

## 目 次

- 人工势场和虚拟领航者结合的多智能体编队  
..... 曲成刚, 曹喜滨, 张泽旭 ( 1 )
- 在轨服务航天器任意轨道主动绕飞  
..... 王 峰, 陈雪芹, 曹喜滨, 耿云海 ( 6 )
- 压电混合约束层阻尼梁结构的振动控制  
..... 李明明, 方 勃, 谭立军, 张洁洁, 唐 冶, 黄文虎 ( 11 )
- 无线电能传输系统驱动源负载网络分析  
..... 李 阳, 朱春波, 宋 凯, 魏 国, 逯仁贵, 徐石明 ( 18 )
- 平板磁芯磁耦合谐振式无线电能传输技术  
..... 郭 尧, 朱春波, 宋 凯, 魏 国, 逯仁贵, 徐石明 ( 23 )
- 超精密机床研究现状与展望  
..... 梁迎春, 陈国达, 孙雅洲, 陈家轩, 陈万群, 于 楠 ( 28 )
- 螺栓连接层合板结构失效模式多尺度数值分析  
..... 刘长喜, 周振功, 张博明, 唐占文, 王晓宏 ( 40 )
- 一种复合材料桁架的制备及弯曲承载性能分析  
..... 熊 波, 林国昌, 张印桐, 罗锡林, 谭惠丰 ( 46 )
- 软件测试资源与成本管控和最优发布策略  
..... 张 策, 崔 刚, 刘宏伟, 孟凡超, 傅忠传 ( 51 )
- GPS/INS 组合导航的变分贝叶斯自适应卡尔曼滤波  
..... 沈 忱, 徐定杰, 沈 锋, 蔡佳楠 ( 59 )
- 双目立体视觉的无人机位姿估计算法及验证  
..... 张 梁, 徐锦法, 夏青元 ( 66 )
- 双模式双三角锥滚动机构设计与运动分析  
..... 李晔卓, 田耀斌, 姚燕安 ( 73 )

H.264/AVC 网络视频的丢包失真评估	刘河潮, 常义林, 陈玉峰 ( 81 )
无线传感器网络能效模型的量化评价与优化	蒋文贤, 程 光 ( 87 )
驾驶员疲劳检测技术的算法设计与硬件实现	姜思羽, 吴 斌, 邱少健, 羊梅君 ( 95 )
供应链弹性综合优化路径选择模型分析	刘家国, 周粤湘, 李 俊, 赵金楼 (101)
自校正控制的虚拟等价系统理论	张维存 (107)
自适应选取聚类中心 K-means 航迹起始算法	宫峰勋, 戴丽华, 马艳秋 (113)
采用拥挤收费的机场时刻管理多用户双层规划模型	王 琨, 朱金福, 高 强 (120)
不完全信息竞价模型在无线电频谱配置的应用	刘伟华, 石文华 (125)

# Journal of Harbin Institute of Technology

Vol.46 No.5 2014-05-30

## CONTENTS

- Multi-agent system formation integrating virtual leaders into artificial potentials  
..... *QU Chenggang, CAO Xibin, ZHANG Zexu* ( 1 )
- The initiative flyaround of on-orbit-servicing spacecraft in-any-plane  
..... *WANG Feng, CHEN Xueqin, CAO Xibin, GENG Yunhai* ( 6 )
- Vibration control of beams with piezoelectric hybrid constrained layer damping treatments  
..... *LI Mingming, FANG Bo, TAN Lijun, ZHANG Jiejie, TANG Ye, HUANG Wenhui* ( 11 )
- Analysis of load network on wireless energy transfer  
..... *LI Yang, ZHU Chunbo, SONG Kai, WEI Guo, LU Rengui, XU Shiming* ( 18 )
- Magnetic resonant wireless power transmission technology based on planar core  
..... *GUO Yao, ZHU Chunbo, SONG Kai, WEI Guo, LU Rengui, XU Shiming* ( 23 )
- Research status and outlook of ultra-precision machine tool  
..... *LIANG Yingchun, CHEN Guoda, SUN Yazhou, CHEN Jiaxuan, CHEN Wanqun, YU Nan* ( 28 )
- Multi-scale numerical analysis for the failure modes of pin-load composite laminate  
..... *LIU Changxi, ZHOU Zhengong, ZHANG Boming, TANG Zhanwen, WANG Xiaohong* ( 40 )
- Fabrication and bending bearing capacity analysis of an integrated manufacturing composite truss  
..... *XIONG Bo, LIN Guochang, ZHANG Yintong, LUO Xilin, TAN Huifeng* ( 46 )
- Software test resources and cost control and optimal release policy  
..... *ZHANG Ce, CUI Gang, LIU Hongwei, MENG Fanchao, FU Zhongchuan* ( 51 )
- Variational bayesian adaptive Kalman filtering for GPS/INS integrated navigation  
..... *SHEN Chen, XU Dingjie, SHEN Feng, CAI Jianan*( 59 )
- Pose estimation algorithm and verification based on binocular stereo vision for unmanned aerial vehicle  
..... *ZHANG Liang, XU Jinfa, XIA Qingyuan* ( 66 )
- Locomotion analysis and design of a triangular bipyramid rolling mechanism with two modes  
..... *LI Yezhuo, TIAN Yaobin, YAO Yanan* ( 73 )

H.264/AVC video quality assessment over IP network based on packet loss  
..... *LIU Hechao, CHANG Yilin, CHEN Yufeng* ( 81 )

Optimization and quantitative evaluation mechanism of energy efficiency model on wireless sensor networks  
..... *JIANG Wenxian, CHENG Guang* ( 87 )

Algorithm design and hardware implementation of driver fatigue monitoring  
..... *JIANG Siyu, WU Bin, QIU Shaojian, YANG Meijun* ( 95 )

A comprehensive optimization path selection model of supply chain resilience  
..... *LIU Jiaguo, ZHOU Yuexiang, LI Jun, ZHAO Jinlou* (101)

Virtual equivalent system theory for self-tuning control  
..... *ZHANG Weicun* (107)

Algorithm of multi-radar multi-target track initiation based on adaptive K-means clustering  
..... *GONG Fengxun, DAI Lihua, MA Yanqiu* (113)

Bi-level programming model of airport slot management for multi-user based on congestion pricing  
..... *WANG Kun, ZHU Jinfu, GAO Qiang* (120)

Application of incomplete information bidding model in radio spectrum allocation  
..... *LIU Weihua, SHI Wenhua* (125)

# 《哈尔滨工业大学学报》

## 第十一届编辑委员会

顾 问	杜善义	王仲奇	张 杰	王子才		
主任委员	蔡鹤皋					
副主任委员	韩杰才	郭 斌	谈和平	徐晓飞		
委 员	王常虹	姚 郁	沈 毅	曹喜滨	崔乃刚	
	赫晓东	孙 毅	陈德应	张中兆	许荣庆	
	史小平	宋申民	姚英学	付宜利	翟文杰	
	吴伟国	郭茂祖	战德臣	张宏莉	谭久彬	
	刘林华	孙东立	陈玉勇	魏俊杰	王 勇	
	孙秀冬	杨春晖	李 钰	冯玉强	郑文忠	
	李 惠	王幼青	武振宇	于水利	赵庆良	
	裴玉龙	邹广天	K.L.Teo			
主 编	段广仁					

## 本刊被下列数据库列为刊源期刊

美国《工程索引》(Ei Compendex)

美国《化学文摘》(CA)

英国《科学文摘》(INSPEC)

日本《科技文献速报》(JICST)

俄罗斯《文摘杂志》(AJ)

美国《数学评论》(MR)

德国《数学文摘》(ZB1 MATH)

美国《剑桥科学文摘》(CSA)

美国《应用力学评论》(AMR)

美国《国际航空航天文摘》(IAA)

美国《现代数学出版物》(CMP)

中国科学引文数据库(CSCD)核心刊

中国科技论文统计分析数据库(CSTPCD)核心刊

中国学术期刊综合评价数据库(CAJCED)

哈尔滨工业大学学报

Harbin Gongye Daxue Xuebao

(月刊 1954年创刊)

第46卷 第5期 2014年5月30日出版

Journal of Harbin Institute of Technology

(Monthly, Started in 1954)

Vol.46 No.5 2014-05-30

主管单位: 中华人民共和国工业和信息化部

主办单位: 哈尔滨工业大学

主 编: 段广仁

编辑出版: 《哈尔滨工业大学学报》编辑部

哈尔滨市南岗区西大直街92号(150001)

电话: 0451-86414260, 86414135

E-mail: hitxuebao@hope.hit.edu.cn

Http://hit.alljournals.cn

印刷单位: 哈尔滨工业大学印刷厂

国内发行: 哈尔滨市邮政局

国外发行: 中国国际图书贸易总公司

(北京399信箱)

Supervised by: Ministry of Industry and Information Technology of the People's Republic of China

Sponsored by Harbin Institute of Technology

Editor-in-Chief DUAN Guangren

Edited & Published by Editorial Board of Journal of Harbin Institute of Technology

Postcode: 150001 E-mail: hitxuebao@hope.hit.edu.cn

Http://hit.alljournals.cn

Distributed by China International Book Trading Corporation (P.O.Box 399, Beijing, China)

中国标准连续出版物号: ISSN 0367-6234  
CN 23-1235/T

邮发代号: 国内 14-67  
国外 928 M

定价: 20.00元/期  
240.00元/年

哈尔滨工业大学学报

第四十六卷 第五期 二〇一四年五月

哈尔滨工业大学学报

第四十六卷 第五期 二〇一四年五月

哈尔滨工业大学学报

第四十六卷 第五期 二〇一四年五月

哈尔滨工业大学学报

第四十六卷 第五期 二〇一四年五月

# 《哈尔滨工业大学学报》征稿简则

《哈尔滨工业大学学报》主要报道自然科学领域的基础理论、工程技术与应用方面的最新研究成果,欢迎省(部)级以上政府基金资助项目(国家自然科学基金、863、973、博士点基金等)相关论文。报道方向包括航天、机械、能源、动力、材料、电气、电子、信息与控制、计算机、化工、生物工程、土木工程、市政环境、暖通空调、道路、桥梁、交通工程、工程力学及有关交叉性学科。

## 投稿要求

1. 原创性论文,有创新性,主题明确、结构完整、论据可靠、论证合理、层次分明、逻辑严密、文字精炼、可读性强。
2. 投稿具有合法性,不存在抄袭、剽窃、篡改等不良行为;来稿未在任何正式出版物上刊载过(网上可检索到全文的会议论文也包括其中),不允许一稿多投。
3. 请严格遵守国家有关保密规定,不泄漏国家机密。

## 写作要求

1. 稿件请用 Word 编辑排版,一般 6000 字左右。附英文题名,5~8 个中、英文关键词。中、英文摘要内容包括:研究目的、主要方法、结果、结论四要素。要求 200~300 字,内容应具体、准确,切忌空洞和主观评价。
2. 文中插图精绘,图中文字清楚,应有图序、图题和图注。表中栏目及图的标目应按标准方式标注。如:时间的标注方式应为  $t/s$  或  $t/min$  或  $t/h$ ,速度的标注方式应为  $v/(m \cdot s^{-1})$ 。
3. 第一作者后面的作者中如有博士生导师,请一并给予介绍(包括姓名、性别、出生年、职称、学位或学历、电话、E-mail);如获基金资助,请在文章首页地脚处标示出项目名称和编号,请标注和文章内容紧密相关的基金项目,不支持独立研究单位的多项基金标注;最下方请标注通信作者姓名及 E-mail 地址。
4. 参考文献必须是公开发表过的文献,按文中引用顺序编号。在文中标出文献序号,详细的文献信息附于文末,建议不少于 15 个文献,英文文献占 60%左右。

请严格按照标准方式著录,各类文献著录方式如下:

- 1) 专著:[序号]作者姓名.书名[M].出版地:出版者,出版年:起页码-止页码。
- 2) 期刊:[序号]作者姓名.论文题目[J].期刊名,出版年,卷(期):起页码-止页码。
- 3) 会议论文集:[序号]作者姓名.论文题目[C]//论文集名.出版地:出版者,出版年:起页码-止页码。
- 4) 硕士及博士学位论文:[序号]作者姓名.论文题目[D].出版地:出版者,出版年。
- 5) 电子文献:[序号]主要责任者.电子文献题名[电子文献类型/电子文献载体].电子文献的出处或可获得地址,发表或更新日期/引用日期(任选).  
电子文献类型标志代码为:数据库 DB;计算机程序 CP;电子公告 EB.  
电子文献载体标志代码为:磁带 MT;磁盘 DK;光盘 CD;联机网络 OL。
- 6) 专利:[序号]专利所有者.专利题名.专利国别:专利号[P],出版日期。  
网站的"作者指南"栏上提供了样例,作者可参考进行撰写。

## 投稿方法

请通过哈尔滨工业大学学术期刊中心(<http://hit.alljournals.cn/>)进入《哈尔滨工业大学学报》网页([http://hit.alljournals.cn/hitxb\\_cn/ch/index.aspx](http://hit.alljournals.cn/hitxb_cn/ch/index.aspx)),于在线投稿系统的"作者登录"一栏进行投稿(首先需要注册)。本刊仅接受作者通过此系统提交的投稿;投稿前请认真阅读本刊网站中的"作者指南";若需查询稿件处理状况,请通过"作者登录"进行查询。同一篇稿件只需投稿一次,以免系统给出多个编号,如果要修改请和编辑部联系。

# 人工势场和虚拟领航者结合的多智能体编队

曲成刚<sup>1</sup>, 曹喜滨<sup>1</sup>, 张泽旭<sup>2</sup>

(1.哈尔滨工业大学 卫星工程技术研究所, 150080 哈尔滨; 2.哈尔滨工业大学 深空探测基础研究中心, 150080 哈尔滨)

**摘要:** 针对多智能体编队控制中的无碰撞、稳定队形保持和智能调整等问题, 提出一种将人工势场和虚拟领航者相结合的多智能体编队控制方法. 首先, 利用人工势场定义智能体之间的相互作用力和期望距离; 其次, 由虚拟领航者固定智能体之间的方位角, 并通过增加虚拟领航者的数量和分布位置在人工势场中控制群组的队形和指挥群组的运动; 最后, 利用系统的动能和人工势能构造的李亚普诺夫函数证明了多智能体编队系统的稳定性. 仿真实验结果验证了本文提出算法的有效性, 可实现无碰撞、稳定地保持和调整智能体系统的编队队形.

**关键词:** 人工势场; 虚拟领航者; 多智能体系统; 协同控制

中图分类号: V448.22      文献标志码: A      文章编号: 0367-6234(2014)05-0001-05

## Multi-agent system formation integrating virtual leaders into artificial potentials

QU Chenggang<sup>1</sup>, CAO Xibin<sup>1</sup>, ZHANG Zexu<sup>2</sup>

(1. Research Institute of Satellite Technology, Harbin Institute of Technology, 150080 Harbin, China;

2. Deep Space Exploration Research Center, Harbin Institute of Technology, 150080 Harbin, China)

**Abstract:** To solve the problems of collision between neighboring agents, a formation control algorithm is presented for multi-agent systems integrating virtual leaders into artificial potentials to keep and adjust formation. Firstly, the interaction forces and expectation distances between neighboring agents are determined by artificial potentials. Then, the formation and the motion direction of the group are controlled in the artificial potentials proposed by means of the amount and distribution locations of virtual leaders. Finally, the approach provides a construction for a Lyapunov function to prove stability of the formation systems using the system kinetic energy and the artificial potential energy. Simulation results show that the controller is effective and can keep or change formation configuration rapidly, stably and exactly with no collision.

**Keywords:** artificial potentials; virtual leaders; multi-agent system; cooperative control

# 在轨服务航天器任意轨道主动绕飞

王 峰, 陈雪芹, 曹喜滨, 耿云海

(哈尔滨工业大学 卫星技术研究所, 150001 哈尔滨)

**摘要:** 针对在轨服务航天器对目标器进行全方位监测和抢修要求, 根据速度脉冲转移算法进行了在轨服务航天器任意轨道的主动绕飞. 文中将绕飞轨道周期分为  $N$  份, 在每份时间内采用速度脉冲转移算法实现预定位置点间位置转移, 进而完成整个预定轨道绕飞. 接着进行了算法的误差分析, 给出了实际选择最少脉冲数的方法以满足预定轨道制导精度. 最后进行任意轨道主动绕飞的数学仿真. 仿真结果表明该制导算法较常规算法节省能量, 能有效地完成任意轨道的主动绕飞.

**关键词:** 速度脉冲转移主动绕飞在轨服务航天器

中图分类号: V442

文献标志码: A

文章编号: 0367-6234(2014)05-0006-05

## The initiative flyaround of on-orbit-servicing spacecraft in-any-plane

WANG Feng, CHEN Xueqin, CAO Xibin, GENG Yunhai

(Research Center of Satellite Technology, Harbin Institute of Technology, 150001 Harbin, China)

**Abstract:** Focusing on the completely inspection and salvage of target spacecraft, this paper presents an algorithm to enable the on-orbit-servicing spacecraft to circumnavigate a target spacecraft in any plane based on the impulse transfer method. By dividing the specified period into  $N$  parts, the impulse transfer method is applied during every part between two specified points until the circumnavigation is accomplished. With the error analysis of algorithm, a method is presented to solve the least pulse number  $N$  in the tolerant guidance error. Finally, a simulation is carried out and the results indicate that the guidance algorithm consumes less energy than others and can accomplish the flyaround in any plane efficiently.

**Keywords:** impulse transfer; initiative flyaround; on-orbit-servicing; spacecraft

# 压电混合约束层阻尼梁结构的振动控制

李明明, 方 勃, 谭立军, 张洁洁, 唐 冶, 黄文虎

(哈尔滨工业大学 飞行器动力学与控制研究所, 150001 哈尔滨)

**摘要:** 为提高主被动混合压电网络的振动控制频带, 结合主被动混合压电网络和被动约束层阻尼结构各自的优点, 提出了一种压电混合约束层阻尼结构用于悬臂梁结构的振动控制. 利用复剪切模量模型描述粘弹性材料的力学特性, 运用 Hamilton 原理和 Rayleigh-Ritz 法推导压电混合约束层阻尼悬臂梁结构的动力学模型. 在此基础上, 采用速度反馈控制策略设计主动控制器, 并对系统的开环和闭环特性进行数值分析. 分析结果表明, 与主被动混合压电网络相比, 压电混合约束层阻尼结构具有更显著的振动控制性能和更宽的振动控制频带. 而且这种压电混合约束层阻尼结构可以很容易地推广到对其他结构的振动控制.

**关键词:** 主被动混合压电网络; 被动约束层阻尼; Hamilton 原理; 分流电路

中图分类号: O328

文献标志码: A

文章编号: 0367-6234(2014)05-0011-07

## Vibration control of beams with piezoelectric hybrid constrained layer damping treatments

LI Mingming, FANG Bo, TAN Lijun, ZHANG Jiejie, TANG Ye, HUANG Wenhui

(Spacecraft Dynamics and Control Institute, Harbin Institute of Technology, 150001 Harbin, China)

**Abstract:** To enhance the vibration control bandwidth of active-passive hybrid piezoelectric network (APPN), a kind of piezoelectric hybrid constrained layer damping (PHCLD), which combined the advantages of the APPN and passive constrained layer damping, was presented to control the vibrations of cantilever beams. Complex shear modulus was used to characterize the dynamic behavior of viscoelastic material, and Hamilton's principle with Raleigh-Ritz method was employed to establish the dynamic model of the cantilever beams with PHCLD treatments. On this basis, the velocity feedback control strategy was used to design the active controller, and numerical simulations were performed to analyze the open-loop and closed-loop characteristics of the beam/PHCLD system. Analysis results indicate that the PHCLD has better vibration control performance and wider vibration control bandwidth as compared with the APPN. Furthermore, this PHCLD treatment could be easily extended to control the vibrations of other kinds of structures.

**Keywords:** active-passive hybrid piezoelectric network; passive constrained layer damping; Hamilton's principle; shunting circuit

# 无线电能传输系统驱动源负载网络分析

李 阳<sup>1</sup>, 朱春波<sup>1</sup>, 宋 凯<sup>1</sup>, 魏 国<sup>1</sup>, 逯仁贵<sup>1</sup>, 徐石明<sup>2</sup>

(1.哈尔滨工业大学 电气工程与自动化学院, 150001 哈尔滨; 2.南瑞集团公司 国网电力科学研究院, 211000 南京)

**摘 要:** 为了提高无线电能传输高频时的高效传输能力, 结合谐振式无线电能传输系统基本结构, 采用单管 E 类功率放大器作为系统驱动源, 对驱动源的负载阻抗特性及影响负载网络的因素进行了分析; 提出了针对无线传能系统的 E 类功率放大器负载网络参数调节方法; 在软开关条件下计算了负载网络最佳匹配参数; 通过调整开关管占空比的方式验证负载网络变化对软开关状态及系统效率的影响. 结果表明, 通过驱动源样机的制作以及负载网络参数调整测试, 实现了在 1 MHz 频率下 78 W 功率的输出, 系统效率达到 76.5%.

**关键词:** 无线电能传输; 驱动源; 负载网络参数; 软开关; 系统效率

中图分类号: TM724

文献标志码: A

文章编号: 0367-6234(2014)05-0018-05

## Analysis of load network on wireless energy transfer

LI Yang<sup>1</sup>, ZHU Chunbo<sup>1</sup>, SONG Kai<sup>1</sup>, WEI Guo<sup>1</sup>, LU Rengui<sup>1</sup>, XU Shiming<sup>2</sup>

(1. School of Electrical Engineering and Automation, Harbin Institute of Technology, 150001 Harbin, China;

2. State Grid Electric Power Research Institute, NARI Group Company, 211000 Nanjing, China)

**Abstract:** To improve the transmission efficiency of resonant wireless power transfer system in high frequency condition, the class E power amplifier is used as a driving source based on the traditional structure of wireless power transfer system. An adjustment method of load network for class E power amplifier in wireless power transfer system is proposed to further reduce the system losses, and then, the optimal matching parameters of load network in soft switching condition are calculated. The effect of load network changes on the system efficiency and the state of soft switching by adjusting the duty cycle of the switch are verified. Result shows that the system output power can get 78 W at 1 MHz frequency, and the system power efficiency is up to 76.5%.

**Keywords:** wireless power transfer; drive source; load network; soft switching; power efficiency

# 平板磁芯磁耦合谐振式无线电能传输技术

郭尧<sup>1</sup>, 朱春波<sup>1</sup>, 宋凯<sup>1</sup>, 魏国<sup>1</sup>, 逯仁贵<sup>1</sup>, 徐石明<sup>2</sup>

(1. 哈尔滨工业大学 电气工程与自动化学院, 150001 哈尔滨; 2. 南瑞集团 国网电力科学研究院, 211000 南京)

**摘要:** 为了增加磁耦合谐振式无线电能传输系统中发射/接收线圈的自感量以及二者间的耦合系数, 提高系统的传输功率和效率, 提出利用高磁导率平板磁芯绕制发射/接收线圈的方案. 对传输系统进行耦合电路建模, 通过电路微分方程给出传输系统相关参数的数学表达式, 设计并优化了系统实验平台, 研究了加入平板磁芯后系统耦合系数的变化, 工作频率对传输的影响, 发射与接收的移位传输以及系统的功率传输特性. 实现了距离 10 cm 以上, 功率 1.85 kW 的无线电能传输, 系统整体传输效率达到 80% 以上. 平板磁芯耦合机构体积小, 在较大水平移位 (25%) 情况下实现了稳定高效传输.

**关键词:** 电气工程; 无线电能传输; 磁耦合谐振; 平板磁芯; 大功率

中图分类号: TM724

文献标志码: A

文章编号: 0367-6234(2014)05-0023-05

## Magnetic resonant wireless power transmission technology based on planar core

GUO Yao<sup>1</sup>, ZHU Chunbo<sup>1</sup>, SONG Kai<sup>1</sup>, WEI Guo<sup>1</sup>, LU Rengui<sup>1</sup>, XU Shiming<sup>2</sup>

(1. School of Electrical Engineering and Automation, Harbin Institute of Technology, 150001 Harbin, China;

2. State Grid Electric Power Research Institute, NARI Group Company, 211000 Nanjing, China)

**Abstract:** Planar core is added to the magnetic resonant wireless power transmission system to increase the self-inductance and the coupling coefficient between the primary coil and secondary coil, and to enhance the transfer power and efficiency. Based on the equivalent circuit analysis, mathematical expression of system parameters are given by the circuit differential equations. Furthermore, a prototype of wireless power transmission system is built, and experiments including coupling coefficient, operating frequency, misalignment, and power transfer characteristic of the system are conducted. The system realizes 1.85 kW power transmission with 10 cm air gap and 80% efficiency. By using the planar core, the coupling mechanism can achieve stable and effective transmission in 25% misalignment, and its volume is smaller.

**Keywords:** electrical engineering; wireless power transmission; magnetic resonant coupling; planar core; high power.

# 超精密机床研究现状与展望

梁迎春<sup>1</sup>, 陈国达<sup>1</sup>, 孙雅洲<sup>1</sup>, 陈家轩<sup>1</sup>, 陈万群<sup>1</sup>, 于楠<sup>2</sup>

(1.哈尔滨工业大学 精密工程研究所, 150001 哈尔滨; 2.克兰菲尔德大学 精密工程研究所, MK43 0AL 贝德福德)

**摘要:** 对国内外超精密机床研究现状和进展进行综述, 对超精密机床技术发展趋势进行展望, 分析我国在超精密机床研究领域存在的主要问题以及与国外的差距, 提出我国超精密机床领域基础研究、技术及产业发展策略与对策。

**关键词:** 超精密加工; 超精密机床; 研究现状; 发展趋势; 发展对策

**中图分类号:** TG5      **文献标志码:** A      **文章编号:** 0367-6234(2014)05-0028-12

## Research status and outlook of ultra-precision machine tool

LIANG Yingchun<sup>1</sup>, CHEN Guoda<sup>1</sup>, SUN Yazhou<sup>1</sup>, CHEN Jiakuan<sup>1</sup>, CHEN Wanqun<sup>1</sup>, YU Nan<sup>2</sup>

(1. Center for Precision Engineering, Harbin Institute of Technology, 150001 Harbin, China;

2. Precision Engineering Institute, Cranfield University, MK43 0AL, Bedfordshire UK)

**Abstract:** Domestic and foreign research status and progress in the field of ultra-precision machine tool is reviewed, and the development trend is given. Based on the analysis of the main issues and the gap between foreign country and our country in the field of ultra-precision machine tool, the development strategies and countermeasures in the basic research, technology and industry are put forward.

**Keywords:** ultra-precision machining; ultra-precision machine tool; research status; development tendency; development strategy

# 螺栓连接层合板结构失效模式多尺度数值分析

刘长喜<sup>1</sup>, 周振功<sup>1</sup>, 张博明<sup>2</sup>, 唐占文<sup>2</sup>, 王晓宏<sup>3</sup>

(1.哈尔滨工业大学 复合材料与结构研究所, 150008 哈尔滨; 2.北京航空航天大学 材料科学与工程学院, 100191 北京;  
3.黑龙江工程学院 机电工程学院, 150030 哈尔滨)

**摘要:** 为充分发挥螺栓连接层合板结构的力学潜能, 构建宏-细观多尺度数值方法, 从细观组分材料性能出发准确地预测结构的失效载荷, 模拟局部损伤的产生、扩展过程, 指导结构设计. 基于有限元软件 ABAQUS 提供的用户自定义子程序 (USDFLD), 引入改进的单胞模型 (GMC 模型), 建立考虑细观组分材料损伤/失效的宏-细观多尺度数值分析模型, 模拟预报螺栓连接层合板结构在双剪切载荷作用下的损伤模式及挤压强度, 模型的预报结果与文献及实验结果吻合较好, 充分证明模型的预报能力. 利用该模型进一步分析试件的几何尺寸对结构损伤模式及挤压强度的影响. 结果表明: 结构宽度与孔径比尺寸的变化对结构的损伤模式及挤压强度均有影响, 且对挤压强度的影响较大, 在结构的设计过程中应给予充分的考虑.

**关键词:** GMC 模型; 多尺度分析; 螺栓连接层合板结构; 损伤模式; ABAQUS

中图分类号: TB33

文献标志码: A

文章编号: 0367-6234(2014)05-0040-06

## Multi-scale numerical analysis for the failure modes of pin-load composite laminate

LIU Changxi<sup>1</sup>, ZHOU Zhengong<sup>1</sup>, ZHANG Boming<sup>2</sup>, TANG Zhanwen<sup>2</sup>, WANG Xiaohong<sup>3</sup>

(1. Center for Composite Materials and Structure, Harbin Institute of Technology, 150008 Harbin, China;

2. Materials Science & Engineering School, BeiHang University, 100191 Beijing, China;

3. Mechanical and Electronic Engineering Department, Heilongjiang Institute of Technology, 150030 Harbin, China)

**Abstract:** To give full play to the mechanical potentiality of the pin-loaded composite laminate, the macro-mesoscopic multi-scale numerical method is developed to predict accurately the failure load of the structure, to simulate partial damage initiation, expansion and to guide the structure design. The improved unit cell model (GMC) is implanted to the numerical model by the user subroutines (USDFLD) provided by ABAQUS. The macro-micro multi-scale numerical model considering the damage/failure of micro-constituent materials is created for the pin-loaded composite laminate based on the general finite element software ABAQUS. The failure modes and the extruding strength of the pin-loaded laminate structure under the double-shear loading are simulated and predicted. By comparing the simulated failure modes with the test results in the literature, and compare the limited load with the experimental results, the feasibility of model is verified. The effect of specimen geometry dimension on the failure mode and the limited extruding strength of pin-loaded laminate structure are analyzed. The change of the width-diameter ratio will affect the failure mode, the extruding strength of the pin-loaded composite laminate and especially for the extruding strength.

**Keywords:** GMC model; multi-scale analysis; pin-load composite laminate; failure modes; ABAQUS

# 一种复合材料桁架的制备及弯曲承载性能分析

熊波<sup>1</sup>, 林国昌<sup>1</sup>, 张印桐<sup>2</sup>, 罗锡林<sup>1</sup>, 谭惠丰<sup>1</sup>

(1.哈尔滨工业大学 复合材料与结构研究所, 150080 哈尔滨; 2.深圳海油工程水下技术有限公司, 518067 广东 深圳)

**摘要:** 为提高复合材料桁架成型几何精度和杆件连接效率, 提出一种一体化成型的复合材料桁架制备方法, 同时设计了杆件固定工装, 通过胶接薄壳、缠绕纤维束和包裹织物实现杆件连接, 制备过程表明该制备方法操作性强、稳定性好, 制备桁架几何精度高; 通过3点弯曲实验和有限元仿真分析了桁架的弯曲承载性能. 结果表明: 杆件连接效率高, 桁架比弯曲刚度; 基于简化模型的有限元模拟方法计算效率高, 结果可靠, 可用于桁架弯曲刚度的表征.

**关键词:** 复合材料桁架; 一体化成型; 弯曲承载性能

中图分类号: TB322

文献标志码: A

文章编号: 0367-6234(2014)05-0046-05

## Fabrication and bending bearing capacity analysis of an integrated manufacturing composite truss

XIONG Bo<sup>1</sup>, LIN Guochang<sup>1</sup>, ZHANG Yintong<sup>2</sup>, LUO Xilin<sup>1</sup>, TAN Huifeng<sup>1</sup>

(1. Center for Composite Materials and Structures, Harbin Institute of Technology, 150080 Harbin, China;  
2. COOEC Subsea Technology Co. LTD, 518067 Shenzhen, Guangdong, China)

**Abstract:** An innovative fabrication method of integrated manufacturing composite truss is developed to improve the geometric accuracy and rods connecting efficiency. Unlike previous research, the rods are connected by bonding composite shell, winding fiber tow and wrapping fabric together with the designed rod fixture. Fabrication process demonstrates good operability and stability of truss manufacture and advanced geometry accuracy of fabrication. Three-point bending test on bending bearing capacity of the truss suggests a high specific bending stiffness with rods connection of high efficiency. In addition, consistent results from a finite element simulation based on a simplified model show its potential in high computational efficiency to evaluate the bending stiffness of the truss.

**Keywords:** composite truss; integrated manufacturing; bending bearing capacity

# 软件测试资源与成本管控和最优发布策略

张 策<sup>1,2</sup>, 崔 刚<sup>1</sup>, 刘宏伟<sup>1</sup>, 孟凡超<sup>2</sup>, 傅忠传<sup>1</sup>

(1. 哈尔滨工业大学 计算机科学与技术学院, 150001 哈尔滨;

2. 哈尔滨工业大学(威海) 计算机科学与技术学院, 264209 山东 威海)

**摘要:** 为全面系统地了解软件测试过程中与可靠性相关的重要过程的研究现状和最新发展, 对测试资源和成本的管理, 以及最优发布技术问题进行了深入研究. 首先将研究问题划分为 4 类, 剖析了测试资源分配与控制, 成本模型和最优发布基本内容, 给出了其公式化的形式化描述和内在关系; 然后从软件体系结构建模、测试过程建模、非线性最优化与仿真求解 3 个方面进行了技术分类评述. 进一步将研究内容从 5 个方面进行归一化分类, 并对选取的典型模型进行了归类比较总结. 最后, 指出了进一步研究发展的主要问题. 研究分析表明, 测试资源分配与成本管控和最优发布策略中, 考虑到软件体系结构特征和不完美排错模型, 向多目标融合方向发展, 并与可靠性评估相关是后续研究的研究.

**关键词:** 测试资源; 可靠性; 成本; 软件可靠性增长模型; 最优发布

中图分类号: TP311

文献标志码: A

文章编号: 0367-6234(2014)05-0051-08

## Software test resources and cost control and optimal release policy

ZHANG Ce<sup>1,2</sup>, CUI Gang<sup>1</sup>, LIU Hongwei<sup>1</sup>, MENG Fanchao<sup>2</sup>, FU Zhongchuan<sup>1</sup>

(1. School of Computer Science and Technology, Harbin Institute of Technology, 150001 Harbin, China;

2. School of Computer Science and Technology, Harbin Institute of Technology at Weihai, 264209 Weihai, Shandong, China)

**Abstract:** To reveal systematically the state of art of relevant sub-processes related to reliability in software test, management of test resource and cost, optimal release are studied in this article. Firstly, research contents are divided into four parts. Secondly, test resource allocation and control, cost model, optimal release, and relation of four parts are discussed, and then the formulations are also described. Thirdly, the related developing technologies are classified and summarized in accordance with software architecture modeling, test process modeling and nonlinear optimum or simulation solving. Furthermore, research contents are unified from five aspects and the latest models are classified and summarized respectively. Finally, future research directions are put forward.

**Keywords:** test resource; reliability; cost; software reliability growth model; optimal release

# GPS/INS 组合导航的变分贝叶斯自适应卡尔曼滤波

沈 忱, 徐定杰, 沈 锋, 蔡佳楠

(哈尔滨工程大学 自动化学院, 150001 哈尔滨)

**摘要:** 为解决 GPS/INS 组合导航的数据融合问题中卡尔曼滤波器因噪声统计特性会发生变化而性能严重退化的问题, 针对组合导航的系统模型提出并推导了一种基于变分贝叶斯学习的自适应卡尔曼滤波算法. 该方法从概率角度将系统状态与噪声的统计矩一起作为待估计的随机变量, 在每次递推地对状态进行估计之前, 用变分贝叶斯学习迭代逼近得到噪声的后验分布. 仿真结果证明: 在组合导航系统中, 该自适应算法能够较好地跟踪变化的噪声方差, 并对速度、位置等系统状态进行估计.

**关键词:** 卡尔曼滤波; 自适应; 变分贝叶斯; 组合导航

中图分类号: V241.62      文献标志码: A      文章编号: 0367-6234(2014)05-0059-07

## Variational bayesian adaptive Kalman filtering for GPS/INS integrated navigation

SHEN Chen, XU Dingjie, SHEN Feng, CAI Jianan

(College of Automation, Harbin Engineering University, 150001 Harbin, China)

**Abstract:** To circumvent the problem in GPS/INS integrated navigation for data infusion that Kalman filter degrades severely since the statistics of the noise might be time-variant, an adaptive Kalman filtering algorithm based on variational Bayesian learning is suggested and used in the integrated navigation system model in which both the moment of noise and the states are considered as stochastic parameters and estimated together. Using a probabilistic approach, a concrete derivation is given to represent how variational Bayesian learning works in a recursive way to approximate the true posterior of the noise together with the states. Experimental results demonstrate that the proposed filter is adaptive and performs well in tracking variances of the noise and estimating the states including position and velocity in GPS/INS integrated navigation system.

**Keywords:** Kalman filtering; adaptive; variational bayes; integrated navigation

# 双目立体视觉的无人机位姿估计算法及验证

张 梁, 徐锦法, 夏青元

(南京航空航天大学 直升机旋翼动力学国家级重点实验室, 210016 南京)

**摘要:** 针对无人飞行器在未知复杂环境下的导航问题, 提出了一种基于双目立体视觉的无人飞行器位置和姿态估计算法. 用双目摄像机采集立体图像序列, 对图像进行立体校正后使用 Harris 算法提取特征角点, 用 NCC 算法获取匹配特征点, 导出摄像机坐标系下的特征点坐标, 得到三维立体特征信息, 使用 RANSAC 算法与 L-M 迭代算法得到无人飞行器姿态和位置估计值. 实验结果表明, 基于双目立体视觉的位姿估计算法能适应未知环境变化, 计算结果与实际位姿量相比误差小, 能满足无人飞行器导航要求, 可为无人飞行器的导航实现提供一套新途径.

**关键词:** 无人飞行器; 双目立体视觉; 特征点提取与匹配; 位姿估计; 迭代算法

中图分类号: V212.4

文献标志码: A

文章编号: 0367-6234(2014)05-0066-07

## Pose estimation algorithm and verification based on binocular stereo vision for unmanned aerial vehicle

ZHANG Liang, XU Jinfa, XIA Qingyuan

(National Key Laboratory of Rotorcraft Aeromechanics, Nanjing University of Aeronautics & Astronautics, 210016 Nanjing, China)

**Abstract:** To the navigation of Unmanned Aerial Vehicle(UAV) in the complex unknown environment, an algorithm of position and attitude estimation based on the binocular stereo vision is described in this paper. Stereo vision pairs are taken by the binocular camera. The feature points are detected with the Harris algorithm after the stereo vision pairs are rectified and the feature points are matched with NCC algorithm. Then the 3D stereo information of the feature points can be calculated in the camera coordinate system and the position and attitude of UAV are estimated with RANSAC algorithm and L-M iteration algorithm. The result of the experiment shows that the position and attitude estimation algorithm based on binocular stereo vision has strong adaptability of the unknown environment. Compared to the real position and attitude, there is a small error. The algorithm can meet the requirements of UAV navigation. A new way can be provided for the UAV navigation.

**Keywords:** unmanned aerial vehicle; binocular stereo vision; feature points detection and matching; position and attitude estimation; iterative algorithm

# 双模式双三角锥滚动机构设计与运动分析

李晔卓, 田耀斌, 姚燕安

(北京交通大学 机械与电子控制工程学院, 100044 北京)

**摘要:** 基于 3-RSR 并联机构, 应用平行四边形机构缩放技术提出一种双模式双三角锥滚动机构. 该机构在一般位置状态和奇异位置状态分别具有折叠模式和移动模式. 在折叠模式下, 仅通过一个自由度即可完成折叠功能, 用以减少其存放或运输时所占的空间, 同时为其提供隐蔽能力; 在移动模式下, 机构展开且处于奇异位置, 通过 3 个自由度来进行移动和转向. 对自由度及其变化原因进行分析, 规划了驱动配置方案. 计算缩放比, 根据机构的运动方式, 规划了滚动步态并进行运动仿真. 制作了一台样机, 验证了机构变形方式与滚动功能的可行性.

**关键词:** 折叠机构; 奇异位置; 双三角锥; 滚动机构

中图分类号: TH112.1; TP242

文献标志码: A

文章编号: 0367-6234(2014)05-0073-08

## Locomotion analysis and design of a triangular bipyramid rolling mechanism with two modes

LI Yezhuo, TIAN Yaobin, YAO Yanan

(School of Mechanical, Electronic and Control Engineering, Beijing Jiaotong University, 100044 Beijing, China)

**Abstract:** Based on 3-RSR parallel mechanism, a triangular bipyramid rolling mechanism with two modes is proposed by using parallelogram mechanism folding technique. The mechanism has folding mode and mobile mode in normal position and singular position respectively. In folding mode, it gains the ability of folding by single degree of freedom, and the ability of folding makes the mechanism decreasing the storage space and acquiring the concealed ability. In mobile mode, the mechanism has three degrees of freedom which makes it rolling by deforming. The structure and the reason of freedom changing are analyzed. A prototype is manufactured to testify the feasibility of deforming method and rolling function.

**Keywords:** folding mechanism; singular position; triangular bipyramid; rolling mechanism

# H.264/AVC 网络视频的丢包失真评估

刘河潮<sup>1</sup>, 常义林<sup>1</sup>, 陈玉峰<sup>2</sup>

(1. 西安电子科技大学 综合业务网理论与关键技术国家重点实验室, 710071 西安; 2. 哈尔滨飞行学院, 150001 哈尔滨)

**摘要:** 针对新一代压缩编码标准 H.264/AVC 所使用的新编码技术在网络传输时误码对视频质量的影响, 提出一种无参考的 H.264/AVC 网络视频的丢包失真评估方法. 首先对信道误码引起的视频失真进行了分析, 然后确定 H.264/AVC 编码新特性对空时域误码传播及误码掩盖的影响, 进而提出一种无参考的 H.264/AVC 网络视频的丢包失真评估方法. 该方法计算复杂度低, 适合对实时传输的视频进行质量监控. 实验结果表明, 使用该方法得到视频序列的 MSE (mean square error) 与使用全参考视频质量评估方法得到视频序列的 MSE 具有很好的一致性, 相关性超过 0.85.

**关键词:** 视频质量评估; 网络丢包; 误码掩盖; H.264/AVC

中图分类号: TN919.85

文献标志码: A

文章编号: 0367-6234(2014)05-0081-06

## H.264/AVC video quality assessment over IP network based on packet loss

LIU Hechao<sup>1</sup>, CHANG Yilin<sup>1</sup>, CHEN Yufeng<sup>2</sup>

(1. State Key Laboratory of Integrated Service Networks, Xidian University, 710071 Xi'an, China;

2. Air Force Harbin Flying College, 150001 Harbin, China)

**Abstract:** A no-reference video quality assessment method is proposed for H.264/AVC network videos. The affection of packet loss on video qualities is first analyzed. Then, the video qualities are assessed by analyzing the spatial-temporal error propagation and error concealment which is induced by the new coding features of H.264/AVC. The complexity of the proposed quality assessment method is low, and it is suitable for assessing qualities of real time videos. Experimental results demonstrate that the MSE (mean square error) of the assessed video qualities is consistent with that obtained by full reference quality assessment. The correlation coefficient is greater than 0.85.

**Keywords:** video quality assessment; network packet loss; error concealment; H.264/AVC

# 无线传感器网络能效模型的量化评价与优化

蒋文贤<sup>1,2,3</sup>, 程光<sup>2,3</sup>

(1. 华侨大学 计算机科学与技术学院, 361021 福建 厦门; 2. 东南大学 计算机科学与工程学院, 211189 南京;  
3. 东南大学 计算机网络和信息集成教育部重点实验室, 211189 南京)

**摘要:** 为解决面向工业实时控制的无线传感器网络在性能和能量效率的平衡问题, 提出了一种能效模型的量化评价和优化设计方案. 该方案通过引入反馈控制的思想, 运用层次分析法构建基于服务质量约束的能效模型评价方法, 采用加权的综合量化指标权重计算服务的可用性; 在此基础上, 给出了基于效用函数的优化模型并设计了一种多度量目标优化算法. 仿真结果表明, 该方法能对网络协议进行调整优化满足有限能量条件下的服务质量约束, 保证数据传输可靠, 降低能量消耗, 延长网络生存时间.

**关键词:** 无线传感器网络; 服务质量; 节能; 能量效率; 量化评价

中图分类号: TP393      文献标志码: A      文章编号: 0367-6234(2014)05-0087-08

## Optimization and quantitative evaluation mechanism of energy efficiency model on wireless sensor networks

JIANG Wenxian<sup>1,2,3</sup>, CHENG Guang<sup>2,3</sup>

1. College of Computer Science and Technology, Huaqiao University, 361021 Xiamen, Fujian, China; 2. School of Computer Science and Engineering, Southeast University, 211189 Nanjing, China; 3. Key Laboratory of Computer Network and Information Integration the Ministry of Education, Southeast University, 211189 Nanjing, China)

**Abstract:** To solve the problem of the balance between performance and energy efficiency on real-time control and industry-oriented wireless sensor networks, we propose a quantitative evaluation and optimal design scheme of energy efficiency model. Firstly, by introducing the feedback control theory, we construct an evaluation method of energy efficiency model under the QoS constraint using an analytic hierarchy process and compute service usability using comprehensive quantitative metric weights based on weighted sum. Then, based on this, we provide an optimization model based on a utility function and design a multi-metric optimization algorithm. The simulation results show that this method can adjust and optimize the network protocol, satisfy QoS constraint under the condition of limited energy, ensure reliable data transmission, reduce energy consumption and prolong network life-time.

**Keywords:** wireless sensor networks; quality of service; energy-saving; energy efficiency; quantitative evaluation

# 驾驶员疲劳检测技术的算法设计与硬件实现

姜思羽, 吴 斌, 邱少健, 羊梅君

(华南理工大学 广州学院, 510800 广州)

**摘要:** 为了减少由疲劳驾驶而引起的交通事故, 提出了一种基于非接触式的驾驶员疲劳驾驶检测方法. 利用摄像头对驾驶员的面部图像进行采集, 经过图像前处理, 采用在线识别的方法对驾驶员的面部特征进行识别, 获取其疲劳状态; 硬件采用 DSP 系列的 TMS320DM642 作为核心处理器, 在判定驾驶员疲劳之后发出报警. 实验结果表明, 使用脉冲耦合神经网络方法对图像进行增强与在线识别, 可以有效地确定人脸与人眼区域, 主控芯片 TMS320DM642 的运算处理能力满足系统的要求, 摄像头焦距为 8 mm 时, 系统有效检测距离为 30~150 cm. 脉冲耦合神经网络方法对于驾驶员疲劳状态检测可靠性较高, 合理地选择硬件平台以及系统的安装位置对检测效果有重要的影响.

**关键词:** 疲劳驾驶; 神经网络; 训练样本; 在线识别; DM642

中图分类号: U469.72

文献标志码: A

文章编号: 0367-6234(2014)05-0095-06

## Algorithm design and hardware implementation of driver fatigue monitoring

JIANG Siyu, WU Bin, QIU Shaojian, YANG Meijun

(Guangzhou College, South China University of Technology, 510800 Guangzhou, China)

**Abstract:** To reduce the loss of people's property caused by traffic accidents because of driver fatigue, a new driver fatigue monitoring method based on non-contact is proposed. First, a camera gets driver's facial image, and then by using online method of identifying to identify the driver's facial features after pre-processing, the fatigue state of the driver can be acquired. Hardware system including TMS320DM642 as the core processor will alarm when driver is fatigue. Experimental results show that the use of pulse coupled neural network method to enhance and identify image, can determine the area of face and eye effectively, the master chip TMS320DM642 meets the requirement of detection distance between 30 cm and 150 cm when camera focal length is 8 mm. Coupled pulse neural network method has high reliability in driver fatigue detection, and choosing the right hardware platform and installation position have important influences on the detection results.

**Keywords:** fatigue driving; neural networks; training samples; online identify; DM642

# 供应链弹性综合优化路径选择模型分析

刘家国, 周粤湘, 李俊, 赵金楼

(哈尔滨工程大学 经济管理学院, 150001 哈尔滨)

**摘要:** 为发挥有限资源的最大效用,在供应链弹性构建的过程中,寻找出弹性瓶颈,确定弹性指标优化顺序至关重要.在综合考虑木桶理论与效价理论结合的基础上,提出了一套供应链弹性综合优化路径选择的方法和模型,并给出了实例分析.结果表明,该优化路径选择方法在简单优化距离上不但考虑了决策者的偏好,而且还考虑了各个指标因素间相互影响的作用使得优化路径选择结果更加符合实际,这为供应链弹性优化指标顺序选择问题提供了参考,具有可行性.

**关键词:** 优化路径选择;木桶理论;效价理论;指标综合优化;供应链弹性

中图分类号: F224.9

文献标志码: A

文章编号: 0367-6234(2014)05-0101-06

## A comprehensive optimization path selection model of supply chain resilience

LIU Jianguo, ZHOU Yuexiang, LI Jun, ZHAO Jinlou

(School of Economics and Management, Harbin Engineering University, 150001 Harbin, China)

**Abstract:** In order to maximum the effectiveness of the limited resources, it is crucial to find out the bottleneck of the resilience and determine optimal path in the supply chain resilience optimization process. Combining the barrel theory and the utility valence theory, this paper puts forward an integrated method for the path selection of supply chain resilience optimization problem. The results show that the optimal path selection method considers both the preferences of the decision-makers and the interaction among the various indicators. The example shows that the optimal path selected by the proposed method is in line with reality, and it is feasible. This provides a reference for the path selection of supply chain resilience optimization problem.

**Keywords:** optimization path selection; wooden barrel theory; utility valence theory; indexes comprehensive optimization; supply chain resilience

# 自校正控制的虚拟等价系统理论

张维存

(北京科技大学 自动化学院, 100083 北京)

**摘要:** 用虚拟等价系统理论统一分析基于任意控制策略和任意参数估计算法的自校正控制系统的稳定性和收敛性. 对于各种被控对象(确定、随机、最小相位、非最小相位), 只要控制策略满足常规条件, 即控制策略对参数估计得到的模型构成稳定闭环系统, 则自校正控制系统当采用适当低阶模型, 参数估计不收敛时也有可能稳定和收敛, 参数估计的取代条件为有界、慢时变以及参数估计误差为相对无穷小量(相对于回归向量范数).

**关键词:** 自校正控制; 稳定性; 收敛性; 虚拟等价系统

中图分类号: TP273

文献标志码: A

文章编号: 0367-6234(2014)05-0107-06

## Virtual equivalent system theory for self-tuning control

ZHANG Weicun

(School of Automation and Electrical Engineering, University of Science and Technology Beijing, 100083 Beijing, China)

**Abstract:** Based on virtual equivalent system (VES) theory, this paper presents the viewpoint that the structure information of plant to be controlled and the convergence of parameter estimates are both unnecessary for the stability and convergence of various types of self-tuning control (STC) systems. A general self-tuning control system comprised of arbitrary control strategy, arbitrary parameter estimation algorithm, and arbitrary plant (deterministic or stochastic, minimum or non-minimum phase), is stable and convergent if only the control strategy stabilizes the parameter-known model; the parameter estimates are bounded and slow time varying with relative infinitesimal estimation error.

**Keywords:** self-tuning control; stability; convergence; virtual equivalent system

# 自适应选取聚类中心 K-means 航迹起始算法

宫峰勋, 戴丽华, 马艳秋

(中国民航大学 电子信息工程学院, 300300 天津)

**摘要:** 为揭示多传感器观测数据的正态分布态势, 实现对源于异类目标的跟踪, 提出一种新的多传感器航迹起始算法, 本算法主要特点是初始聚类中心的自适应选取以及对逻辑估计法的起始夹角修正. 估计算法中采用不相似性度量阈值的角度衡量方法, 同时还结合聚类数目自适应归纳及初始聚类中心的推演逼近, 从而使单传感器的航迹起始估计算法可以应用于多传感器的航迹起始根据; 然后对聚类后的数据采用修正的逻辑航迹起始算法起始目标航迹. 蒙特卡洛估计表明, 新的自适应 K-means 聚类估计区分呈团状分布的不同目标的能力好, 且通过估计算法得到的目标非常接近真实目标位置. 经过自适应聚类处理后的目标航迹起始估计可有效滤除杂波干扰, 降低虚警概率, 能够获得较好的多传感器航迹起始.

**关键词:** K-means 聚类; 聚类中心; 自适应; 相似性度量; 阈值; 航迹起始

中图分类号: TN957.51; V249.121

文献标志码: A

文章编号: 0367-6234(2014)05-0113-07

## Algorithm of multi-radar multi-target track initiation based on adaptive K-means clustering

GONG Fengxun, DAI Lihua, MA Yanqiu

(School of Electronics and Information Engineering, Civil Aviation University of China, 300300 Tianjin, China)

**Abstract:** According to the feature that the measurements of the same target at the same time have spherical shape, an algorithm of track initiation based on adaptive K-means clustering and modified logic-based approach is proposed in this paper. The improved K-means clustering algorithm can determine the cluster number and the initial cluster centers adaptively. Then the center of each cluster is found and taken as the measurement of the targets at this moment. By doing so, the track initiation process is simplified. According to the target's movement characteristic, a modified logic-based method is used to initiate the target track. Simulation results show that the improved K-means clustering algorithm can recognize the number of targets correctly and the recognized targets are close to the true targets; the modified logic-based approach can effectively suppresses clutter and reduces the probability of false alarm.

**Keywords:** K-means clustering; cluster center; adaptive; similarity measure; threshold; Track initiation

# 采用拥挤收费的机场时刻管理多用户双层规划模型

王 琨, 朱金福, 高 强

(南京航空航天大学 民航学院, 211106 南京)

**摘 要:** 为了研究繁忙机场时刻资源紧张导致航班延误、机场使用效率降低问题,探讨了高峰时段收取拥挤费用对机场航班需求的影响,并在考虑直达航班和联程中转航班不同特点的基础上,建立了机场时刻管理多用户双层规划模型,得到各时段、各类航班的航班量和拥挤收费费率.算例分析显示,优化后各时段航班量的波动性和平均延误时间均有所降低.

**关键词:** 繁忙机场;时刻管理;拥挤收费;双层规划

中图分类号: U8

文献标志码: A

文章编号: 0367-6234(2014)05-0120-05

## Bi-level programming model of airport slot management for multi-user based on congestion pricing

WANG Kun, ZHU Jinfu, GAO Qiang

(College of Civil Aviation, Nanjing University of Aeronautics and Astronautics, 211106 Nanjing, China)

**Abstract:** To research the problem of flight delays occurring in rush hour of busy airport which make airport's operation lower efficiency, the effect of congestion pricing being aimed at rush hour on slot demand is analyzed. A bi-level programming model of airport slot management for multi-user is established to determine the congestion pricing rate and corresponding flight flow, which considers the characteristic of direct flight and connecting flight. The case analysis shows that the volatility of flight volume and average delay time in different time are decreased. The model is an effective method of reducing flight delays and improving operation efficiency of busy airport.

**Keywords:** busy airport; slot management; congestion pricing; bi-level programming

# 不完全信息竞价模型在无线电频谱配置的应用

刘纬华<sup>1</sup>, 石文华<sup>2</sup>

(1.东北大学 工商管理学院, 110819 沈阳; 2.北京邮电大学 经济管理学院, 100876 北京)

**摘要:** 为探索资源产权制度和有偿使用制度的实现机制, 以无线电频谱为例, 依据一阶密封拍卖原理, 通过建立运营商在无线电频谱拍卖过程中的不完全信息竞价模型, 分析运营商的投标数量、竞价成功概率等因素对于运营商最优报价的影响以及中标者数量对运营商期望利润函数的影响, 并求解模型得出运营商报价的一般表达式. 分析表明, 将拍卖机制运用于无线电频谱资源分配, 既充分体现频谱资源的经济价值, 又有利于频谱资源的有效配置, 同时是在运营商利润最大化前提下的优化决策.

**关键词:** 资源配置; 频谱; 拍卖; 不完全信息

中图分类号: TN92

文献标志码: A

文章编号: 0367-6234(2014)05-0125-04

## Application of incomplete information bidding model in radio spectrum allocation

LIU Weihua<sup>1</sup>, SHI Wenhua<sup>2</sup>

(1.School of Business Administration, Northeastern University, 110819 Shenyang, China;

2.School of Economics and Mangement, Beijing University of Posts and Telecommunications, 100876 Beijing, China)

**Abstract:** To explore the reasonable mechanisms of resources property rights and the compulsory system, taking the radio spectrum as an example and in according to the first order sealed auction principle, this paper establishes an incomplete information bidding model during the radio spectrum auction process to analyze the impacts on operators optimal of factors such as the number of operators bidding, bidding probability of success and so on, and the effects on operators expected profit function of the number of successful bidders, and draw the general expression of operators quote by solving model. Analysis showed that the application of auction mechanism in the radio spectrum resource allocation not only fully reflected the economic value of spectrum resources, but also conducive to the efficient allocation of spectrum resources, and was the ptimizing decisions as well under the premise that the profits of operators was maximized.

**Keywords:** resource allocation; spectrum; auction; incomplete information