

# 计算机测量与控制

2019年 第27卷 第11期 (总第254期)  
月刊 公开发行 1993年创刊

主管单位:中国航天科工集团有限公司  
主办单位:中国计算机自动测量与控制技术协会  
编辑出版:《计算机测量与控制》杂志社

资深顾问: 栾恩杰院士 张履谦院士 陈定昌院士  
社 长: 奚全生

副 社 长: 肖登伟

编委会主任: 潘旭东

编委会副主任: 奚全生

编委会委员(按姓氏笔画排序):

于功敬 王军政 王海亮 王海涛 支超有  
付 平 付梦印 叶廷东 左 毅 史红卫  
兰智高 任祥顺 许川佩 刘 嘉 刘才学  
刘广武 刘文怡 朱纪洪 华更新 乔立岩  
吕 翔 邢兰昌 李清东 连晓峰 张友鹏  
张 雷 何怡刚 应怀樵 严 涛 肖明清  
吴 响 汪祖民 周德云 姚一杨 郭阳明  
赵 雯 徐忠东 马恩云 阎 芳 常天庆  
彭进业 路 辉 蔡小斌 潘安君 魏清新

主 编: 苟永明

副 主 编: 孟汉城

英文编辑: 杨力生

编辑部: 任旺芳 唐德生 白春安 顾捷

广告部: 孙颖

通讯地址: 北京市海淀区阜成路甲8号  
航天科工大厦四层

邮政编码: 100048

电 话: 主编室: (010) 68371578

编辑部: (010) 68371556转12-23

广告部: (010) 68767886

传 真: (010) 68372068

电子邮箱: ck@chinamca.com

投稿网址: www.chinamca.com

印 刷: 北京强华印刷厂

总发行处: 北京报刊发行局

订 阅 处: 全国各地邮局

邮发代号: 82-16

ISSN 1671-4598

刊 号: CN 11-4762/TP

国外代号: M1480

广告经营许可证: 京海工商广字第8179号(1-1)

帐 户: 《计算机测量与控制》杂志社

帐 号: 11001085400059612076

开户银行: 建行北京阜成路支行

出版日期: 2019年11月25日

国内定价: 每期定价40.00元/册

责任编辑: 唐德生

版权所有 未经同意 不得转载

# 目 次

## • 测试与故障诊断 •

- 基于精密星敏感器的航天器高精度姿态测量标定方法.....段宇恒, 管 亮(1)
- 具有同步整流功能的智慧环保设备运行监测系统设计.....李亚娟(6)
- 小样本深度学习方法实现LED TV屏缺陷检测.....周永福, 曾 志, 罗中良(11)
- 飞行试验脚踏力测试系统在线校准技术研究.....冯铭瑜, 陈星星(16)
- 火箭地面测控系统的电磁兼容性设计.....王晓晖, 陈 纲(20)
- 基于深度学习的无人机巡检图像销钉故障检测.....宁柏锋(25)
- 面向移动智能终端的人体心率监护系统设计与实现.....魏 琪, 林增刚, 郭阳明, 孔德岐, 张 双(30)
- 轮毂检测建模及测量数据处理方法研究.....刘业峰, 王继轩, 王富状, 赵 元, 孙福英(34)
- 环境空气TVOC在线监测系统的研究与开发.....张华杰, 陈海永, 兰淑静, 武传伟, 王 栋, 侯贤祥, 王海超(39)
- 基于健康管理技术的机载计算机智能故障诊断方法.....马小博, 王 芳, 陈 益, 李亚锋(43)
- 大推力氢氧补燃循环发动机故障仿真.....邓 晨, 薛 薇, 郑孟伟, 李子亮, 叶莺樱(48)
- 射频超导腔性能测量平台的设计与实现...李爱玲, 郑 健, 周立鹏, 彭朝华, 陆 泽(54)
- 基于无人机机载激光雷达的海岛建筑物高度测算技术.....杭 芬(58)

## • 控制技术 •

- 无刷直流电机自适应调速控制系统的设计.....卢 军, 程诗卿, 黄海波, 陈宇峰, 高 云, 王志虎(62)
- 基于FPGA的伺服电机转速控制系统研究.....张 龙, 叶 松, 张宝国(66)
- 基于物联网的输电线路巡检机器人控制策略研究.....李 睿(70)
- 融合眼电及头部姿态的智能轮椅控制.....陈振东, 杨飞帆, 刘惠鹏(74)
- 基于组态软件的电梯控制与仿真.....吴晓雪, 何 南, 谷 军(79)
- 基于LoRa物联网技术的火龙果大棚监控系统的设计与应用.....杨 扬(82)
- 基于双霍尔传感器的磁性小球悬浮控制系统研究...张 驰, 陆永华, 梁立鹏, 赵采仪(86)
- 某扑翼飞行器风洞流场控制系统设计.....杨孝松, 盖 文, 江 涛(91)
- 基于自适应Backstepping的飞机重心变化稳定控制律设计.....明瑞晨, 刘小雄, 李 煜, 张悦航(96)
- 云台式PGK伺服系统控制器设计.....张刘帅, 杨新民, 赵 坤(101)
- 基于滑模变结构控制的路径跟踪研究.....张华胜, 宋旋漩, 潘礼正(106)
- 基于MMX-VPU的Simatic控制系统的人工智能模块.....苏 越(110)
- 基于神经网络的配网系统光伏输出功率控制分析.....孟庆强, 刘 铭(115)

## • 军事装备测控技术 •

- 装甲装备指挥控制性能自动测试系统设计.....张又明, 季文龙, 刘瑞之, 牛建民, 张义武(120)

## • 测试软件工程 •

基于DSP+FPGA的激光半主动导弹飞控软件设计.....袁莉,孙雪阳,陈伟(125)

## • 设计与应用 •

对地观测卫星任务规划研究.....邓宝松,孟志鹏,义余江,余焯,周晓光(130)

遥测GPS/BD定位数据实时引导雷达局部组网技术.....李鹏勃,马方远,杜剑英,王茜,刘鹏(140)

基于VxWorks的复杂飞行器模拟平台设计.....李恺,曾贵明,梁君,王健康,张声艳(143)

基于ZigBee架构的疗养院智能安防系统设计.....李麟,潘云(148)

基于拉依达准则与线性拟合的改进型无迹卡尔曼滤波粗大误差补偿算法.....张振慧,张正江,胡桂廷,朱志亮(153)

基于伪谱法的滑翔轨迹多级迭代优化策略.....唐怡,黄俊,黎茂锋,刘志勤,陈波(157)

基于龙芯平台的PXI设备驱动设计.....杜影,朱元元,刘康丽,毕硕,谷静(163)

低压用电客户保障系统的研究与应用.....潘旭辉,岑正军,陈成,任小诚,谭志立(167)

基于星型链路的飞行器高码率数据采集传输系统设计与实现.....陈玉坤,梁君,荣刚,曾发(171)

基于改进DNN-LSTM算法的车辆前方行人行为识别方法.....窦雪婷,王硕,季鑫盛(175)

基于VPX标准的车载综合信息系统设计.....卫攸宁,杨鹏,张宇,毛微,袁佳(180)

基于位置反解算法的并联机器人坐标变换方法.....肖海霞,朱双美(184)

基于商用片上系统的小卫星能源管理单元设计.....苏蛟,姚雨迎,刘元默,徐军(188)

单天线认知无线电中的协作频谱感知和无线能量传输.....吕玉静,宋志群,刘玉涛(193)

三坐标DBF雷达SystemVue仿真建模方法研究.....尹园威,刘月航(197)

操控中的一种半程载波捕获与跟踪方法.....李强,张志宝,李怡,薛瑞,王超(202)

多核虚拟化分区技术在航空电子系统中的应用.....潘皓(206)

基于偏最小二乘法的翼型稳健设计替代模型.....蔡文杰,黄俊,黎茂锋,刘志勤,陈立伟(210)

基于RGB通道自适应的维纳滤波图像去模糊研究.....孙成阳,毛家发,胡亚红,盛伟国(215)

基于软件无线电平台的中频信号处理系统设计.....张迪,韩爽(220)

基于VI-SLAM的四翼无人机多目标视觉定位技术.....董巍(224)

基于改进的SURF图像配准算法研究.....金斌英(228)

基于ARM的嵌入式工具管理系统的设计与实现.....阚艳,张子明,李金猛,韩梁,周勇军(233)

一种混凝土预制构件智能循环养护系统设计.....苏沛东,甄红卫,柴娜,曹英荣(239)

基于均值漂移与空间信息的导向模糊C均值遥感图像分割算法.....张晓磊,潘卫军,陈佳炀,张智巍,王思禹(243)

## • 试验与评价技术 •

基于故障确认的一体化测试性试验验证平台.....高洪青(249)

海洋大气波导环境下反舰导弹作战效能评估.....熊威,车梦虎(252)

基于ANSYS的包装箱虚拟仿真试验研究.....张丽丽,赵元,刘业峰(255)

装备故障预测与健康管理能力验证评估技术.....闻化,胡志伟(260)

## • 智能仪器与传感技术 •

基于IEEE1451的靶场分布式无线传感器网络构建方案.....刘康丽,朱元元,吴晓晔,毕硕,谷静(265)

基于STC89C51单片机的防盗报警系统设计.....韩爽,张迪(270)

基于DDS技术的LFM信号产生与FPGA实现.....谭德勇,陆聪,杨维明,卫春芳(275)

**Competent Authority:**

China Aerospace Science and Industry Corporation Limited

**Sponsor:**

China Association of Computer Automated Measurement and Control Technology

**Edited and Published by:**

Magazine Agency of Computer Measurement & Control

**Senior Consultants:**

Luan Enjie Academician  
Zhang Lūqian Academician  
Chen Dingchang Academician

**Publisher:**

Xi Quansheng

**Vice Publisher:**

Xiao Dengwei

**Chief Editor:**

Gou Yongming

**Vice Chief Editor:**

Meng Hancheng

**English Editor:**

Yang Lisheng

**Address:**

4th floor,China Aerospace Mansion No.a8  
Fucheng road,Haidian district,Beijing  
100048,China

**Tel:** 010-68372068

**Fax:** 010-68372068

**E\_mail:** ck@chinamca.com

**Http:** www.chinamca.com

**General Issue:**

Beijing Bureau for Distribution of Newspapers and Journals

**Domestic Distrubutor:**

All Local Post Office in China

**Code Name:** 82-16

**Publication Number:**

ISSN 1671-4598 , CN 11-4762/TP

**Overseas Distributor:**

China International Book Trading Corporation,  
P.O.Box 399,Beijing,100044, China

**Overseas Postal Code Name:** M1480

**Publishing Date:** 25th /Nov.2019

**Domestic Price:** ¥40/Each

**Overseas Price:** \$12/Each

# Contents

## • Test and Fault Diagnosis •

High Precision Attitude Measurement and Calibration Method of Spacecraft Based on Precision Star Sensor.....	Duan Yuheng,Guan Liang(1)
Design of Intelligent Environmental Protection Equipment Operation Monitoring System with Synchronized Rectification Function.....	Li Yajuan(6)
Defect Inspection for LED TV Screen Using Deep Learning Method on Small Sample Datasets.....	Zhou Yongfu,Zeng Zhi,Luo Zhongliang(11)
Research on on-line Calibration Technology of the Pedal Force Testing System in Flight Test.....	Feng Mingyu,Chen Xingxing(16)
Electromagnetic Compatibility Design of Rocket Ground Measurement and Control System.....	Wang Xiaohui,Chen Gang(20)
Pin Fault Detection in UAV Inspection Image Based on Deep Learning.....	Ning Baifeng(25)
Design and Implementation of Human Heart Rate Monitoring System Based on Mobile Intelligent Terminals.....	Wei Qi,Lin Zenggang,Guo Yangming,Kong Deqi,Zhang Shuang(30)
Research on Hub Inspection Modeling and Measurement Data Processing Method.....	Liu Yefeng,Wang Jixuan,Wang Fuzhuang,Zhao Yuan,Sun Fuying(34)
Research and Development of The Environmental Air TVOC Online Monitoring Device.....	Zhang Huajie,Chen Haiyong,Lan Shujing,Wu Chuanwei,Wang Dong,Hou Xianxiang,Wang Haichao(39)
An Intelligent Fault Diagnosis Method for Airborne Computer Based on Health Management Technology.....	Ma Xiaobo,Wang Fang,Chen Yi,Li Yafeng(43)
Fault Simulation for Heavy-lift LH2/LOX Staged Combustion Cycle Engine.....	Deng Chen,Xue Wei,Zheng Mengwei,Li Ziliang,Ye Yingying(48)
Design and Implementation of RF Superconducting Cavity Performance Measurement Platform.....	Li Ailing,Zheng Jian,Zhou Lipeng,Peng Zhaohua,Lu Ze(54)
Height Measurement Technology of Island Buildings Based on UAV Airborne Lidar.....	Hang Fen(58)

## • Control Technology •

Design of Brushless DC Motor Adaptive Speed Control System.....	Lu Jun,Cheng Shiqing,Huang Haibo,Chen Yufeng,Gao Yun,Wang Zhihu(62)
Research on Speed Control System of Servo Motor Based on FPGA.....	Zhang Long,Ye Song,Zhang Baoguo(66)
Research on IoT Control Strategy of Inspection Robot for Transmission Line.....	Li Rui(70)
Intelligent-Fusion Wheelchair Control Based on EOG and Head Posture.....	Chen Zhendong,Yang Feifan,Liu Huipeng(74)
Elevator Control and Simulation Based on Configuration Software.....	Wu Xiaoxue,He Nan,Gu Jun(79)
Design and Application of Dragon Fruit Shed Monitoring System Based on LoRa Internet of Things Technology.....	Yang Yang(82)
Research on Magnetic Ball Levitation Control System Based on Double Hall Sensor.....	Zhang Chi,Lu Yonghua,Liang Lipeng,Zhao Caiyi(86)
Design of Flow Field Control System for a Flapping Wing Aircraft Wind Tunnel.....	Yang Xiaosong,Gai Wen,Jiang Tao(91)
Adaptive Backstepping Control for Gravity Change of Aircraft Center.....	Ming Ruichen,Liu Xiaoxiong,Li Yu,Zhang Yuehang(96)
Cloud Desktop PGK Servo System Controller Design.....	Zhang Liushuai,Yang Xinmin,Zhao Kun(101)
Research on Path Tracking Based on Sliding Mode Variable Structure Control.....	Zhang Huasheng,Song Xuanxuan,Pan Lizheng(106)
Artificial Intelligence Module of Simatic Control System Based on MMX-VPU.....	Su Yue(110)

Analysis of Photovoltaic Output Power Control of Distribution Network System Based on Neural Network.....  
.....Meng Qingqiang,Liu Ming(115)

### ● Military Equipment Technology in Measurement and Control ●

Scheme Design of Automatic Test System for Command & Control Performance of Armored Armament.....  
.....Zhang Youming, Ji Wenlong, Liu Ruizhi, Niu Jianmin, Zhang Yiwu(120)

### ● Test Software Engineering ●

Design of Flight Control Software for Laser Semi-active Guided Missile Based on DSP+FPGA..... Yuan Li, Sun Xueyang, Chen Wei(125)

### ● Design and Application ●

Research of Task Scheduling of Earth Observing Satellites..... Deng Baosong, Meng Zhipeng, Yi Yujiang, Yu Ye, Zhou Xiaoguang(130)  
Local Networking Technology of Real-time Guidance Radar for Telemetry GPS/BD Positioning Data.....

.....Li Pengbo, Ma Fangyuan, Du Jianying, Wang Qian, Liu Peng(140)

Design of Complex Aircraft Simulation Platform Based on Vxworks..... Li Kai, Zeng Guiming, Liang Jun, Wang Jiankang, Zhang Shengyan(143)

Design of Intelligent Security System for Sanatorium Based on ZigBee Architecture..... Li Lin, Pan Yun(148)

Improved Unscented Kalman Filter Based on Gross Error Compensation Algorithm with Pauta Criterion and Linear Fitting.....

.....Zhang Zhenhui, Zhang Zhengjiang, Hu Guiting, Zhu Zhiliang(153)

Multistage Iterative Optimization Strategy for Gliding Trajectory Based on Pseudo-spectral Method.....

.....Tang Yi, Huang Jun, Li Maofeng, Liu Zhiqin, Chen Bo(157)

Design of PXI Device Driver Based on LOONGSON Platform and NeoKylin Operating System..... Du Ying, Zhu Yuanyuan, Liu Kangli, Bi Shuo, Gu Jing(163)

Research and Application of Low Voltage Power Customer Support System..... Pan Xuhui, Cen Zhengjun, Chen Cheng, Ren Xiaocheng, Tan Zhili(167)

Pedestrian Action Recognition Based on Improved DNN-LSTM Algorithm..... Dou Xueting, Wang Shuo, Ji Xinsheng(175)

Design of Vehicle Comprehensive Information Processing System Based on VPX Standard..... Wei Youning, Yang Peng, Zhang Yu, Mao Wei, Yuan Jia(180)

Coordinate Transformation Method of Parallel Robot Based on Position Inverse Solution Algorithm..... Xiao Haixia, Zhu Shuangmei(184)

Design of Energy Management Unit for Small Satellite Based on Commercial System on Chip..... Su Jiao, Yao Yuyin, Liu Yuanmo, Xu Jun(188)

Simultaneous Cooperative Spectrum Sensing and Wireless Power Transfer in Single-antenna Cognitive Radio..... Lü Yujing, Song Zhiqun, Liu Yutao(193)

Research on Simulation Modeling of System Vue for Three-dimensional DBF Radar..... Yin Yuanwei, Liu Yuehang(197)

A Half-Way Carrier Acquisition and Tracking in Space Operation..... Li Qiang, Zhang Zhibao, Li Yi, Xue Rui, Wang Chao(202)

Multi-core Virtualization and Partitioning for Avionics System..... Pan Hao(206)

An Airfoil Robust Design Alternative Model Based on Partial Least Squares..... Cai Wenjie, Huang Jun, Li Maofeng, Liu Zhiqin, Chen Liwei(210)

Research on Image Deblurring Based on RGB Three-Channel Adaptive Wiener Filter..... Sun Chengyang, Mao Jiafa, Hu Yahong, Sheng Weiguo(215)

Design of IF Signal Processing System Based on Software Radio Platform..... Zhang Di, Han Shuang(220)

Multi-target Visual Positioning Technology of Four-wing UAV Based on VI-SLAM..... Dong Wei(224)

Research on Image Registration Based on Improved SURF Algorithm..... Jin Binying(228)

Design and Implementation of Embedded Tools Management System Based on Arm..... Kan Yan, Zhang Ziming, Li Jinneng, Han Liang, Zhou Yongjun(233)

Design of the Utility Model Relates to an Intelligent Circulating Maintenance System for Precast Concrete Members.....

.....Su Peidong, Zhen Hongwei, Cai Na, Cao Yingrong(239)

Guided Fuzzy C-means Clustering with Mean Shift and Spatial Information for Remote-Sensing Image Segmentation.....

.....Zhang Xiaolei, Pan Weijun, Chen Jiayang, Zhang Zhiwei, Wang Siyu(243)

### ● Test & Evaluation Technology ●

Research on Integrated Testability Verification Platform Based on Fault Identification..... Gao Hongqing(249)

Combat Effectiveness Evaluation of Anti-ship Missile in Ocean Atmospheric Duct Environment..... Xiong Wei, Che Menghu(252)

Research on Virtual Simulation Experiment of Packaging Box on the Basis of ANSYS..... Zhang Lili, Zhao Yuan, Liu Yefeng(255)

Validation and Evaluation Techniques of Equipment PHM System..... Wen Hua, Hu Zhiwei(260)

### ● Intelligent Instruments and Sensing Technology ●

Distributed Wireless Sensor Network Construction Scheme for Shooting Range Based on IEEE1451.....

.....Liu Kangli, Zhu Yuanyuan, Wu Xiaoye, Bi Shuo, Gu Jing(265)

Design of Anti-theft Alarm System Based on STC89C51 Single Chip Microcomputer..... Han Shuang, Zhang Di(270)

LFM Signal Generation and FPGA Implementation Based on DDS Technology..... Tan Deyong, Lu Cong, Yang Weiming, Wei Chunfang(275)