

ISSN 1671—4598

CODEN JCYKAR

● 第三届国家期刊奖百种重点期刊

● 中国科技核心期刊



QK2135469

# 计算机测量与控制

COMPUTER MEASUREMENT & CONTROL

2021年9月 第29卷 第9期

Vol. 29 No. 9 Sep. 2021



中国计算机自动测量与控制技术协会 主办

# 目次

## • 综述与评论 •

航天装备测试技术现状与发展.....蔡远文,程龙,辛朝军,刘党辉,李岩,张宇,解维奇(1)

## • 测试与故障诊断 •

基于自主诊断重构技术的航天器故障检测系统设计.....万磊,戴滨,蒋寒(5)

基于MIL-STD-1553B的运载火箭故障诊断与故障注入方法.....赵岩,李佳,解世禄,王德义,陈娟(10)

风洞群真空泵组集中监测与智能故障诊断系统的设计.....罗昌俊,马永一,王小飞,明丽洪,冯春艳(17)

基于加权密集连接网络和注意力机制的滚动轴承故障诊断.....赵一瑾(23)

基于单片机负载控制的无人机电气设备监测系统设计.....吴瑕,郎玉庆(29)

一种单粒排种器单片机检测系统设计.....教传艳(33)

铁路客运站旅客异常行为智能识别和监测方法研究.....李君,陈瑞凤,徐春婕,吕晓军(37)

基于信号经验模态分解与分集合并的齿轮故障诊断.....邓博元,崔伟成,曾庆松,李晨璿(43)

基于线激光扫描的航空发动机叶片非接触式检测研究.....龙智,郑琪,张天辉,方建军,马迎春(50)

基于改进YOL0v3和立体视觉的园区障碍物检测方法.....胡丹丹,张莉莎,张忠婷(54)

基于改进键合图方法的层次机电系统的测试性建模与分析.....龙玉峰,史贤俊,肖支才,张婕,杨宇(61)

地质勘探钻机钻探实时深度测量系统设计.....袁丽艳(67)

基于数据源识别和驱动分析的软件系统测试方法.....魏波,张慧颖,司倩然(73)

## • 控制技术 •

基于物联网技术的低产井间歇抽油自寻优控制系统设计.....高娟,王维,庞波,庞静,郭振华(78)

载人机器人平顺轨迹规划及自抗扰跟踪控制方法.....高庆吉,侯世昊,岳凤发,邢志伟(83)

基于黄金分割双种群遗传算法的区域交通信号控制.....张诗煜,嵇启春,孟月波(90)

一种时间同步1553B总线通信协议RT突发数据发送控制方法.....兰天,周凡卉,杨培尧,张红军,余晟(95)

基于模糊神经网络的二自由度主动悬架滑模控制系统设计.....李娜(101)

基于混合滤波的四旋翼无人机抗干扰姿态控制系统设计.....黄智,张建强,苏润丛(105)

结冰风洞试验段转盘控制系统设计与应用.....熊建军,冉林,赵照,张鸿健,李自雨(110)

基于高斯牛顿法的可匹配机器人高精度自动抓放料方法.....代康,秦健勇,谢凯(115)

列车网络控制系统研究.....程广洋,王云飞,周洋,刘力豪(121)

基于手势识别远程同步控制的智能机械臂研究.....黄晓林,周浩锋,曾泳达,谢志雄(128)

## • 军事装备测控技术 •

潜艇水下毁伤试验综合测量与分析方法研究.....韩大伟,张东俊,王天忠,杨卫东(132)

电磁曲射炮实验装置的设计与实现.....	刘文昊,高传智,谢 玮 (137)
武器装备测试数据立方体模型的构建.....	汪浩洋,吴 伟,向 超,唐 健,汤佳骏 (142)
某便携式自动充氮装置设计.....	张 驰,王天辉,刘宗杰 (147)
海战场雷达末制导系统抗干扰技术研究.....	姚 旺,丛彦超,孔志杰,赵晓宁,周国峰 (152)

**• 测试软件工程 •**

基于LabVIEW的自由射流风洞系统加热气流模拟软件设计.....	杨立英,刘晓敏 (156)
-----------------------------------	---------------

**• 设计与应用 •**

基于CPU+FPGA的临近空间信道模拟器设计.....	路 辉,董昕玉 (161)
应用大数据模型实现气象防雷的预警分析方法.....	刘鸿斌 (170)
基于K-SVD的星载GPS观测数据压缩方法.....	刘迎娜,赵里恒,李宏刚,董娟娟,李伟超 (174)
基于改进Live-Wire算法的无人机遥感影像标注.....	崔红霞,陈丽君,赵昊罡 (182)
配电线路拓扑及台户区分自校验系统的研究.....	吴宗兵,董冉昊,廖 苏,张世权 (187)
基于小模数减速器两冗余多圈绝对编码器研制.....	熊 伟,王 臻,马亚军,侍 威,李文璋 (192)
基于加权特征投影的信源数估计方法.....	王 纯,高于晰 (198)
通信距离约束下异构水下爬游机器人任务分配.....	刘雅丽,高立娥,李 乐,郭利伟,刘卫东 (204)
高层次综合技术在遥测地面站数据处理中的应用.....	迟东明,刘兆辉,王燕玲 (210)
指控装备使用记录系统设计与实现.....	白 芳,郭宝锋,李召瑞 (215)
动车组牵引控制单元DSP程序设计与实现.....	王 丽,孙 华,陈 敬,张 东 (220)
基于振动的固态物料料位计模块设计.....	梁 玮,高天德 (226)
基于CODAC框架的托卡马克装置人身安全联锁系统研究.....	孙 江,夏 凡,吴 豪,李 波,王 硕 (233)
水下无线供电数据传输系统设计.....	刘佳炜,高天德,刘培洲,张博强 (238)
基于多工业机器人及变位机的自动焊接系统设计与仿真.....	刘海龙,杨 利,吴海波 (245)
孔间厚度对双孔法测定材料局部强度的影响及方法改进.....	牟 遇,张爱华,王 平,朱 亮,祁 靖 (250)
基于USRP的无线触发系统设计.....	高月红,陈 露,杨昊天 (256)
基于HPSO的自适应路由节点优化部署策略.....	樊成鹏,张丽娜 (262)

**• 试验与评价技术 •**

红外成像导引头抗干扰性能评价指标体系.....	闫 舟,杨望东 (268)
-------------------------	---------------

**• 智能仪器与传感技术 •**

一种可扩展的WSN节能分簇算法.....	王莹莹,郑永爱,王咏梅 (274)
----------------------	-------------------

# Contents

## • Summary and Comment •

Current Status and Development of Space Equipment Test Technology.....  
.....CAI Yuanwen,CHENG Long,XIN Chaojun,LIU Danghui,LI Yan,ZHANG Yu,XIE Weiqi(1)

## • Test and Fault Diagnosis •

Design of Spacecraft Fault Detection System Based on Autonomous Diagnosis and Reconstruction Technology.....  
.....WAN Lei,DAI Bin,JIANG Han(5)  
Launch Vehicle Fault Injection and Fault Diagnosis Based on MIL-STD-1553B Data Bus.....  
.....ZHAO Yan,LI Jia,XIE Shilu,WANG Deyi,CHEN Juan(10)  
Design of Vacuum Pumps Centralized Monitoring and Intelligent Fault Diagnostic System for Wind Tunnel Group....  
.....LUO Changjun,MA Yongyi,WANG Xiaofei,MING Lihong,FENG Chunyan(17)  
Rolling Bearing Fault Diagnosis Based on Weighted Dense Connection Network and Attention Mechanism.....  
.....ZHAO Yijin(23)  
Design of UAV Electrical Equipment Monitoring System Based on MCU Load Control.....WU Xia,LANG Yuqing(29)  
Design of Single Chip Microcomputer Detection System for Single Seed Metering Device.....JIAO Chuanyan(33)  
Research on Intelligent Recognition and Monitoring Method of Railway Passenger Abnormal Behavior.....  
.....LI Jun,CHEN Ruifeng,XU Chunjie,Li Xiaojun(37)  
Gear fault diagnosis based on Empirical Mode Decomposition and Signal diversity merging.....  
.....DENG Boyuan,CUI Weicheng,ZENG Qingsong,LI Chenxuan(43)  
Research on Noncontact Detection of Aeroengine Blade Based on Linear Laser Scanning.....  
.....LONG Zhi,ZHENG Qi,ZHANG Tianhui,FANG Jianjun,MA Yingchun(50)  
Obstacle Detection Method in Campus Based on Improved YOLOv3 and Stereo Vision.....  
.....Hu Dandan,ZHANG Lisha,ZHANG Zhongting(54)  
Testability Modeling and Analysis of Hierarchical Electromechanical System Based on Improved Bond Graph Method  
.....LONG Yufeng,SHI Xianjun,XIAO Zhicai,ZHANG Jie,YANG Yu(61)  
Design of Drill Depth Real-time Measuring System for Geological Exploration.....YUAN Liyan(67)  
Software System Test Method Based on Data Source Identification and Analyzing.....  
.....WEI Bo,ZHANG Huiying,SI Qianran(73)

## • Control Technology •

Design of Self-optimizing Control System for Intermittent Pumping of Low-production Wells Based on Internet of Things  
Technology.....GAO Juan,WANG Wei,PANG Bo,PANG Jing,GUO Zhenhua(78)  
Manned Robot Smooth Trajectory Planning and Auto-disturbance-rejection Tracking Control Method.....  
.....GAO Qingji,HOU Shihao,YUE Fengfa,XING Zhiwei(83)  
Regional Traffic Signals Control with Golden Ratio Dual Population Genetic Algorithm.....  
.....ZHANG Shiyu,JI Qichun,Meng Yuebo(90)  
A Burst Data Transmission Control Method of RT Device for Time Synchronization 1553B Bus Communication Protocol  
.....LAN Tian,ZHOU Fanhui,YANG Peiyao,ZHANG Hongjun,YU Sheng(95)  
Design of Sliding Mode Control System for 2-DOF Active Suspension Based on Fuzzy Neural Network.....LI Na(101)  
Design of Anti-jamming Attitude Control System of Quadrotor UAV Based on Hybrid Filtering.....  
.....HUANG Zhi,ZHANG Jianqianag,SU Runcong(105)  
Design and Application of Test Section Turntable Control System in Icingwind Tunnel.....  
.....XIONG Jianjun,RAN Lin,ZHAO Zhao,ZHANG Hongjian,LI Ziyu(110)  
High Precision Automatic Grasping and Discharging Method of Matching Robot Based on Gauss Newton Method.....  
.....DAI Kang,QIN Jianyong,XIE Kai(115)  
Research on Train Network Control System.....CHENG Guangyang,WANG Yunfei,ZHOU Yang,LIU Lihao(121)  
Research on Remote Synchronous Control of Intelligent Manipulator Based on Gesture Recognition.....  
.....HUANG Xiaolin,ZHOU Haofeng,ZEN Yongda,XIE Zhixiong(128)

## • Military Equipment Technology in Measurement and Control •

Study on Comprehensive Measuring and Analyzing Method of Underwater Submarine Damage Test.....  
.....HAN Dawei,ZHANG Dongjun,WANG Tianzhong,YANG Weidong(132)

Design and Realization of Electromagnetic Curve Shooting Gun Experimental Device.....	LIU Wenhao,GAO Chuanzhi,XIE Wei(137)
Establishment of Data Cube for Weapon Equipment Test.....	WANG Haoyang,WU Wei,XIANG Chao,TANG Jian,TANG Jiajun(142)
Design of Portable and Automatic Nitrogen Filling Equipment.....	ZHANG Chi,WANG Tianhui,LIU Zongjie(147)
Research on Anti-jamming Technology of Radar Terminal Guidance System in Naval Battlefield.....	YAO Wang,CONG Yanchao,KONG Zhijie,ZHAO Xiaoning,ZHOU Guofeng(152)

### ● Test Software Engineering ●

LabVIEW-based Design of Heating Air Flow Simulation Software for Free Jet Wind Tunnel System.....	YANG Liying,LIU Xiaomin(156)
---	------------------------------

### ● Design and Application ●

Design of a Near Space Channel Simulator Based on CPU+FPGA.....	Lu Hui,Dong Xinyu(161)
Application of Big Data Model to Realize Early Warning Analysis Method of Meteorological Lightning Protection.....	LIU Hongbin(170)
Compression Method of GPS Observation Data for Satellite Navigation Based on K-SVD.....	LIU Yingna,ZHAO Liheng,LI Honggang,DONG Juanjuan,LI Weichao(174)
Annotation Method of UAV Remote Sensing Images Based on Proposed Live-Wire Algorithm.....	CUI Hongxia,CHEN Lijun,ZHAO Haogang(182)
Research on Topology of Distribution Lines and Self-checking System for Distinguishing Between Households.....	WU Zongbing,Dong Ranhao,LIAO Su,ZHANG Shiquan(187)
Development of Two-redundant Multi-turn Absolute Encoder Based on Small Modulus Reducer.....	XIONG Wei,WANG Zhen,MA Yajun,SHI Wei,LI Wenzhang(192)
Estimation Method of Number of Sources Based on Weighted Eigenspace Projection.....	WANG Chun,GAO Yuxi(198)
Task Assignment of Heterogeneous Underwater Crawling Robots with Communication Distance Constraints.....	LIU Yali,GAO Li'e,LI Le,GUO Liwei,LIU Weidong(204)
Application of High-Level Synthesis in Data Processing of Telemetry Ground Station.....	Chi Dongming,LIU Zhaohui,WANG Yanling(210)
Design and Implementation of the Recording System of Command and Control Equipment.....	BAI Fang,GUO Baofeng,LI Zhaorui(215)
Design and Implementation of DSP Program for Traction Control Unit of EMU.....	WANG Li,SUN Hua,CHEN Jing,ZHANG Dong(220)
Design of Solid Material Level Meter Module Based on Vibration.....	LIANG Wei,GAO Tiande(226)
Research on Personal Safety Interlocking System of Tokamak Based on CODAC.....	SUN Jiang,XIA Fan,WU Hao,LI Bo,WANG Shuo(233)
Design of Data Communication System for Underwater Wireless Energy Transmission.....	LIU Jiawei,GAO Tiande,LIU Peizhou,ZHANG Boqiang(238)
Simulation and Design of Automatic Welding Workstation Based on Multi-industrial Robot and Positioner.....	LIU Hailong,YANG Li,Wu Haibo(245)
Effect of Thickness Between Double Holes in Double-holes Micro-shear Method on Determination of Local Strength of Material and Method Improvement.....	MU Yu,ZHANG Aihua,WANG Ping,ZHU Liang,QI Jing(250)
Design of Wireless Trigger System Based on USRP.....	GAO Yuehong,CHEN Lu,YANG Haotian(256)
Optimal Deployment Strategy of Adaptive Routing Nodes Based on HPSO.....	FAN Chengpeng,ZHANG Lina(262)

### ● Test & Evaluation Technology ●

Infrared Imaging Guide Head Anti-interference Performance Evaluation Index System.....	YAN Zhou,YANG Wangdong(268)
--	-----------------------------

### ● Intelligent Instruments and Sensing Technology ●

An Extensible and Energy-efficient Clustering Algorithm of WSN.....	WANG Yingying,ZHENG Yongai,WANG Yongmei(274)
---	--

# 计算机测量与控制

## Jisuanji Celiang Yü Kongzhi

2021年 第29卷 第9期 (总第276期)  
月刊 公开发行 1993年创刊

Computer Measurement & Control Vol.29 No.9  
Sep.2021 (Series 276) Monthly Started in 1993

资深顾问: 栾恩杰院士 张履谦院士

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 于大为 马恩云 王军政 王海亮 王海涛 王宪保 王鑫 支超有 凤雷 付平 付梦印 叶廷东  
兰智高 任祥顺 许川佩 刘才学 刘广武 刘文怡 刘亚斌 刘业峰 刘小雄 朱纪洪 华更新 乔立岩 吕翔  
邢兰昌 李清东 李剑 李凯 李祺 连晓峰 张友鹏 张航瑛 何怡刚 严涛 肖明清 吴响 吴伟  
吴亚东 陈建云 陈春俊 汪步云 周德云 庞新富 姚一杨 郭阳明 徐忠东 徐昕 高月红 常天庆 彭进业  
温鹏 路辉 蔡小斌 潘安君 魏清新

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

原刊名: 计算机自动测量与控制

社长: 奚全生

副社长: 肖登伟

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 顾捷 叶靖 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

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.jsjclyzk.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

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: 2021年9月25日

责任编辑: 唐德生

版权所有 未经同意 不得转载

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 Lüqian Academician

Director of editorial committee: Pan Xudong

Deputy director of editorial committee: Xi Quansheng

Publisher: Xi Quansheng

Deputy Publisher: Xiao Dengwei

Chief Editor: Gou Yongming

Deputy Chief Editor: Meng Hancheng

English Editor: Yang Lisheng

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

General Issue: Beijing Bureau for Distribution of Newspapers and Journals

Domestic Distributor: 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 /Sep. 2021

Domestic Price: ¥45/Each



微信服务号



微刊阅读

刊号: ISSN 1671-4598  
CN 11-4762/TP

邮发代号: 82-16

国外代号: M1480

定价: 45.00元

ISSN 1671-4598



9 771671 459213