

计算机测量与控制

2019年 第27卷 第5期 (总第248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: 于滨

编委会副主任: 奚全生 杨俊

编委会委员(按姓氏笔画排序):

于功敬 王国峰 王军政 王海亮 王海涛
支超有 孙肖南 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 刘亚斌
朱纪洪 朱培灿 华更新 李学锋 李绪志
乔立岩 吕 翔 张友鹏 张 琼 张宏军
张 雷 何怡刚 汪祖民 应怀樵 严 涛
肖明清 吴 响 杨 军 陈建云 陈建辉
周永彬 周德云 郭阳明 席震东 胡昌华
赵 雯 徐忠东 莫为铭 夏开建 栾咏红
阎 芳 常天庆 谢 维 程 进 鲍 斌
路 辉 蔡小斌 蔡远文 潘安君

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

刊 号: ISSN 1671-4598

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5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

• 综述与评论 •

软件故障定位技术研究综述 李 雷, 陈朝晖, 李 轶, 李经松 (1)
现代模拟电路故障诊断技术发展综述 李光升, 欧 博, 石海滨 (5)

• 测试与故障诊断 •

基于6LoWPAN和IPv6的猪舍环境远程监测系统 胡国强, 杨彦荣 (9)
基于深度卷积网络的复杂环境中绝缘子串特征检测
..... 纪 超, 黄新波, 曹 雯, 朱永灿, 张 烨 (13)
1000Base-T型网络物理层特征信号测试技术研究 杨 洋, 沈小青, 章文斌, 顾卫红 (18)
航空发动机整机振动测量和分析方法 刘 兵 (22)
基于深度信念网络的脑电信号疲劳检测系统 朱龙飞, 王鹏程 (26)
隐式半马尔科夫模型下的变压器故障诊断方法 李 刚, 米琛浩, 郑顾平, 夏彦卫 (30)
基于故障树的轨道交通车载电源可靠性分析
..... 李 恒, 柴晓冬, 徐纪康, 王 伟, 陆鑫源 (35)
基于改进布谷鸟算法-BP神经网络的松茸发酵过程软测量建模
..... 朱湘临, 宋 彦, 王 博, 丁煜函, 朱 莉, 姜哲宇, 陈 威 (39)
基于改进的神经网络对航空发动机故障率预测研究 薛永亮, 陈振林 (44)
电饭煲内胆不粘涂层厚度在线检测系统设计 钟新锋, 刘文榜, 王 冠, 刘 璨 (48)
蝙蝠算法优化极限学习机的滚动轴承故障分类
..... 覃爱淞, 吕运容, 张清华, 胡 勤, 孙国玺 (53)
基于改进小波包阈值降噪的滚动轴承故障分析 石志炜, 张丽萍 (58)
基于云计算的靶场测试装备可用性服务架构研究 余学锋, 文 海, 张开维, 赵增兴 (64)
基于中高空无人机的遥测中继系统研究 张雪冬 (67)
基于改进果蝇算法优化WKELM的医疗滚动轴承故障诊断技术研究
..... 何 成, 刘长春, 吴 涛, 武 洋, 徐 颖, 陈 童 (71)

• 控制技术 •

基于改进遗传模拟退火算法的BP神经网络的畸变校正研究 王 岚, 李新华 (77)
基于FPGA和EMIFA的SPI控制器系统设计 杨宇科, 王保成 (82)
基于PROFINET和VXI总线的1.2 m风洞测控系统设计与实现
..... 荣祥森, 邓章林, 贾 霜, 杨海滨, 马列波 (87)
小卫星对上级定向的姿控设计与验证 张宏德, 赵心欣, 卢 伟 (91)
全自动变压器绕线机自动排线控制技术研究 许家忠, 张 剑, 刘美军, 杨 海 (96)
电梯平衡链测长设备控制系统的设计与研究 史先传, 杭云龙, 徐镇冬, 苏胜辉 (100)

• 军事装备测控技术 •

四旋翼无人机飞控系统的设计与实现 张海军, 陈映辉 (105)
抗扰的板球控制系统的设计与应用 谢景卫 (109)
基于STM32的多功能翻身系统设计与控制 肖 蕾, 程武山 (114)

移动终端标准信息在线录入误差控制系统设计	王 昕,周育忠,石嘉豪,李俊超,王 宏	(118)
基于RTX64的软运动控制器设计与实现	杨 啸,李 迪,李 松,王世勇	(122)
基于无线通讯列车控制系统的全自动无人驾驶地铁系统研究		康海涛 (127)

• 测试软件工程 •

基于机器学习的军用软件过时淘汰评估方法研究	帅 勇,宋太亮,郑玉杰,郑雪松,唐 浩	(131)
-----------------------------	---------------------	-------

• 设计与应用 •

HGV平衡滑翔式轨迹可达区域计算方法研究	樊朋飞,郭云鹤,凡永华,闫 杰	(136)
虚拟停车电子围栏设计研究		彭育强 (141)
基于地理信息系统的低压配电用户安全预警系统	潘旭辉,王泽睿,任召廷,文 蕾,高斌彬	(145)
基于Android手机的家居安防系统的设计与实现	朱 玲,李艳东,徐凤霞,么洪飞	(150)
基于OpenCL的自动微分并行实现及其应用	叶爱芬,王 环,沈 雁	(155)
医学影像诊断学自主学习系统的设计与实践	孙 谦,肖雪雯,胡俊峰,吴 响	(160)
基于ABTS协议的FC-AE-1553交换管理模块研究与实现	朱浩文,杨凌云,张 震,罗 鹏,郑壁青	(164)
基于FPGA的高帧频图像跟踪系统设计		马帅旗 (169)
基于无线通信的配电网用户实时防窃电系统设计	蔡耀年,唐 杰,马燕玲,李贤靓	(173)
面向电压监测终端的远程升级加密通讯方法		包依勤 (178)
适用多种码速率的遥控副载波数字化解调设计	沈小虎,王翠莲,周 东	(183)
基于多旋翼无人机的热红外地表温度场反演系统设计	胡 鹏,伍光胜,傅铭治,罗意斓	(188)
基于仿人机械手的五指力封闭抓取算法	于建均,安 硕,阮晓钢,于乃功,张子豪	(192)
基于云计算的数据安全风险及防御策略研究		王晓妮,段 群 (199)
基于形状索引的DoG特征结合GPRT的人脸关键点检测算法		赵 康 (203)
采用自适应扰动观察法的光伏并网系统最大功率点跟踪	谢 维,饶国勇,蔡建美,李立新,陈 逊	(207)
模块化设计的智能物模采集平台研发与应用		董瑞强,乔志杰 (212)
无人售货的无线通信关键技术研究与应用		张俊文 (216)
面向多航天器协同的自主任务规划方法研究	陈 丹,程 伟,高延超,王怡健	(221)
基于Web的地形匹配系统设计与开发	高 香,宋敦江,梅 新	(226)
连接CNC系统和套料软件的中间件设计与实现	李科林,王静静,瞿少成	(231)
多旋翼无人机磁罗盘校准方法	程玮玮,宋延华,王 伟	(236)
高动态Ku/Ka双天线民航动中通系统设计	崔向宇,郝小鹏,张 勇	(240)
六足仿生机器人的设计与实现	樊启润,唐 彪,孙开鑫,万美琳,卢 仕	(245)
基于移动终端的智能看护系统设计	向 琦,陈 旭,王春城,刘满禄,任万春	(251)
步进电机恒流驱动电路设计	张 超,王 淳,张晓敏,张 晗,康建兵	(255)

• 试验与评价技术 •

基于FPGA数据采集的USBKey安全评估系统设计与实现	董 攀,白长虹	(260)
------------------------------------	---------	-------

• 智能仪器与传感技术 •

基于簇的无线传感器网络交会路由协议	杨 旭,王春佳,李 莉	(265)
基于片上系统+FPGA的航管雷达终端综合记录系统设计	杨东华,蔡委哲,王志祥,刘 楠	(271)
自动化列车通信网络分析仪设计	赵建博,孙晓东,胡国强,王新政,胡雪峰	(276)

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 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 /Mar.2019

Domestic Price: ¥40/Each

Overseas Price: \$12/Each

Contents

• Summary and Comment •

Overview of Software Fault Localization Technology.....
.....Li Lei, Chen Zhaohui, Li Yi, Li Jingsong(1)
Summary of Development of Modern Diagnostic Techniques of Analog Circuit Fault.....
.....Li Guangsheng, Ou Bo, Shi Haibin(5)

• Test and Fault Diagnosis •

Piggery Environment Remote Monitoring System Based on 6LoWPAN and WLAN.....
.....Hu Guoqiang, Yan Yanrong(9)
Research on Insulator String Detection Based on Improved Convolutional Neural Network.....
.....Ji Chao, Huang Xinbo, Cao Wen, Zhu Yongcan, Zhang Ye(13)
Research on Consistency Testing Technology of 1000Base-T Ethernet Physical Layer.....
.....Yang Yang, Shen Xiaoqin, Zhang Wenbin, Gu Weihong(18)
Vibration Measurement and Analysis of Aero-engine.....
.....Liu Bing(22)
EEG Fatigue Detection System Based on Deep Belief Network.....
.....Zhu Longfei, Wang Pengcheng(26)
Transformer Fault Diagnosis Method Based on Hidden Semi-Markov Model.....
.....Li Gang, Mi Chenhao, Zheng Guping, Xia Yanwei(30)
Reliability Analysis of Urban Rail Transit Vehicle Power Supply Based on Fault Tree.....
.....Li Heng, Chai Xiaodong, Xu Jikang, Wang Wei, Lu Xinyuan(35)
Soft Sensor Modeling of Matsutake Fermentation Based on Improved CS-BPNN.....
.....Zhu Xianglin, Song Yan, Wang Bo, Ding Yuhuan, Zhu Li, Jiang Zheyu, Chen Wei(39)
Study on Prediction of Aeroengine Failure Rate Based on Improved Neural Network.....
.....Xue Yongliang, Chen Zhenlin(44)
Design of on-line Detection System for Thickness of Unstick Coating in Rice Cooker.....
.....Zhong Xinfeng, Liu Wenbang, Wang Guan, Liu Can(48)
Rolling Bearing Fault Diagnosis Method Based on Extreme Learning Machine Optimized by Bat
Algorithm.....
.....Qin Aisong, Lü Yunrong, Zhang Qinghua, Hu Qin, Sun Guoxi(53)
Fault Analysis of Rolling Bearing Based on Improved Wavelet Packet Threshold Denoising.....
.....Shi Zhiwei, Zhang Liping(58)
Research of Range Test Equipment Service Architectures for Availability Based on Cloud Calculating
Analysis Technology.....
.....Yu Xuefeng, Wen Hai, Zhang Kaiwei, Zhao Zengxing(64)
Research of Telemetry Relay System Based on Medium-high Altitude Unmanned Aerial Vehicle.....
.....Zhang Xuedong(67)
Rolling Bearings Fault diagnosis researchbased on WKELM Optimized by Improved FOA Algorithm.....
.....He Cheng, Liu Changchun, Wu Tao, Wu Yang, Xu Ying, Chen Tong(71)

• Control Technology •

Study of Distortion Correction of BP Neural Network Based on Improved Genetic Simulated Annealing
Algorithm.....
.....Wang Lan, Li Xinhua(77)
Design of a SPI controller system based on FPGA and EMIFA.....
.....Yang Yuke, Wang Baocheng(82)
Design and Implementation of 1.2 m Wind Tunnel Measurement and Control System Based on
PROFINET and VXI bus.....
.....Rong Xiangsen, Deng Zhanglin, Jia Shuang, Yang Haibin, Ma Liebo(87)
Design and Verification of Small Satellite Attitude Control to Upper Stage Rocket.....
.....Zhang Hongde, Zhao Xinxin, Lu Wei(91)
Research on Tension Control Technology of Insulation Belt of Automatic Transformer Winding Machine
.....
.....Xu Jiazhong, Zhang Jian, Liu Meijun, Yang Hai(96)
Design and Study of Control System for Elevator Balance Chain Length Measuring Equipment.....
.....
.....Shi Xianchuan, Hang Yunlong, Xu Zhendong, Su Shenghui(100)

• Military Equipment Technology in Measurement and Control •

Research and Implementation of Flight Control System of Quadrotor Unmanned

Aerial Vehicle.....	Zhang Haijun, Chen Yinghui(105)
Design and Application of Ball Plate Control System.....	Xie Jingwei(109)
Design and Control of Multi-function Turning System Based on STM32.....	Xiao Lei, Cheng Wushan(114)
Design of Online Error Control System for Mobile Terminal Standard Information....	Wang Xin, Zhou Yuzhong, Shi Jiahao, Li Junchao, Wang Hong(118)
Research and Implementation of Soft Motion Controller Based on RTX64.....	Yang Xiao, Li Di, Li Song, Wang Shiyong(122)
Research for Fully Automatic Operation Based on CBTC Metro System.....	Kang Haitao(127)

● Test Software Engineering ●

Military Software Obsolescence Evaluation Based on Machine Learning.....	Shuai Yong, Song Tailiang, Zheng Yujie, Zeng Xuesong, Tang Hao(131)
--	---

● Design and Application ●

Footprint Calculation of HGV with Equilibrium Gliding Trajectory.....	Fan Pengfei, Guo Yunhe, Fan Yonghua, Yan Jie(136)
Research on Virtual Parking Electronic Fence Design.....	Peng Yuqiang(141)
Security Pre-warning System of Low Voltage Distribution Power Users Based on Geographical Information System.....	Pan Xuhui, Wang Zerui, Ren Zhaoting, Wen Lei, Gao Binbin(145)
Design and Implementation of Home Security System Based on Android Phone.....	Zhu Ling, Li Yandong, Xu Fengxia, Yao Hongfei(150)
Automatic Differentiation Based on OpenCL Parallel Computing and Its Application.....	Ye Aifen, Wang Huan, Shen Yan(155)
Design and Practice of Autonomous Learning System for Medical Imaging Diagnostics.....	Sun Qian, Xiao Xuewen, Hu Junfeng, Wu Xiang(160)
Research and Implementation of FC-AE-1553 Bus Exchange Management Module Based on ABTS Protocol.....	Zhu Haowen, Yang Lingyun, Zhang Zhen, Luo Peng, Zheng Biqing(164)
Design of High Frame Rate Image Tracking System Based on FPGA.....	Ma Shuaiqi(169)
Design of Real-time Anti Theft System for Distribution Network Users Based on Wireless Communication...Cai Yaonian, Tang Jie, Ma Yanling, Li Xianliang(173)	
Remote Upgrading Encryption Communication Method for Voltage Monitoring Terminal.....	Bao Yiqin(178)
Remote Sub-carrier Digital Demodulation for Multiple Code Rates.....	Shen Xiaohu, Wang Cuilian, Zhou Dong(183)
Design of Thermal Infrared Surface Temperature Field Inversion System Based on Multi Rotor UAV...Hu Peng, Wu Guangsheng, Fu Mingzhi, Luo Yilan(188)	
Five-finger Closed Grasp Algorithm Based on Humanoid Manipulator.....	Yu Jianjun, An Shuo, Ruan Xiaogang, Yu Naigong, Zhang Zihao(192)
Research on Data Security Risk and Defense Strategy Based on Cloud Computing.....	Wang Xiaoni, Duan Qun(199)
Shape Index Based DoG Feature and GPRT Face Key Detection Algorithm.....	Zhao Kang(203)
Maximum Power Point Tracking Using Adaptive Perturbation and Observation Algorithm for Grid-connected Photovoltaic System.....	Xie Wei, Rao Guoyong, Cai Jianxian, Li Lixin, Chen Xun(207)
Development and Application of Modular Design Intelligent Physical Simulation Acquisition Platform.....	Dong Ruiqiang, Qiao Zhijie(212)
Research on Wireless Communication Technology of Unmanned Sales.....	Zhang Junwen(216)
Research on Self-organization Mission Planning for Multi-spacecraft Coordination.....	Chen Dan, Cheng Wei, Gao Yanchao, Wang Yijie(221)
Design and Development of Web-based Terrain Matching System.....	Gao Xiang, Song Dunjiang, Mei Xin(226)
Design and Implementation of Middleware for Connecting CNC System and Nesting Software.....	Li Kelin, Wang Jingjing, Qu Shaocheng(231)
Calibration Method of Magnetic Compass for Multi-Rotor UAV.....	Cheng Weiwei, Song Yanhua, Wang Wei(236)
Design of High Dynamic Ku/Ka Dual-antenna Civil Aviation System.....	Cui Xiangyu, Xi Xiaopeng, Zhangyong(240)
Design and Implementation of Hexapod Bionic Robot.....	Fan Qiqun, Tang Biao, Sun Kaixin, Wan Meilin, Lu Shi(245)
Design of Intelligent Care System Based on Mobile Terminal.....	Xiang Qi, Chen Xu, Wang Chuncheng, Liu Manlu, Ren Wanchun(251)
Design of Constant Current Driver Circuit of Stepper Motor.....	Zhang Chao, Wang Chun, Zhang Xiaomin, Zhang Han, Kang Jianbing(255)

● Test & Evaluation Technology ●

Design and Implementation of a USBkey Equipment Security Evaluation System Based on Real-time Acquisition of FPGA....	Dong Pan, Bai Changhong(260)
---	------------------------------

● Intelligent Instruments and Sensing Technology ●

Cluster-based Wireless Sensor Network Rendezvous Routing Protocol.....	Yang Xu, Wang Chunjia, Li Li(265)
Design of Integrated Recording System for Air Traffic Control Radar Terminal Based on SOC and FPGA.....	Yang Donghua, Cai Weizhe, Wang Zhixiang, Liu Nan(271)
Automatic Train Communication Network Analyzer Design.....	Zhao Jianbo, Sun Xiaodong, Hu Guoqiang, Wang Xinzheng, Hu Xuefeng(276)