zero. Experimental results are included to illustrate the effectiveness of the proposed approach.

E-10

Fast Robust PCA on Background Modeling

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Abstract This paper extends the subspace learning method Robust principal component analysis (RPCA) for background modeling to recover the background scene from video sequence with static camera. We propose a novel matrix reformulation and optimization process for RPCA

method to solve background modeling problem. The experiments are conducted among our proposed method and other statistical methods including RPCA algorithm and its variants under wallflower datasets and LRSLibrary benchmarks separately. The results of experiments show that our method exceeds the existing RPCA in time complexity in a great manner, while keeps and even improves the modeling performance over other modeling algorithms.

E-11

Esophagus Tumor Segmentation Using Fully Convolutional Neural Network and Graph Cut

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Abstract The development of Esophagus radiation treatment plan demands accurate Esophagus tumor segmentation. However, such task was often prevented by random distribution and weak boundaries of Esophagus tumors on CT images. To address these challenges, we develop a novel framework based on the combination of Fully Convolutional Neural Network (FCN) and graph cut algorithms. FCN is utilized to establish an Esophagus tumor classifier on the training dataset with expert-labeled tumor regions. When segmenting Esophagus tumors on the test dataset, the tumor probability maps are first estimated. Graph cut is next used to extract the actual tumor regions by enforcing the spatial constraints. 87 CT sequences were selected as the validation dataset, and 3-fold cross-validation was performed to evaluate the segmentation accuracy. Tumor volume overlap between ground-truth and segmentation results was only 71% by exploiting FCN alone, while it was improved to 80% by combining graph cut algorithm. These promising results suggest that the combination of FCN and graph cut can accurately segment Esophagus tumors, which has a great potential to reduce human burden in contouring tumor regions as well as improve the accuracy of radiation treatment planning.

E-12

An Immersive Roaming Method Based on Panoramic Video

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Abstract The idea for panoramic video immersive roaming is from the current mature street view, such as Google Street View, and Baidu Street View. The method of video's immersive roaming proposed in this paper will overcome the disadvantages of the Google Street View which based on panoramic pictures. The method mainly involves the adaptive tuning of the camera algorithm, the immersive viewing angle forward and camera switching algorithm. Finally, the method is proved to achieve panoramic video immersive roaming through panoramic video, and there is high practical value.

E-13

Research of Ore Particle Size Detection Based on Image Processing

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Abstract The size distribution of ore particles is an important basis for evaluating the crushing effect, and is also the main index for the optimal control of mineral processing equipment. Image processing technology is used to process the images collected by the camera on line, which can get the information of ore particle size in real time and feedback or adjust the parameters of the crushing machine in time. We first study the image pretreatment methods on ore images to separate foreground and background images. Then the improved watershed segmentation algorithm is used to segment the ore images. Finally, the distribution information of the ore particle can be obtained through the projected diameter of the ore particles. The experimental results show that the analysis results are effective in real applications, which can meet the needs of on-line detection of ore particles.

E-14

Person Re-identification based on Minimum Feature using Calibrated Camera

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Abstract Although several approaches of person re-identification can be found in the paper, tracking people restricted in an open area is still an active research. In this paper, we propose a method assuming each pedestrian as a collection of multiple elements of the database. From the lowest point for the sector, layer by layer up to the top, we collect the minimum feature of the object. The features include statistic feature based on Bhattacharyya distance, SURF feature and Color histogram. After the pedestrian identification, and then start tracking. All the patches can be tracked individually and the vectors are calculated with the world coordinate. Not only that, the algorithm also uses the calibrated parameters of multi-camera to directly compute the pedestrian scale, and at the same time limit the region of searching, rather than using all the complex features as before. The experiment is carried out using two sets of publicly available database (PETS and CHUK). According to the experiment results, our method has a strong robustness, even for the larger changes in the scale of person can also be identified. Algorithm can also deal with many occasions, the accuracy is also high, compared to many of the existing state-of-art algorithm.

E-15

Design of a New Multi-functional Humanoid Finger Sensor

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Abstract Current robot tactile sensors have shortcoming such as low reliability and lack of uniform calibration methods. A new multi-functional humanoid finger sensor based on liquid conduction and able to measure three-dimensional force, temperature and micro vibration simultaneously and its multifunctional calibration system are designed. In order to satisfy requirements for real-time and accuracy of the calibration and use of the finger sensor, a modular software architecture is proposed, which can integrate human-computer interaction and data transmission. Finally, the finger sensor and its calibration system is proven to be stable and reliable by calibration experiments and object identification test, indicating that the finger sensor is suit to recognize the target.

F. 电子电力系统及控制

F-1

The Design of New Energy-saving DC Brake Device

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Abstract In order to meet the needs of the market, such as small size, low power consumption, and low cost, the finite element analyzing software is used to design DC brake. The optimization design of DC electromagnet using magnet is introduced, including the determination of the electromagnet material, air-gap length, etc. According to the characteristics of DC brake, which are needing larger initial suction and maintaining smaller suction, the control circuit is designed, which is strong excitation starting, weak excitation maintaining. This circuit is simple, reliable and has achieved high efficiency and energy saving purposes. The results of experiments indicate that the DC brake has characteristics of small starting current, simple structure, rapid action, high reliability and durability.

F-2

SOC Estimation of Extended Kalman Filter Based on the Model Data Optimization

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Abstract An accurate power-battery state of charge (SOC) estimation plays an important role in battery electric vehicles (EVs). Affected by random factors such as working conditions and environment, Li-ion power battery has very strong time-varying nonlinearity in the application of EVs, the research on SOC estimation of power battery is of great theoretical significance and application value. This paper studies the SOC estimation using extended Kalman filter (EKF),

which is based on the Thevenin equivalent circuit model. And then a reasonable optimization method of the parameters of the model is presented to improve the SOC estimation accuracy. The simulation results demonstrate that the optimization method can improve the SOC estimation precision remarkably with little in fluence on the initial error convergence by means of EKF.

F-3

A Protection Strategy of Microgrid Based on EtherCAT

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Abstract This paper proposes a protection scheme of microgrid and it is based on EtherCAT communication protocol. There are two algorithms in this scheme. One is used to detect fault, and it is based on superposition theorem. The other one is used to locate and eliminate the fault. In order to verify the correctness of the algorithm which is used to detect fault, a simulation model in MATLAB is established. Use the topology's information of microgrid and fault's information to construct matrix, then complete the work about locating fault and eliminating fault by matrix operation. In this paper, the advantages of EtherCAT communication protocol are discussed, and the primary design of master station and slave station is carried out. Lay the foundation for detailed design of microgrid protection system.

F-4

Reliability Analysis of Distribution Network with Microgrid Based on Hybrid Energy Storage

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Abstract The reliability evaluation of distribution network with microgrid is an important aspect of reliability research of power system. Firstly, the stochastic models of output power of micro power source are established, and the charge/discharge strategy of hybrid energy storage is established. The microgrid is formed in a certain way. Secondly, through dividing the area of syste

and reducing load when the output power is insufficient, the outage time of each load point is determined. The system reliability indexes are calculated by sequential Monte Carlo simulation. The effectiveness of the evaluation method is verified by simulation results of IEEE RBTS BUS6, to which the microgrid is connected.

F-5

On Line Partial Discharge Localization in Cable Based on Time Varying Kurtosis and Time Window Energy Ratio

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Abstract On the basis of using traveling wave method to carry out location of PD of high voltage cable, the time varying kurtosis method which used in the field of Seismic signal detection is introduced to solve the problem that the positioning accuracy is dependent on the accuracy of time delay estimation. The time window energy ratio method is introduced to solve the problem that the time-varying kurtosis which cannot identify the PD pulse is difficult to obtain the first break time on line. Firstly, the time window of the partial discharge is detected by the energy ratio of the time window, and then the local time-varying kurtosis curve is obtained. Finally, based on the time varying kurtosis, the online picking up time is achieved. The simulation results show that this method not only has high precision and strong anti-interference ability, but also can realize that relative error in −4 dB noise environment is 0.23%.

F-6

Solar Power Based Wireless Charging System Design

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Abstract This paper designs a solar charging system which can convert solar energy into electrical energy and wirelessly charge devices such as mobile phones. First, we research the related documents to get the information of the features of solar energy wireless charging system;

then we select components which are suitable for this system and use PROTEL software to draw the schematic diagram and PCB diagram. Then we process and weld the PCB to obtain the hardware circuit of solar wireless charging system. At last, we test and process the system data to obtain the electrical circuit parameters.

F-7

Research on the Smooth Switching and Coordinated Control System of Microgrid Based on Master-Slave Control

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Abstract There is a problem of smooth switching between grid-connected mode and the island mode under the master-slave control structure of microgrid. This paper uses the simulation software MATLAB to build a simulation model of dual power supply low voltage microgrid. In grid-connected mode,the main power is disconnected, the slave power supply uses PQ control method. Once the fault occurs on the side of the large power grid or microgrid, microgrid must switch to the island mode. At this time, the main power supply is controlled by V/f to support the stability of voltage and frequency. The slave power supply uses PQ control method for constant power output. If there is no communication channel between master and slave controller, the control strategy may misoperate or operation failed. In this paper, EtherCAT communication protocol is used to realize the communication between the master controller and the slave controller, and the TwinCAT software is used as the main controller to study the coordinated control system based on EtherCAT.

F-8

Research on Cable Fault Location Algorithm Based on Improved HHT

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Abstract The accurate calibration of the fault traveling wave head is the key to realize the cable

fault traveling wave ranging. Modal aliasing will appear when the traveling wave ranging method based on HHT carries on empirical mode decomposition, so that the ranging accuracy is low. In order to solve this problem, an improved HHT algorithm based on ensemble empirical mode decomposition (EEMD) is put forward. At first, the EEMD algorithm is used to extract the inherent modal function of the fault traveling wave head. Secondly, the instantaneous frequency is calculated by the Hilbert transform. Thirdly, the traveling wave head is accurately calibrated by the abrupt change point of the instantaneous frequency. Then use the double-terminal fault ranging algorithm to achieve more accurate fault location. Finally, the 10 kV distribution network model based on the cable line is built in PSCAD/EMTDC software. A large number of simulation results show that the proposed method is feasible, and it is more precise than traditional methods.

F-9

Design an Induction Motor Rotor Fux Observer Based on Orthogonal Compensation of the Stator Flux and Back EMF

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Abstract To address the problems of error accumulation and drift caused by pure integral part in the traditional voltage model flux observer and amplitude and phase error when the first-order low-pass filter is introduced into the traditional voltage model flux observe and saturation threshold selection in the first-order low-pass filter saturated feedback link, this paper applied a compensation method based on orthogonal principle of the stator flux and back EMF in observing Induction motor rotor flux. We analyzed the principle of this new voltage model and derived the compensation algorithm due to the introduction of the amplitude and phase error with the low-pass filter. Simulation experiments verified the correction of the compensation algorithm, the application of this method in observing Induction motor rotor flux is right and effective. The induction motor vector control system had a good dynamic and steady state performance.

F-10

Extended Set-Membership Filter for Dynamic State Estimation in Power System

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Abstract This paper introduces an extended set-membership filter (ESMF) method in the field of power system state estimation, when the noises is unknown but bounded (UBB), this method can enhance the reliability and accuracy of estimation result. The method is based on a dynamic state model. ESMF is applied to this system. ESMF provides 100% confidence in the reliability and safety of the power system. In this paper, ESMF is derived and demonstrated through the IEEE 30 test system.

F-11

Circuit Fault Diagnosis Method of Wind Power Converter with Wavelet-DBN

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Abstract With the increasing wind capacity, the proportion of wind power in the grid is getting higher. Therefore, it is critical for the stable operation of the power grid to find out the location of the wind turbine failures. This paper proposes a fault diagnosis method of the wind turbine converter based on the deep belief network. Firstly, multiscale analysis of the signal is carried out by using wavelet transform to extract the characteristic vector of fault signal. DBN is used to obtain fault recognition models by supervised learning that uses the feature vector. Finally, the simulation results reveal that the method has a good ability to identify the converter fault.

G. 先进智能算法及其应用

G-1

Fault Diagnosis of Hoist Braking System Based on Improved Particle Swarm Optimization Algorithm

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Abstract Reliability of the mine hoist braking system is directly related to the safety of staff in the pit. For the sake of improving the accuracy of the fault diagnosis of the hoist braking system, a radial basis function (RBF) neural network diagnostic method based on improved particle swarm optimization (PSO) algorithm is proposed. Then, the hoist braking system fault diagnosis model is established, which uses some kinds of braking system fault characteristic parameters as input variables and adopts several kinds of main fault types as output ones. In view of the strong global convergence of the genetic algorithm (GA), the idea of crossover and mutation is introduced into PSO and the paper employs to optimize the parameters of hidden layer of RBF neural network. The simulation results show that the improved diagnosis strategy improves fault diagnostic speed and precision of the hoist braking system.

G-2

Average Weight Based Branching Heuristic Strategy for Satisfiability Solvers

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Abstract The number of clauses and the number of variables in real life are very huge for satisfiability problem. Branching heuristic strategy plays an important role in SAT, a solver based on conflict-driven clause-learning, which is completely. In other words, efficient branching heuristics are the key to solving the satisfiability problem quickly. In this paper, we propose a new

branching heuristic inspired by a bit-encoding phase selection policy used to improve Glucose 2.1 and exponential recent weighted average algorithm used to solve the bandit problem. The weight of the current clause is the weight of the new conflict clause plus the weight of the historical clauses. We let the weight of literal correspond to a binary value in each conflicting clause. Its advantage is the use of the weight of the historical clauses. The main idea of this strategy is to give priority to the literals in recent conflict clause, and also to use feedback information from historical clauses.

G-3

Approximate Solution for Three-Player Mixed-Zero-Sum Nonlinear Game via ADP Structure

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Abstract In this paper, a three-player mixed-zero-sum game situation with nonlinear dynamics is proposed, and an approximate dynamic programming (ADP) learning scheme is used to solve the proposed problem. First, the problem formulation is presented. A value function for player 1 and 2 nonzero-sum game is constructed, another value function for player 1 and 3 zero-sum game is presented for three-player nonlinear game system. Because of the difficulty to solve the nonlinear Hamilton-Jacobi (HJ) equation, the single-layer critic neural networks are used to approximate the optimal value functions. Then the approximated critic neural networks (NNs) are directly used to learn the optimal solutions for three-player mixed-zero-sum nonlinear game. A novel adaptive law with the estimation performance index is proposed to estimate the unknown coefficient vector. Finally, a simulation example is presented to illustrate the proposed methods.

G-4

An Evolution Perception Shape Creation Mechanism for 3D Shapes

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Abstract Making use of existing shapes to create creative shapes is a challenging problem in the field of 3D modeling. To resolve this problem, we change the problem of shape creation change into the shape evolution problem and an evolution perception 3D shape creation mechanism (EPSCM) is proposed. The core idea of EPSCM is fittest survive and genetic diversity. On the one hand, we present the shape evolutionary method based on the shape components, including crossover operation, the variant operation and the phagolysis operation, which could evolve diversity shape individuals under the condition of preserving shape functions. On the other hand, we design the evolution multiplication strategies, including structural constrains and fitness selection scheme, so as to further ensure the diversity and adaptability of EPSCM. Experimental results show that EPSCM could obtain novel and creative 3D shapes under the condition limited 3D shapes.

G-5

Optimization of the Water Supply System Based on an Adaptive Particle Swarm Algorithm

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Abstract The optimization of water supply pipe networks based on traditional particle swarm algorithm is easy to trap into local optimum and slow to converge the optimum. In this paper, an adaptive particle swarm optimization algorithm with variation (VAPSO) is proposed. The inertia weight is dynamically adjusted by particle swarm complexity, and the variation threshold is dynamically adjusted by single particle complexity. The experiment of water supply system with VAPSO shows that the proposed algorithm has faster convergence speed and a significant advantage in optimizing performance. It can reduce the network diameter cost effectively.

G-6

An Interpolation Method of Soil Erosion Based on Flexible Factor

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Abstract Interpolation is a model to estimate value of an unknown point with a set of known points. In order to get the value of the soil erosion with high precision, it is necessary to develop a high precision soil erosion interpolation method. The paper introduces an interpolation method based on Flexible Factor, called Flexible Factor Based Inverse Distance Weighting (FFBIDW) and two popular classic interpolation methods called Ordinary Kriging (OK) and Inverse Distance Weighting (IDW). Considering the precipitation's effect to the soil erosion, FFBIDW has more accurate result. FFBIDW will be checked by a series of experiments with Yunnan's soil erosion data and have a compare to OK and IDW using RMSE. The test results demonstrate FFBIDW's correctness and feasibility.

G-7

An Improved Particle Filter Algorithm Based on Swarm Intelligence Optimization

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Abstract Due to the problem of particle degene racy and loss of particle diversity in particle filter algorithm, this paper proposes an improved particle filter algorithm referring to some ideas of optimized algorithm like particle swarm and fire fly group. The proposed algorithm utilizes the fire fly algorithm to optimize particle filter and avoid re-sampling process; makes the particles move towards the location of better weight particles and prevents the small weight particles from disappearing after several iterations. Meanwhile, this algorithm sets a transition threshold and iteration times in order to improve the real-time property of the algorithm. Experimental results show that the improved algorithm possesses higher estimation accuracy and keeps good diversity of particle.

G-8

Corrosion Map Software System Based on Empirical Model

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Abstract Comprehensive understanding of corrosion intensity for material in atmosphere has an important significance for selecting equipments and designing material protecting schemes. In this paper, a Chinese visual corrosion map software is written by C#WinForm and SQL Server, it designs a transformation function that map corrosion categories and corrosion rates to gradient pseudo colors, which greatly improves the accuracy and sensitivity in displaying corrosion intensity. In order to establish corrosion map by a small amount of data, an empirical model that speculating the corrosion rates based on climatic and environment data is used to expand data. The software shows distribution of corrosion intensity in China with integrated database management capabilities, and will help researchers a lot who are in the field of corrosion.

G-9

A Hybrid Discrete Artificial Bee Colony Algorithm for Multi-objective Blocking Lot-Streaming Flow Shop Scheduling Problem

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Abstract A blocking lot-streaming flow shop (BLSFS) scheduling problem involves in splitting a job into several sublots and no capacity buffers with blocking between adjacent machines. It is of popularity in real-world applications but hard to be effectively solved in light of many constrains and complexities. Thus, the research on optimization algorithms for the BLSFS scheduling problem is relatively scarce. In view of this, we proposed a hybrid discrete artificial bee colony (HDABC) algorithm to tackle the BLSFS scheduling problem with two commonly used and

conflicting criteria, i.e., makespan and earliness time. We first presented three initialization strategies to enhance the quality of the initial population, and then developed two novel crossover operators by taking full of valuable information of non-dominated solutions to enhance the capabilities of HDABC in exploration. We applied the proposed algorithm to 16 instances and compared with three previous algorithms. The experimental results show that the proposed algorithm clearly outperforms these comparative algorithms.

G-10

Active Disturbance Rejection Twice Optimal Control for Time Delay System

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Abstract Time delay makes system control be a challenge. Twice optimal algorithm is an effective approach to address time delay. However, it needs model information of a system. In order to reduce its dependence on system model, active disturbance rejection control is adopted. With the help of extended state observer, uncertainties and disturbances are able to be estimated, and those uncertainties and disturbances can be compensated by control signal in real time. By combining active disturbance rejection control and twice optimal control, active disturbance rejection twice optimal control (ADRTOC) is proposed. Comparisons between ADRTOC and PI plus Smith predictor control have been presented. Numerical results confirm that ADRTOC has better performance.

G-11

Generating Test Data Covering Multiple Paths Using Genetic Algorithm Incorporating with Reducing Input Domain

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Abstract The problem of efficiently generating test data covering multiple paths was focused on this study, and a method of generating test data covering multiple paths using a genetic algorithm incorporating with reducing the input domain of a program was presented. In this method, all target paths are first divided into several groups based on the same independent sub-path, and the input variables corresponding to the independent sub-path are determined. Then, a multi-population genetic algorithm is used to generate test data to cover these target paths, each sub-population generating test data covering target paths belonging to the same group. During the evolution, the input variables corresponding to the traversed independent sub-path are remained fixed, and the ranges of crossover and mutation operations are reduced, leading to these sub-populations' search in a reduced input domain so that the efficiency of generating test data is improved.

G-12

Reasoning for Qualitative Path Without Initial Position in VAR-Space

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Abstract Qualitative path is a basic concept in qualitative motion reasoning. In this paper, we propose an algorithm for reasoning the qualitative path in Voronoi Adjacency-Relation Space. Different from the previous approach in which both the dynamic Voronoi edges and the initial position are required, our approach only needs the dynamic Voronoi edges. The basic idea is that the algorithm tracks all possible initial positions, gradually rules out the impossible situation and ultimately gets the correct path. Finally, experiments have been conducted and results show that the proposed algorithm is effective.

H. 时间序列分析与生物医学工程

H-1

EEG Multi-fractal De-trended Fluctuation Mental Stress Analysis

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Abstract In this paper, mental stress is evaluated by algorithm based on Multi-fractal De-trended Fluctuation Analysis. The key parameters of Multi-fractal De-trended Fluctuation Analysis that is singular index, Hurst index are discussed. Based on the optimal selection of the parameters, the EEG mental stress is evaluation based on EEG signal analyses. We record electroencephalogram (EEG) of 14 students and ensured the optimal order being [−5 5] via comparing the relationship between fractal indices and order, then achieved the estimate of mental stress with the β wave in EEG. The results show that Hurst index and quality index of the EEGs under mental stress are greater than those in the relaxing state, and with the increase of order, quality index is amplified and the variation of the singular index is more obvious while Hurst index decreases and tends a constant. We also compare the width of singular spectrum of the EEGs of different mental state, discovering that the features of multi-fractal spectrum of different states are different and the width of singular spectrum of the EEGs under mental stress are greater than the relax condition.

H-2

The Simulation of Neural Oscillations During Propofol Anesthesia Based on the FPGA Platform

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Abstract This paper focuses on the realization of the Pharmacokinetic (PK)-Jansen Rit neural mass model (JRNMM) for visualization neural oscillations and accelerating the calculations of complex model on hardware platform. Firstly, we set up a combined model named PK-JRNMM and produce simulated EEG-like (sEEG) signals in DSP-Builder. Then, the scheme of SOPC embedded platform is employed to reproduce the model function via Field Programmable Gate Array (FPGA). Finally, the sEEG signals can be achieved through the digital to analog conversion (DAC) and Liquid Crystal Display (LCD). The realization of this platform takes advantage of the parallel computing characteristics with FPGA processor. It will provide a new tool for the fast simulation and realization of the complex neural models in hardware platform.

H-3

The Development of a Brain-Controlled Lock Based on SSVEP and MI

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Abstract Ordinary locks, even fingerprint or iris locks are no longer as safe as they used to be. However, the brain-controlled lock can solve this problem because of different electroencephalogram (EEG) for different people. In this paper, the lock is controlled by a Brain–Computer Interface (BCI) system. The Motor Imagery (MI) procedures for EEG process are de-noising, feature extraction, and classification. And steady state visual evoked potential (SSVEP) can judge different frequencies by canonical correlation analysis (CCA) method. The BCI system with 2 parts, each for 9 targets, chooses which part of flickers by MI and frequencies as number codes by SSVEP. 3 subjects are tested on offline and online experiments. The developed BCI system performs well in experiments, and the average accuracy is 87%.

H-4

The Development of a Wheelchair Control Method based on sEMG Signals

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Abstract This paper proposed a control method of the electric wheelchair based on surface electromyography (sEMG) signals. In this method, a mapping between hand motions and control commands was established. When a certain kind of hand motion was recognized from sEMG signals, corresponding control would be applied in the wheelchair. The sEMG signals was as raw material for the pattern recognition type of classifier, which promoted the accuracy rate and robustness. The fusion features of Autoregressive (AR) model coefficient and root mean square ratio (RMSR) were used as features of data of hand motions. Support vector machine (SVM) as one of state-of-the-art supervised learning models, was used as classifier. Furthermore, comprehensive real-time simulation and control experiment were implemented. The accuracy rate of hand motions recognition in real-time reached 95% and the success rate of control experiment was up to 88%, which showed the proposed method was feasible and practical.

H-5

A Shallow-Dense Network Approach to Synchronization Pattern Classification of Multivariate Epileptic EEG

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Abstract A long-standing issue in the field of neuroscience is identifying evolving patterns from multivariate electroencephalography (EEG) signals superimposed with intensive noise. With insufficient prior knowledge, it becomes even more important to (1) accurately detect synchronization dynamics among data channels and (2) adaptively classify evolving patterns to better characterize the intrinsic nature of brain activities represented by the EEG. This study uses a shadow-dense network approach to solve these problems. The maximal information coefficient (MIC) method is extended to enable global synchronization measurement of all data channels embedded in the EEG. The global MIC measures are organized in time sequence to represent the evolving synchronization patterns. A shallow-dense neural network is designed to adaptively characterize the nonstationary patterns and then classify them. Experiments are performed to evaluate this approach over an epileptic EEG dataset. It is found that this approach can classify seizure states with accuracy, sensitivity, and specificity of 97.292%, 98.696%, and 96.116%,

respectively; these results are superior to those of most existing methods. The proposed approach achieves this performance without denoising the EEG; in contrast, denoising is essential in existing methods. Furthermore, the proposed approach requires only one hyperparameter, which avoids the potential errors caused by excessive parameter settings in existing methods.

H-6

Continuous Prediction of Joint Angle of Lower Limbs from sEMG Signals

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Abstract In order to realize the rehabilitation training of mirror movement in stroke patients, a new motion analysis method of EMG signal is proposed. First, surface electromyography (sEMG), hip joint and knee joint angles of 6 lower limb muscles are collected synchronously. Then, by introducing the coherence analysis and calculating the significant area index, the coupling relationship between the sEMG and the joint angle is quantitatively described, and the muscles of the most coupling relationship are set to the input channels of the model. Next, we introduce the least squares extreme learning machine algorithm based on golden section (GS-LSELM), and establish a nonlinear prediction model between sEMG and joint angle. Finally, the experimental results show that the proposed method can quickly build the model under different motion periods, and it could be used in the tracking control of the rehabilitation robot.

H-7

Effect of Parametric Variation of Center Frequency and Bandwidth of Morlet Wavelet Transform on Time-Frequency Analysis of Event-Related Potentials

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Abstract Time-frequency (TF) analysis of event-related potentials (ERPs) using Complex Morlet Wavelet Transform has been widely applied in cognitive neuroscience research. It has been widely suggested that the center frequency (fc) and bandwidth (σ) should be considered in defining the mother wavelet. However, the issue how parametric variation of fc and σ of Morlet wavelet transform exerts influence on ERPs time-frequency results has not been extensively discussed in previous research. The current study, through adopting the method of Complex Morlet Continuous Wavelet Transform (CMCWT), aims to investigate whether time-frequency results vary with different parametric settings of fc and σ. Besides, the nonnegative canonical polyadic decomposition (NCPD) is used to further confirm the differences manifested in time-frequency results. Results showed that different parametric settings may result in divergent time-frequency results, including the corresponding time-frequency representation (TFR) and topographical distribution. Furthermore, no similar components of interest were obtained from different TFR results by NCPD. The current research, through highlighting the importance of parametric setting in time-frequency analysis of ERP data, suggests that different parameters should be attempted in order to get optimal time-frequency results.

H-8

A Review of Retinal Vessel Segmentation and Artery/Vein Classifi cation

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Abstract The Fundus blood vessel is the only vascular system that can be observed noninvasively in the human body. Through the fundus photograph, we can get arterial and venous structures. Changes in the shape and size of blood vessels are important features for the diagnosis of diabetes, hypertension and other diseases. The segmentation of the blood vessels and the classification of arteries and veins are the basis for obtaining the characteristics and quantitative indicators. This paper discusses the research progress of retinal vessel segmentation and arteriovenous classification on the fundus images, and summarizes the research background, various methods along with advantages and disadvantages. It aims to guide the researchers to understand the research content and progress in this field, and to provide a comprehensive foundation for the follow-up research work.

H-9

Research and Application of Extracting Data Sampling Point from Time Series Database

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Abstract In order to solve the problem of extracting data points and displaying time curve of industrial process, the linear difference algorithm, median algorithm, maximum algorithm and minimum algorithm are proposed. The result shows that proposed algorithms can solve those problems and meet requirements of real-time data extraction in industry process. As a result, it has played a catalytic role for the application of time series database and the development of industrial process.

H-10

Quantitative Inspection of Shear MarkBased on Lyapunov Dimension

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Abstract Base on the analysis of the Lyapunov dimension that can be used to characterize the system dynamic status and the irregularity degree, and according to the nonlinear dynamic characteristics on surface profile of shearing marks, the analysis method on characteristics of shearing marks based on Lyapunov dimension is proposed. The collected surface profile curve of shearing marks is treated as the time series. The time series are reconstructed by phase space reconstruction theory. In order to make the reconstructed phase space fully reflect the system dynamic characteristics, the determination problem of time delay and embedding dimension are discussed. On above basis, the Lyapunov dimension is calculated, and the ratio of embedding dimension and the time delay multiplied by the Lyapunov dimension are taken as the characteristic quantity of the mark surface. It can be seen that the Lyapunov dimension and the characteristic

quantity of the mark surface are different according to the analysis and calculation of the Lyapunov dimension of the surface profile curve of the shearing marks. It is proved that the characteristic quantity is an effective parameter to characterize the surface profile of different shear marks. The characteristics of marks can be extracted and recognized effectively. Therefore the theoretical basis and technical method are provided for studying the surface characteristics of shearing marks.

I. 多智能体系统

I-1

Decision Making in Multi-agent Systems Based on the Evolutionary Game with Switching Probabilities

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Abstract Much attention has been paid on exploring the solutions for cooperative dilemma in multi-agent systems. Thereinto, the evolutionary game theory which describes cooperative dilemma is seen as an effective approach. Notably, many of previous works are based on the ideal hypothesis that individuals can feasibly obtain their neighbours' payoffs to update strategies. Considering the difficulty of getting the exact information about payoffs, we propose the switching probabilities between strategies which do not require the payoffs. Here the evolutionary dynamics driven by the switching probabilities in a three-strategy game model is established. Results show that the steady state of the gaming system is closely related with the switching probability matrix. These findings give a novel account about the decision making process in the gaming systems, when a strategy updating rule weakening the ideal assumption about payoffs is established.

I-2

Event-Triggered Control for Multi-agent System with a Smart Leader

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Abstract This paper studies the consensus problem of the leader-following system. First of all, we propose a new kind of leader, smart leader, by adding the velocity states of the followers to the leader's control algorithm. We also use the event-triggered control to make the leader only use the feedback at necessary time. Then a distributed control law for both the leader and followers is designed. Compared with the multi-agent system with traditional leader, the system with a smart leader can reach the consensus more quickly, smoothly and have a smaller control energy consumption. Moreover, we propose a suffcient condition which can ensure the system can reach the consensus. Finally, some simulation examples are presented for illustration.

I-3

Fixed-Time Consensue-Based Scheme for Economic Dispatch of Smart Grid

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Abstract In this paper, we introduce a new economic dispatch strategy to solve the energy management problem in a smart grid which is a distributed and cooperative method. Different from the existing works, this paper aims to achieve the optimization in a settling time. The balance between supply and demand constraint can be kept during the computing time. Then, it is demonstrated that the total cost can reach it's minimal value in the settling time with initial values satisfied the balance constraint. Finally, we verify the effectiveness of the theoretical result with a numerical simulation

I-4

Bipartite Containment Control of Nonlinear Multi-agent Systems with Input Saturation

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Abstract This paper considers the bipartite containment problem for nonlinear multi-agent systems with multiple leaders over a signed directed graph. Each follower's dynamic is taken as a strict-feedback form with unknown nonlinearity and input saturation. A distributed adaptive control law is designed and analyzed. A simulation example demonstrates the proposed control algorithm.

I-5

Algebraic Criteria for Consensus Problems of Signed Directed Networks

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Abstract This paper proposes some algebraic criteria for consensus problems and structure of signed networks whose interactions among agents are denoted by singed digraphs. Firstly, we develop a new method to obtain the left eigenvector of the Laplacian matrix associated with zero eigenvalue. With the left eigenvector, auxiliary vector is constructed and correlated with the connectivity of signed digraph. Finally, sufficient and necessary algebraic criteria for consensus problems and structure of signed graphs are provided based on auxiliary vector. Numerical instances are presented to verify the theoretical results.

I-6

Distributed Adaptive Control for Consensus of Unknown Nonlinear Multi-agent Systems

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Abstract This paper is concerned with consensus problem of multi-agent systems. Assuming that the communication among distinct agents in the entire group can be represented by a digraph structure, a distributed adaptive control protocol is presented to solve the leader-follower consensus problems for multi-agent systems having non-identical unknown nonlinear dynamics and uncertain disturbance. The proposed protocol is distributed because each agent's control protocol only utilizes the information of it's neighbor agents. In addition, the adaptive updating law for neural networks determined by projection method. It is shown that with our proposed protocol, all the consensus errors converge to zero asymptotically.

I-7

Consensus of Mixed-Order Multi-agent Systems with Directed Topology

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Abstract In this paper, an in-depth study about the consensus problem of mixed-order multi-agent system with directed topology is performed. Specifically, this system is composed of two classes of agents respectively described by first-order and second-order dynamics. By the aid of state transformation, two different methods are proposed to solve the consensus. Still, two meaningful examples are provided to verify the effectiveness of the gained theoretical results. This paper is expected to establish a more realistic model and provide effective measures to solve the consensus problem.

I-8

Event-Triggered Consensus Control for Linear Multi-agent Systems Using Output Feedback

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Abstract This paper studies the event-triggered consensus problem of multi-agent systems with general linear dynamics. To be specific, an observer-based event-triggered control protocol is proposed using the local output feedback information. It is proved that the multi-agent system reaches consensus under the proposed protocol, and the gain matrices of the protocol can be determined by solving a group of LMIs. In the end, a simulation example is given to verify the theoretical results.

I-9

Following Consensus in Multi-vehicle Systems with Chain and Ring Coupling

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Abstract This paper investigates coordinated control problem of multi-vehicle systems by the use of the vehicle-following models with optimal velocity function. A concept of following consensus for multi-vehicle systems is first introduced, and two following consensus protocols for two topology cases of chain and ring coupling are then proposed, respectively. It is shown that the multi-vehicle systems with chain coupling are more easy to achieve the following consensus compared with the case of ring coupling. Subsequently, simulation examples illustrate and visualize the effectiveness and feasibility of the theoretical results.

I-10

Hierarchical Consensus Algorithm of Multi-agent System Based on Node-Contribution-Based Community Decomposition

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Abstract To improve the convergence speed of multi-agent system, a hierarchical consensus algorithm based on community decomposition is proposed. Considering converting the single-layer consensus problem to multi-layers consensus problem, the topology graph is divided into several sub-graphs by utilizing community decomposition algorithm based on node contribution firstly, and the sub-graphs achieve consensus respectively. And then apply the hierarchical decomposition consistency algorithm to the system. The convergence speed of the multi-agent system is improved significantly by optimizing the topology on the premise of maintaining the original topology constraints. For the first-order linear system, the effectiveness of this algorithm is demonstrated by simulations compared with the standard model.

I-11

Adaptive Tracking a Linear System with Unknown Periodic Signal in Multi-agent Systems

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Abstract This paper studies the tracking control problem of multi-agent systems where each agent has homogeneous sensor and heterogeneous dynamic system, the moving target has unknown periodic input signal and the unknown periodic input can be modelled as a finite dimensional Fourier decomposition. Since some agents cannot detect the target, a distributed estimation based tracking control algorithm is applied. We first design a consensus based distributed observer to estimate the state and the unknown periodic input of the system from the available measurement outputs. Leader-follower consensus protocol is applied, and the stability condition of the estimation errors is given. Then, based on the estimations, a model reference adaptive control (MRAC) algorithm is adopted to design the tracking controller. It is proved that under the proposed distributed estimation based tracking control algorithm, each agent can asymptotically track the target. A numerical simulation is given to prove the feasibility of the algorithm in this paper.

J. 机器人控制

J-1

Adaptive Controller for Flexible-Joint Robot

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Abstract An adaptive controller is proposed for flexible-joint robot subject to parameter uncertainties. The backstepping control framework has been used to obtain the virtual controller and the actual control input. Besides, the derived controller is based on non-certainty-equivalent adaptive control methodology. A set of twoorder filters are also embedded into the corresponding attractive manifold design. It is proved that the position of flexible-joint robot can stabilize towards the desired position, and moreover the estimate of uncertain parameters can converge to the real values to some degrees.

J-2

A 3D Reconstruction Method Based on the Combination of the ICP and Artificial Potential Field Algorithm

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Abstract For real-time and accurate three-dimensional (3D) reconstruction during autonomous mobile robot navigation, a method based on the combination of iterative closest points (ICP) and artificial potential field algorithm (APF) is proposed. In real-time path planning, the mobile robot uses the artificial potential field method to obtain the environment point-cloud image by Kinect. Then, the combination of the improved ICP method and the initial transformation matrix is applied to complete the 3D reconstruction. The experimental results show that the proposed algorithm is

more efficient than normal distributions transform (NDT) and the traditional three-dimensional ICP method.

J-3

Modeling and Dynamic Characteristic Analysis of Flexible Manipulator

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Abstract The dynamic model of the flexible link manipulators (FLMs) is established and dynamic characteristic is analyzed in the paper. First, in order to improve the accuracy of the system, the model of the FLMs is constructed based on the assumed mode method with boundary conditions; second, the natural frequency and vibration mode functions are analyzed in detail. The residual vibration of the loaded flexible arm tip is derived. A simple controller is adopted to inhibit vibration. This research has provided a foundation for refinement of the FLMs model and for the active control of the vibration analysis, which possess a high practical value in engineering.

J-4

State Feedback Stabilization of Stochastic Non-holonomic Mobile Robots under Arbitrary Switchings

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Abstract This work is aimed at the stabilization problem of stochastic nonholonmic mobile robots under arbitrary switchings. The model of stochastic nonholonomic mobile robots under arbitrary switching is given. Based on this model, state feedback controllers and switching control strategy are given. Furthermore, the system states are asymptotically stabilized at the zero equilibrium point in probability. Finally, the efficiency of controllers is demonstrated by a numerical example.

J-5

Adaptive Tracking Control of a Single-Link Flexible Robotic Manipulator System with Unmodeled Dynamics and Motion Constraint

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Abstract This paper studies the tracking control problem of a single-link flexible robotic manipulator system with unmodeled dynamics and motion constraint. A dynamic surface control scheme is proposed to design the adaptive controller ensuring both desired tracking performance and constraint satisfaction. A virtual state observer is constructed to estimate the unmeasured state signals. The RBF NNs are used to approximate unknown functions. Dynamic signal and nonlinear mapping are introduced to deal with the dynamic uncertainties and solve motion constraint problem, respectively. A simulation study is presented to verify the effectiveness of the proposed control approach.

J-6

Improved Biogeography-Based Optimization Algorithm for Mobile Robot Path Planning

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Abstract In view of biogeography-based optimization algorithm has the disadvantages of application limitations and slow convergence speed when in solving the problem of mobile robot path planning. This paper proposes an improved biogeography-based optimization algorithm, which is used to solve the global path planning of mobile robot in static environment. In the proposed algorithm, the navigation point model is selected as the working area model of mobile robot, and the nonlinear migration model and mutation mechanism with the elite retention mechanism are introduced to the biogeography-based optimization algorithm to improve its performance. Simulation proves the feasibility and the effectiveness of the proposed path planning algorithm.

J-7

A New Localization System for Tracking Capsule Endoscope Robot Based on Digital 3-Axis Magnetic Sensors Array

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Abstract This paper proposes a new magnetic localization system for capsule endoscope robot which works wirelessly in the human body by using a 4 × 4 sensors array, composed by the latest digital magnetic sensors, QMC5883L. In order to locate a capsule effectively and non-invasively, we apply the static magnetic field method by enclosing a small cylindrical permanent magnet in the capsule. The position and orientation of the permanent magnet are related to its magnetic signals like field intensity and direction which can be measured by the sensors array outside the human body. The relations between the magnet and its signals can also be formulated by equations, as a cylindrical permanent magnet can be considered as a magnetic dipole model. In Matlab, we can approach the equations for parameters containing location information by using non-linear least squares algorithm with Levenberg-Marquardt optimization method. The experimental results show that accuracy is well controlled and the digital sensors are applicable for the tracking systems.

J-8

The Design and Realization of Control System for a Two Degree of Freedom Parallel Manipulator

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Abstract With the development of Computer numerical control (CNC) technology, motion control is widely used in many fields of our life. There are more and more demands on the accuracy, short

distance transportation, and operation of small materials. Manipulator control can not only ensure the accuracy, stability and speed, but also relief the people from the harsh, tedious and hard work. Besides, it ensures the safety of people and improves the efficiency of the work simultaneously. In this paper, the control system of a two degree of freedom parallel manipulator is designed. Finally, manipulator is controlled to move arbitrarily, according to its dynamic model.

J-9

System and Walking Gait Design for Hexapod Search and Rescue Robot

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Abstract In order to adapt to the complex disaster environment, this paper considers the system design of hexapod search and rescue robot. Such hexapod robot is suitable to different kinds of roads and obstacle, which can avoid to the shortcomings of crawler robots. This hexapod search and rescue robot includes the six foot body, voice modular, obstacle avoidance and remote monitoring function. Based on the relationship between the center of gravity and the supporting polygon, the design of the hexagon robot's walking gait is presented. The feasibility of the hexapod search and rescue robot is verified by the prototype experiment.

K. 控制理论前沿与应用

K-1

Design and Simulation of Fuzzy PID Controller Based on Variable Output Domain of Discourse

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Abstract The traditional variable domain of discourse fuzzy PID controller has complex structure and difficulty of expansion factor designing. This paper puts forward a new variable output domain of discourse fuzzy PID controller, and designs a new type of function expansion factor. The new variable output domain of discourse fuzzy PID controller only needs to adjust the output domain of the fuzzy controller according to the error, and not changing the input domain of the fuzzy controller. The structure of the new variable domain of discourse fuzzy PID controller is simpler and the control precision is more accurate compared with the new one. The new function expansion factor is smaller, which further improves the real-time performance of the controller. The simulation is constructed based on the platform of MATLAB. The results show that the variable domain of discourse fuzzy PID controller has better real-time, robustness and anti-jamming ability.

K-2

A Robust Fast Type-2 Fuzzy Induction Control System

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Abstract Vector control system for induction motor decouples current by coordinate transformation, in order to gain a wide range of speed regulation. This flux orientation control system is sensitive to the parameters of rotor in induction motor, results in poor robustness. While the Type-2 fuzzy logic, developed from type-1 fuzzy logic, is preferable for resolving the problem about uncertainty of parameters. The adoption of type-2 fuzzy logic in the field of Vector control system for induction motor is a promising approach to resolve the problem about the poor robust result from the change of rotor parameters in induction motor control system. However, due to its high complexity and the need for large amount of calculation, type-2 fuzzy logic is not applied well in real-time system like induction motor control system. In this article, a type-2 fuzzy induction motor is designed through a novel IEKM type reduction algorithm. Besides, a simplified vector control system for fast type-2 induction motor is designed based on the Column pivot element SVD-QR algorithm. The effectiveness of this system is confirmed by simulation and the test result.

K-3

Attribute Reduction of Preference Linguistic-Valued Decision Information Systems

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Abstract Dominance-based linguistic-valued information systems have attracted much attention in practical applications in which more information can be provided and employed than real-valued information systems. This paper proposes an approach to attribute reduction of dominance-based linguistic-valued decision information systems. All linguistic-values are represented by trapezoidal fuzzy numbers and a new fuzzy dominance relation is constructed to characterize the degree of one fuzzy number dominating another. Based on the presented fuzzy dominance relation, a model of dominance fuzzy rough set is developed and its properties are investigated. A way to measure attributes significance is established by introducing new fuzzy entropy. Comparative experiments are conducted to verify the effectiveness of the proposed model.

K-4

Sliding Mode Based He'non Mapping Control

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Abstract A new control strategy based on discrete-time variable structure systems theory is proposed to target the He'non mapping. This method enables the asymptotical stability of the control with uncertain discrete-time environments. Under auspices of the new designing strategy, the states of the system can reach the sliding manifold without chattering and converge exponentially to the zero states, in spite of the matched and mismatched perturbations. The efficacy of the suggested scheme was illustrated with the well-known He'non mapping, and results shown that it can be a promising candidate strategy to the other complex systems.

K-5

An Adaptive Finite Time Control for the Electrical Drive with Elastic Coupling

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1. An Adaptive Finite Time Control for the Electrical Drive with Elastic Coupling

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Abstract In this paper, a novel adaptive nonsingular terminal sliding mode control (ANTSMC) based parameter estimation is developed for servo system with unknown system parameters. An auxiliary filter variable is employed to derive parameter estimation error information without measuring the acceleration. The estimation error is used as new leakage term in parameter update law. The key idea of the proposed parameter estimation scheme is that a sliding mode technique is introduced to ensure the finite time convergence of the estimation error in the presence of persistent excitation (PE). Moreover, an adaptive observer is designed to estimate the unmeasured state variables. Then, an adaptive nonsingular terminal sliding mode controller is designed for the servo system to achieve high performance tracking control. Finally, simulation results are used to illustrate the effectiveness of the proposed control method.

K-6

Synchronous Control of Multi-motor Driving Servo Systems

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Abstract A nonlinear continuous predictive control method based on sliding mode is proposed to realize the synchronous control of multi-motor driving servo systems. The continuous-time recursive least-squares algorithm with forgetting factor is developed to estimate the disturbance and the unknown parameters, which compensates the influence of noise and guarantees that the parameter estimation converges to the true values. The continuous prediction control law is improved by using the sliding mode variable structure scheme, which ensures the rapid synchronization of the motors and deals with the problem of model uncertainty. The simulation results are presented to demonstrate the effectiveness of the method.

K-7

Fault Detection and Diagnosis for Servo Systems with Backlash

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Abstract This paper is concerned with the fault detection and diagnosis problem for the single motor servo systems. The continuous-time nonlinear servo system with disturbance, actuator fault and backlash is modeled. An observer based on radial basis function neural network is constructed to approximate the unknown backlash nonlinear, and a threshold is computed to detect the occurrence of fault. Then, another radial basis function neural network is provided to identify the fault information after a fault occurs. Finally, simulation results show the effectiveness and applicability of the proposed method.

K-8

Global Adaptive Tracking for Multivariable Nonlinear Systems with Unknown Control Direction

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Abstract For a class of multivariable nonlinear systems with unknown control direction, the adaptive backstepping method is utilized to handle the parameter uncertainties in this paper. A new switching mechanism based on the monitoring functions (MFs) is proposed to address the control direction uncertainty. The proposed method guarantees the boundedness of the tracking error with the prescribed performance and globally makes it evolve to zero eventually. Finally, a simulation result is demonstrated to show the effectiveness of the approach.

K-9

New Progress on Research of Weighted Multiple Model Adaptive Control

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Abstract This paper is concerned with the stability of weighted multiple model adaptive control (WMMAC) system, which is a long-standing issue in the field of robust adaptive control. First, a new weighting algorithm is proposed with assured convergence under smooth conditions. Second, based on virtual equivalent system methodology, the stability results of WMMAC system for both linear time-invariant (LTI) and parameter jump linear plants are presented. The analysis method is independent of specific local control strategy and specific weighting algorithm.

K-10

New Methods for Utilization of Predictive Information in Neural Network PID Controller

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Abstract In this paper, we analyze the utilization of predictive information in neural network PID controller (NN-PID). Based on the accuracy of predictive model, two novel methods are proposed to improve control performance. When predictive model is high-accuracy, two-step ahead predictive information is incorporated into loss function to adjust the weight of NN. When the predictive model is low-accuracy, only one-step ahead information is used and learning rate is adjusted based on the prediction error. Consequential simulation are conducted with each method.

K-11

Unknown Dynamic Estimator Based Control for Hydraulic Servo Systems

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Abstract This paper investigates precise tracking control for a class of high-order hydraulic servo systems. For modeling of servo systems, the unknown nonlinearities of the hydraulic actuator and valve that may decrease the tracking performance and system stability are taken into account and then addressed via an unknown dynamic estimator with a simple structure and fewer tuning parameters. A recursive control design procedure is developed to achieve precise position tracking, where the calculations of the derivatives of the virtual control laws in traditional backstepping are remedied. The suggested controller guarantees that both the estimation error and tracking error will converge to a small set around zero. Simulation results are provided to verify the effectiveness of the proposed control strategy.

K-12

Neural Network Adaptive Control for Hysteresis Hammerstein System

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Abstract An adaptive neural network (NN) controller is investigated for Hammerstein system with Prandtl-Ishlinskii (PI) hysteresis dynamics. The high order neural network (HONN) is applied with a new filter to performance control the system and the unknown hysteresis parameters is estimated by adaptive law. The stability of the proposed closed-loop adaptive NN control system is proved by using Lyapunov function. Finally, simulation results verify the effectiveness of the proposed adaptive controller.

K-13

Synchronization of Discrete-Time Delayed Neural Networks with Stochastic Missing Data: A Switching Method

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Abstract This paper deals with the problem of synchronization of discrete-time delayed neural networks subject to stochastic missing data. The aim of the addressed problem is to design a feedback controller for the error system, such that under unreliable communication links, the error system is guaranteed to be globally asymptotic stable. By adopting the switching techniques and constructing the corresponding Lyapunov-Krasovskii functionals, sufficient condition is established for the existence of the desired controller. The obtained criterion is in terms of LMIs which can be solved by using Matlab Toolbox. Finally, numerical example is given to show the effectiveness of the proposed method.

K-14

Stability Analysis for a Class of Caputo Fractional Time-Varying Systems with Nonlinear Dynamics

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Abstract This paper investigates mainly stability problem of equilibrium points for a class of Caputo fractional time-varying systems with nonlinear dynamics. By employing Gronwall-Bellman's inequality, Laplace transform and estimates of Mittag-Leffler functions, when the fractional-order belongs to the interval (0, 2), several stability criterions for fractional time-varying system described by Caputo's definition are presented. Besides, some problems about the stability of fractional time-varying systems in existing literatures are pointed out. Finally, an example and corresponding numerical simulations are presented to show the validity and feasibility of the proposed stability criterions.

K-15

Exponential Stability of Switched Stochastic Systems with Multiple ADT Switching

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Abstract This paper addresses the mean square exponential stability of switched stochastic Itô linear systems. By use of *H*-representation method and modedependent average dwell-time (MDADT) switching, a new stability criterion is presented for the considered models. It is shown that even if all its subsystems are essentially unstable, a set of appropriately designed MDADT switchings can guarantee the switched stochastic system to be exponentially stable in mean square. An illustrative example is supplied to show the effectiveness of the obtained results.

K-16

Linear Active Disturbance Rejection Control for Piezo-Fexural Nanopositioning Stage

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Abstract Piezoelectric actuators are commonly used in nanopositioning stages. Due to the hysteresis of piezoelectric actuator, accurate position control of a nanopositioning system is always a challenging task. In this paper, linear active disturbance rejection control (LADRC) is designed to address hysteresis. With the help of extended state observer, hysteresis can be estimated, and it can be compensated by control signal in real time. Simulation results confirm LADRC is able to eliminate hysteresis and improve positioning precision.

K-17

Linear Active Disturbance Rejection Control for Nanopositioning System by ITAE Optimal Tuning Approach

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Abstract Nano-positioning systems with piezoelectric actuators are widely used. However, hysteresis, a common phenomenon in piezoelectric material, makes the control of nano-positioning system be a challenge. A simple and effective approach to deal with hysteresis is necessary. In this paper, both hysteresis and other disturbances are regarded as total disturbance, and linear active disturbance rejection control (LADRC) is utilized. With the help of extended state observer (ESO), total disturbance can be estimated and it can be compensated by control signal in real time. Integral of time-multiplied absolute-value of error (ITAE) optimal bandwidth parameterization approach is utilized to determine the parameters of LADRC. Numerical results are presented to confirm LADRC and its tuning approach.

L. 其他

L-1

A 3D Printing Task Packing Algorithm Based on Rectangle Packing in Cloud Manufacturin

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Abstract In Cloud Manufacturing environment, massive 3D Printing services in various types provide users with the ability of mass customization. The large number of 3D printing tasks bring more challenges on printing task scheduling to improve 3D printers' utilization and thus saving time and materials. This paper establishes the model of 3D printing process in different types and figures out the existence of auxiliary processes. Aiming at decreasing the ratio of auxiliary process time consumption, this paper develops an algorithm derived from the rectangle packing problem to pack printing tasks whose model size are relatively small into one task and print them all in one 3D printing process. Experiments show that the ratio of auxiliary process time consumption significantly reduced by this algorithm.

L-2

A Practical Approach for Test Equipment Perception and Virtualization in Cloud Manufacturing

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Abstract As an advanced manufacturing paradigm, Cloud Manufacturing provides a new way to solve the problems in the testing process. In cloud manufacturing, resource perception and resource virtualization are the foundation of building an actual service platform. According to the characteristic of test equipment, a practical approach for test equipment perception and virtualization is proposed, which is based on cloud computing, Automatic Test Markup Language (ATML) description and data mapping. A test service platform prototype is given to validate the feasibility of this approach.

L-3

Iron Ore Sintering Subsection Temperature Model on the Airflow Rate by PID Control

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Abstract Sintering is a complicated process in which the sintered ores are produced for the blast furnace. In this paper, a subsection temperature model on airflow rate is proposed to explain the effect of the airflow rate on the sinter bed temperature. Furthermore, the sintering process control strategy is put forward applying PID algorithm based on the optimization of airflow rate. The sintering process is divided into 24 stages to track the sinter bed temperature. Experimental results show that the airflow quantity is sufficient for the coke combustion and remarkable effects can be achieved on the electricity consumption saving of the main exhaust fan which is up to 32.6%.

L-4

Simulation and Study of the Incinerator's Combustion Control System

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Abstract This paper introduces two modeling methods of the incinerator's combustion control system. Aiming at the features of the control system which apply to the incinerator's combustion system, this paper uses the techniques of system identification which are based on the least square method and the neural network, introduces two ways of model identification in the incinerator's combustion control system, then they can be helpful for the following design of the control system. By simulating the model of the incinerator's combustion control system, desired results can be obtained for following the track of the main control target-temperature.

L-5

Analysis on Time Triggered Flexible Scheduling With Safety-Critical System

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Abstract Time triggered Network communication technology has been applied to the China's next generation multi-purpose complex Aerospace Vehicle. This vehicle is based on the technology in the system satisfy safety critical communication need, and can also take into account other large amount of data of low priority communication tasks. In this paper, combined with the actual characteristics of aerospace vehicle's mission requirements, according to the study of the key security information system level scheduling method based on this technology, a global optimal requirement decomposition and message scheduling algorithm based on automatic planning is proposed. The automatic generation algorithm of message scheduling table according to the system message transmission needs, and to meet the needs of key safety messages in the table does not meet the labeling and suggestions, providing the basis for the design of aircraft overall communication timing and strategy. Matlab/Simulink is used to modeling, simulating and

verifying the algorithm. The simulation results meet the requirements of the communication design of the aircraft system

L-6

Simulation of Wind Farm Scheduling Algorithm Based on Predictive Model Control

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Abstract In this paper, a simulation study is carried out on the coordinated active and reactive dispatch of wind farm based on Model Predictive Control (MPC). Compared with the traditional scheduling algorithm, this method combines the active and reactive scheduling, and balances the active and reactive target by changing the weight coefficients of the cost functions. The proposed control method can not only track the scheduling instructions accurately and smoothly, but also can make fluctuations of bus' voltage in the wind farm stable. Therefore the anti-perturbation capability of wind farm system is improve. A simulation model is built in MATLAB/SIMULINK environment, and the results show that the MPC is effective for wind power dispatch.

L-7

Pulp Concentration Control based on Dynamic Matrix Control

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Abstract In the papermaking industry, the stability of the pulp concentration determines the quality of the paper. However, the change of the pulp concentration is in a state of fluctuation for a long time and the pulp concentration control system has the characteristics of large lag, non-linearity and time-varying. It is difficult to achieve the desired control effect by using the traditional PID controller in the concentration control process. Therefore, use of dynamic matrix control algorithm to design the controller can solve the problem of disturbance and modeling

complexity. In this paper, dynamic matrix control algorithm and PID control simulation results show that the dynamic matrix control algorithm has better control quality. The output satisfies the constraint limit with higher probability, and the output constraints and performance index can be met.

L-8

IMA System Overall Fault Management Method Research Based on ASAAC Architecture

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Abstract This paper describes the architecture of the integrated modular avionics (IMA) system; summarizes the various fault management functions; and proposes an extended layered IMA system overall fault management architecture combined with fault prognosis and fault handling functions based on the European allied standard avionics architecture council (ASAAC) standards. The logic process for each level of overall fault management and the implementation method of the overall fault management of IMA system are given.

L-9

Analysis of the Fluid Approximation of Stochastic Process Algebra Models

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Abstract With the advent of the Internet of Things (IoT) as a major force of change in industry, Cyber Physical Systems (CPS) is right for building the concept smart Environment. In CPS, the internal computational and physical elements generally interact, reflect and influence each other in

order to obtain and analyze human behaviors and their social activities, finally to help them facilitate experiences. Nevertheless, the system complexity and scale become challenges of discrete state modelling formalisms especially in the capability issue. For the stochastic process algebra, performance evaluation process algebra (PEPA), a fluid approximation approach dealing with this problem has been developed, which approximates the continuous time Markov chain underlying a model using ordinary differential equations (ODEs). This paper establishes some basic properties for the ODE based approximation, e.g., uniqueness, existence and boundedness of ODE solutions. Our research in particular presents a convergence of the solutions for nonsynchronised models.

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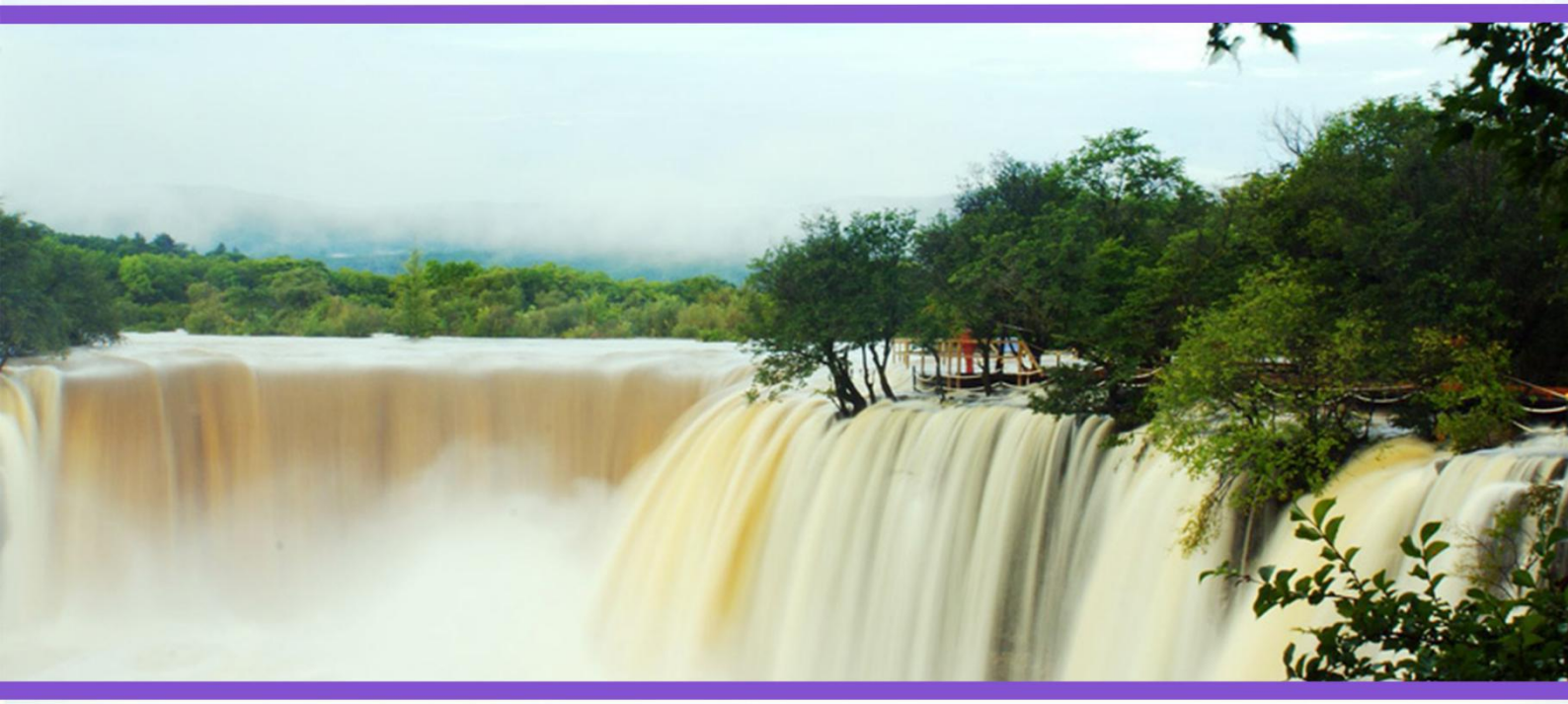

SOCIETY OF INTELLIGENT AEROSPACE SYSTEMS

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