



中国期刊全文数据库(CJFD)全文收录期刊  
“万方数据—数字化期刊群”全文上网期刊

中国学术期刊综合评价数据库统计源期刊  
《中国核心期刊(遴选)数据库》收录期刊

ISSN 1672-6413  
CN 14-1319/TH

2023 6

# 机械工程与自动化

MECHANICAL ENGINEERING  
& AUTOMATION

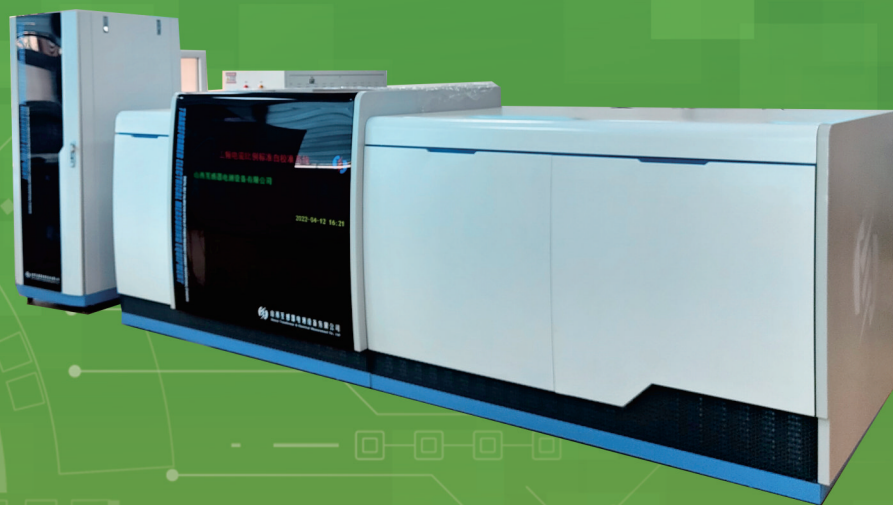
■ 山西省机电设计研究院有限公司

■ 山西省机械工程学会

JIXIE GONGCHENG YU ZIDONGHUA JIXIE GONGCHENG YU ZIDONGHUA



山西互感器电测设备有限公司  
Shanxi transformer electrical measuring equipment co.,LTD



ISSN 1672-6413



9 771672 641235



地 址：山西省太原市胜利街228号

电 话：0351-3185443 0351-3045332

邮 编：030009

机械工程与自动化

二〇二三年

第六期

## 编辑委员会

委 员:(以姓氏笔划为序)

王文先 王守信 王志恒  
王 铁 申若虹 吕 明  
刘建成 许并社 池成忠  
张士宏 张建民 张建林  
张治民 张保国 李永堂  
李保成 李 桓 杨世春  
晋民杰 徐弘山 郭会光  
黄庆学 谢克明 韩 焱

主 编: 赵屹涛

主管部门: 中国机械科学研究总院集团有限公司

主办单位: 山西省机电设计研究院有限公司

山西省机械工程学学会

编辑出版: 《机械工程与自动化》编辑部

地 址: 太原市胜利街228号

邮政编码: 030009

电 话: (0351) 3084269

发行范围: 国内外发行

国内发行: 山西省邮政报刊发行局

邮发代号: 22-117

国外发行: 中国国际图书贸易总公司

国外代号: BM8245

印 刷: 山西省建筑科学研究院印刷科技  
有限公司

出版日期: 双月中旬

封面设计: 崔建英

广告经营许可证号: 1400004000080

刊 号: ISSN 1672-6413  
CN 14-1319/TH

期 定 价: 12.00元

网址: <http://www.meajournal.com>

邮箱: [jxgcbjb8@163.com](mailto:jxgcbjb8@163.com)

# 目 次

· 试验研究 ·	
仿象鼻绳驱连续型机械臂结构设计及运动学分析 .....	冯家琪, 全伟才, 赵建豪, 许靖伟, 唐炫铭, 刘 博 (1)
基于 Anylogic 的民用飞机客舱应急撤离仿真研究 .....	尹莉萍, 方鹏亚, 任淑红 (4)
不锈钢管悬伸长度对车削颤振稳定性影响分析 .....	李和伟, 梁 利, 孙兴伟, 杨赫然 (6)
轴承预紧力对电主轴刚度及使用寿命的影响分析 .....	郭 辉, 王英为, 张 亮, 杨文华, 徐方超, 孙 凤 (9)
基于组合振动的弱磁铁矿石颗粒分选 .....	张浩强, 覃东强, 蔡 柳, 卢森幸 (12)
基于自动驾驶道路场景的语义分割方法研究 .....	张佳琪, 袁 骏, 惠永科, 胡 勇, 张 睿 (15)
纳米陶瓷结合剂 CBN 砂轮磨削高温镍基合金研究 .....	王志辉, 徐升智, 白国庆 (19)
铝合金压印接头静力学性能及动态响应特性研究 .....	宋春雨, 雷 蕾, 金映丽, 赵志强, 石 也 (22)
均匀化热处理对电弧增材制造 GH4169 合金组织影响 .....	郑新蓉, 温东旭, 吴和保, 李建军 (25)
基于数字显微镜的高动态范围成像方法研究 .....	郑小钰, 杨赫然, 孙兴伟, 董祉序, 刘 寅 (29)
基于改进 RRT 算法的路径规划研究 .....	韩金利 (31)
激光冲击 TC4 钛合金残余应力热松弛数值模拟研究 .....	吴小燕, 汤 洋, 葛茂忠, 郭小军, 张永康, 马艳东 (34)
螺杆转子磨削去除深度研究 .....	陈斯睿, 孙兴伟, 袁立志, 董祉序, 刘 寅, 杨赫然 (37)
混合磁悬浮平台的零功率特性分析 .....	张晓友, 尚利冬, 赵 川, 孙 凤, 金俊杰, 徐方超 (40)
抬车方法对车体强度影响的试验研究 .....	李春超, 张培胜 (43)
阀控缸系统参数辨识方法研究 .....	张海洋, 梁 全 (46)
横风环境下明线运行列车气动特性分析 .....	马天放, 赵 洁, 张旭平 (49)
双目免标定视觉伺服系统 .....	刘楚天, 陈晓瀚, 胡嘉成 (52)
基于 BP 神经网络的集装箱制造过程绿色度评价研究 .....	张比鹏, 韩 聪, 王靖涵 (55)
· 计算机技术应用 ·	
关于电液伺服阀零位特性的多参数影响分析 .....	龙勇云, 闫立东, 潘旭东, 王广林 (58)
基于 CFD 的水冷板热性能仿真研究 .....	王一川, 潘 登, 刘奕成 (60)
基于 NX-MCD 平台的加工线设计与控制仿真研究 .....	奚晓嫵 (63)
基于 ABAQUS 软件的空气弹簧静刚度分析 .....	董军哲, 秦喜民, 周 盼, 杨 茂 (66)
基于 ANSYS 的云梯车梯臂模态分析 .....	冯 辉, 农 权, 孟 杰, 郭嘉璇, 罗芸莹 (69)
基于模态试验的动力电池箱上盖的优化设计 .....	鲁春艳, 韦毅恒, 赵锦华, 郭旭阳, 何安平, 万长东 (72)
采用 MATLAB 中的 SISO 工具设计 PID 控制系统 .....	杨通培, 陈溪奉 (75)
基于模型的工程机械安全控制研究与应用 .....	闫亚宾, 白 扬, 李 磊, 张 强 (78)
基于 CAE 与试验对标方法的汽车车轮研究 .....	邱祖峰, 罗茶根, 舒华英 (81)
锥角比对双锥药型罩射流成型影响的数值模拟 .....	郝 钢, 李艳飞, 刘裕涛 (84)
大跨度轻量化桥式起重机主梁有限元分析 .....	李秋来, 穆广金 (86)
针对 MiniLED 芯片载板的图像清晰度评价函数设计 .....	卢振威, 汤 晖, 林志杭, 吴诗锐, 梁明虎, 区校贤 (89)
基于模糊 PID 的双泵变频液压系统仿真分析 .....	刘显晖, 高 挺, 李建强, 杨 帆, 单争南 (91)
射频同轴电缆插入损耗影响因素综合分析 .....	杨建保 (94)
三孔仿形拉瓦尔喷嘴风冷淬火换热特性分析 .....	李明利, 杨 建, 高明昕, 徐祥宏 (96)

某轻卡蓄电池支架性能分析与轻量化设计 .....	李翔翼 (98)
· 机械设计 ·	
半自动口罩耳带焊接机设计与实现 .....	侯柏林 (101)
基于 TRIZ 的西林瓶自动轧盖机快换式轧刀设计 .....	武涛 (104)
基于 Arduino 起重运输机器人的设计 .....	杨得胜, 程嘉豪, 吕婷婷, 谭伟俊, 蔡琼仪, 何伟锋 (107)
高效青皮核桃处理一体机的设计与研究 .....	赖浩然, 黎骏轩, 刘雨洁, 何志良, 曾嘉俊 (111)
基于磁弱强化植入纳米润滑砂轮磨削装置设计 .....	曹勇斌, 谢攀, 曾振豪, 阳清 (114)
一种高效滚筒式防卡线滑轮机构设计 .....	罗艺华 (116)
攀爬除锈机器人的系统研究 .....	赫乾辰, 施嘉胜, 李小鹏, 乔俊福 (118)
圆管带式输送机设计要素探究 .....	张广生, 常小林 (120)
电池包自动安装设备结构设计与应用 .....	章丽 (123)
液压可调式皮带运输机的研发及应用 .....	赵黎, 韩丹, 翟常伟, 刘冬峰, 王凯, 张少卿 (125)
一种针对桥梁施工用混凝土搅拌装置的设计 .....	赵伟 (126)
某大型背架结构复合优化设计 .....	阳丁 (128)
综采工作面收尾清煤机设计 .....	管文雅 (130)
基于 SLAM 算法的清洁设备研究 .....	王琦, 崔志鹏, 曾祥明, 李佳睿, 薛培延, 乔俊福 (133)
· 工艺研究 ·	
多阶梯轴数控车削工艺设计与仿真加工 .....	金江 (135)
双机架平整兼二次冷轧机组宽展预报的研究 .....	夏铮, 宋志明, 郭晓萌, 张诚, 张冀 (138)
蒸汽发生器换热管衬管液压胀接工艺研究 .....	张梦金, 刘晓阳, 茹静 (140)
· 质量监测与故障诊断 ·	
基于压缩激励模块的工业产品缺陷分类算法 .....	刘瑞珍, 王冠程, 郭彪 (143)
浅谈电缆导体直流电阻试验检测的优化措施 .....	马玉翠, 杨腾飞, 马宝君, 李政 (146)
6063 铝辊表面异常腐蚀分析 .....	邓番林, 吴冰冰, 樊申腾, 张文彬, 曾志卫 (148)
影响偏光片清扫机清扫效果因素分析 .....	石鹏飞, 王荣鑫, 贾健, 胡文平, 宋俊耀, 马瑞雪 (150)
· 自动化技术 ·	
基于 Tengine 的实验室门禁系统的实现 .....	过怡, 詹鹏彦, 任义超 (153)
基于 Ethernet/IP 总线的堆垛天车控制系统设计 .....	张华龙 (155)
伺服控制在管端微粗设备中的应用 .....	杜学斌, 马辉, 高国杰, 马海宽, 高尚晖, 高璐 (159)
基于“电压法”的组合互感器误差测试方法 .....	周桐, 郑永杰 (162)
用于检测生化需氧量的恒温系统设计 .....	陈艺元, 刘长宇, 郭迅, 李玉瑛, 龙文昌, 林慧珍 (164)
智能织物气密性测试仪的研制 .....	何翔 (167)
绞车提升信号系统优化及应用 .....	王敏 (169)
矿用提升机变频调速控制系统设计 .....	郑海峰 (172)
基于 LiOH 净化密封舱空气检测系统设计 .....	史振宇, 江伟斌 (174)
· 实用技术 ·	
基于任务导向法汽车覆盖件检具的智能测量实训 .....	李刚, 牛卫晶 (177)
EBH315Q 掘进机在赵庄矿的应用 .....	王小龙 (180)
非金属壳体水压试验装备增压系统技术改进 .....	洪源隆, 李俊辉, 寇永乐, 马海宽 (182)
大型复杂箱体成型控制技术研究 .....	李臣达, 高杨, 贾江鹏, 李志敏, 崔卫则, 贾彦奎 (185)
滚筒式减速器(加载)试车方案的研究与应用 .....	朱海鹏, 石晓虎, 梅雪, 孙万喜 (187)
110 kV 备自投装置在智能化变电站的应用 .....	芦君艺 (189)
企业建设 IT 服务管理体系研究和应用 .....	郭志刚 (192)
动车组测力车钩研制方法探讨 .....	马丽英, 张培胜 (194)
山地齿轨交通接触轨防护罩工程设计方法 .....	钱科元, 杨阳, 张茂帆 (197)
斜沟煤矿选煤厂低压停送电系统远程智能改造 .....	杨正东 (199)
矿井局部通风管控系统研究与应用分析 .....	吴小斌 (202)
基于燃煤电厂动态分离器设备的改造与运行 .....	吴小明 (204)
智能电网中的调度自动化技术应用 .....	孙晓宇 (207)
矿用本质安全型开关电源研究 .....	蔡辉 (209)
一种定位节点绝缘阻值异常原因分析及优化 .....	郝涛广 (211)
基于 STM32 的多功能矿灯设计与验证 .....	段海贝 (213)
· 专题综述 ·	
智能变色涂层综述 .....	蒋志伟, 胡劲光, 杨沛, 魏雷 (215)
物联网的网络安全技术研究 .....	穆丽沙, 夏静文 (218)
车用发动机油性能评估方法研究进展 .....	曾振豪, 杨飞辉, 蒋志伟, 魏雷 (221)
氮化硅陶瓷球制备技术的研究进展 .....	徐欢 (224)
来稿须知 .....	(106)
征订启事 .....	(145)
· 机电新产品 ·	
山西互感器电测设备有限公司简介 .....	封面, 封底
中国机械科学研究总院集团有限公司简介 .....	封二
山西省机电设计研究院有限公司简介 .....	封三
《机械工程与自动化》2023 年 1~6 期总目次 .....	( I )
期刊基本参数: CN 14-1319/TH * 1972 * b * A4 * 230 * zh * P * ¥12.00 * 1 000 * 85 * 2023-12	

# MECHANICAL ENGINEERING & AUTOMATION

(Bimonthly, Started Publication in 1972)

No. 6, 2023

(Series No. 241)

## Contents

Structure Design and Kinematics Analysis of Rope-Driven Continuous Bionic Elephant-Trunk Robot Arm .....	
..... FENG Jia-qi, QUAN Wei-cai, ZHAO Jian-hao, XU Jing-wei, TANG Xuan-ming, LIU Bo	(1)
Simulation Study on Civil Aircraft Cabin Emergency Evacuation Based on Anylogic .....	YIN Li-ping, FANG Peng-ya, REN Shu-hong (4)
Analysis of Influence of Overhang Length of Stainless Steel Tube on Turning Flutter Stability .....	
..... LI He-wei, LIANG Li, SUN Xing-wei, YANG He-ran	(6)
Analysis of Influence of Bearing Preload on Rigidity and Service Life of Electric Spindle .....	
..... GUO Hui, WANG Ying-wei, ZHANG Liang, YANG Wen-hua, XU Fang-chao, SUN Feng	(9)
Particle Separation of Weak Magnetite Based on Combined Vibration .....	ZHANG Hao-qiang, QIN Dong-qiang, CAI Liu, LU Sen-xing (12)
Research on Semantic Segmentation Method Based on Autonomous Driving Road Scene .....	
..... ZHANG Jia-qi, YUAN Jun, HUI Yong-ke, HU Yong, ZHANG Rui	(15)
Study on Grinding High Temperature Nickel-Base Alloy with Nano-Ceramic Bonded CBN Wheel .....	
..... WANG Zhi-hui, XU Sheng-zhi, BAI Guo-qing	(19)
Study of Static Mechanical Properties and Dynamic Response Characteristics of Aluminum Alloy Clinched Joints .....	
..... SONG Chun-yu, LEI Lei, JIN Ying-li, ZHAO Zhi-qiang, SHI Ye	(22)
Effect of Homogenization Heat Treatment on Organization of GH4169 Alloy by Arc Additive Manufacturing .....	
..... ZHENG Xin-rong, WEN Dong-xu, WU He-bao, LI Jian-jun	(25)
Research on High Dynamic Range Imaging Method Based on Digital Micromirror .....	
..... ZHENG Xiao-yu, YANG He-ran, SUN Xing-wei, DONG Zhi-xu, LIU Yin	(29)
Research on Path Planning Based on Improved RRT Algorithm .....	HAN Jin-li (31)
Numerical Simulation Study on Residual Stress Thermal Relaxation of TC4 Titanium Alloy Treated by Laser Shock .....	
..... WU Xiao-yan, TANG Yang, GE Mao-zhong, GUO Xiao-jun, ZHANG Yong-kang, MA Yan-dong	(34)
Study on Grinding Removal Depth of Screw Rotor .....	
..... CHEN Si-ru, SUN Xing-wei, YUAN Li-zhi, DONG Zhi-xu, LIU Yin, YANG He-ran	(37)
Zero Power Characteristic Analysis of Hybrid Magnetic Levitation Platform .....	
..... ZHANG Xiao-you, SHANG Li-dong, ZHAO Chuan, SUN Feng, JIN Jun-jie, XU Fang-chao	(40)
Experimental Study on Effect of Lifting Method on Car Body Strength .....	LI Chun-chao, ZHANG Pei-sheng (43)
Research on Parameter Identification Method of Valve Controlled Cylinder System .....	ZHANG Hai-yang, LIANG Quan (46)
Analysis of Aerodynamic Characteristics of Open Line Running Trains in Crosswind Environment .....	
..... MA Tian-fang, ZHAO Jie, ZHANG Xu-ping	(49)
Binocular Calibration-Free Vision Servo System .....	LIU Chu-tian, CHEN Xiao-han, HU Jia-cheng (52)
Research on Green Degree Evaluation of Container Manufacturing Process Based on BP Neural Network .....	
..... ZHANG Bi-peng, HAN Cong, WANG Jing-han	(55)
Multi-Parameter Influence Analysis on Zero Position Characteristics of Electro-Hydraulic Servo Valve .....	
..... LONG Yong-yun, YAN Li-dong, PAN Xu-dong, WANG Guang-lin	(58)
Simulation Study on Thermal Performance of Water-Cooling Plate Based on CFD .....	WANG Yi-chuan, PAN Deng, LIU Yi-cheng (60)
Simulation Study of Machining Line Design and Control Based on NX-MCD Platform .....	XI Xiao-yan (63)
Static Stiffness Analysis of Air Spring Based on ABAQUS Software .....	DONG Jun-zhe, QIN Xi-min, ZHOU Pan, YANG Mao (66)
Modal Analysis of Ladder Arm of Ladder Truck Based on ANSYS .....	
..... FENG Hui, NONG Quan, MENG Jie, GUO Jia-xuan, LUO Yun-ying	(69)
Optimization Design of Upper Cover of Power Battery Box Based on Modal Test .....	
..... LU Chun-yan, WEI Yi-heng, ZHAO Jin-hua, GUO Xu-yang, HE An-ping, WAN Chang-dong	(72)
Design PID Control System by SISO Tool in MATLAB .....	YANG Tong-pei, CHEN Xi-feng (75)
Research and Application of Construction Machinery Safety Control Based on Model .....	
..... YAN Ya-bin, BAI Yang, LI Lei, ZHANG Qiang	(78)
Research on Automotive Wheels Based on CAE and Experimental Benchmarking Methods .....	
..... QIU Zu-feng, LUO Cha-gen, SHU Hua-ying	(81)
Numerical Simulation of Influence of Cone Angle Ratio on Jet Forming of Double-Cone Shaped Charge .....	
..... HAO Gang, LI Yan-fei, LIU Yu-tao	(84)
Finite Element Analysis of Main Beam of Long Span Lightweight Bridge Crane .....	LI Qiu-lai, MU Guang-jin (86)
Design of Evaluation Function for Image Definition for MiniLED Chip Carrier Board .....	
..... LU Zhen-wei, TANG Hui, LIN Zhi-hang, WU Shi-ru, LIANG Ming-hu, OU Xiao-xian	(89)
Simulation Analysis of Double-Pump Variable Frequency Hydraulic System Based on Fuzzy PID .....	
..... LIU Xian-hui, GAO Ting, LI Jian-qiang, YANG Fan, SHAN Zheng-nan	(91)
Comprehensive Analysis of Factors Affecting Insertion Loss of RF Coaxial Cable .....	YANG Jian-bao (94)
Analysis of Heat Transfer Characteristics of Air-Cooled Quenching of Three-Outlet Profiling Laval Nozzle .....	
..... LI Ming-li, YANG Jian, GAO Ming-xin, XU Xiang-hong	(96)
Performance Analysis and Lightweight Design of Light Truck Battery Bracket .....	LI Xiang-yi (98)
Design and Implementation of Semi-Automatic Mask Earband Welding Machine .....	HOU Bo-lin (101)
Design of Quick-Change Cutter for Automatic Capping Machine of Penicillin Bottle Based on TRIZ .....	WU Tao (104)

Design of Lifting Transport Robot Based on Arduino .....	YANG De-sheng, CHENG Jia-hao, LV Ting-ting, TAN Wei-jun, CAI Qiong-yi, HE Wei-feng (107)
Design and Research of High-Efficiency All-In-One Machine for Processing Green-Skin Walnut .....	LAI Hao-ran, LI Jun-xuan, LIU Yu-jie, HE Zhi-liang, ZENG Jia-jun (111)
Design of Grinding Device for Implanting Nano Lubricated Grinding Wheels Based on Magnetic Weak Strengthening .....	CAO Yong-bin, XIE Pan, ZENG Zhen-hao, YANG Qing (114)
Design of High Efficiency Drum Type Anti-Stuck Pulley Mechanism .....	LUO Yi-hua (116)
System Research of Climbing Derusting Robot .....	HE Qian-chen, SHI Jia-sheng, LI Xiao-peng, QIAO Jun-fu (118)
Research on Design Elements of Round Pipe Belt Conveyor .....	ZHANG Guang-sheng, CHANG Xiao-lin (120)
Structural Design and Application of Automatic Installation Equipment for Battery Pack .....	ZHANG Li (123)
Development and Application of Hydraulic Adjustable Belt Conveyor .....	ZHAO Li, HAN Dan, ZHAI Chang-wei, LIU Dong-feng, WANG Kai, ZHANG Shao-qing (125)
Design of Concrete Mixing Device for Bridge Construction .....	ZHAO Wei (126)
Compound Optimal Design of Large Back Frame Structure .....	YANG Ding (128)
Design of Coal Cleaning Machine for Fully Mechanized Coal Mining Face .....	GUAN Wen-ya (130)
Research on Cleaning Equipment Based on SLAM Algorithm .....	WANG Qi, CUI Zhi-peng, ZENG Xiang-ming, LI Jia-ru, XUE Pei-yan, QIAO Jun-fu (133)
Multi-Step Axis NC Turning Process Design and Simulation Processing .....	JIN Jiang (135)
Research on Spread Prediction of Double-Stand Temper and Secondary Cold Rolling Mill .....	XIA Zheng, SONG Zhi-ming, GUO Xiao-meng, ZHANG Cheng, ZHANG Ji (138)
Research on Hydraulic Expansion Process for Heat Exchange Tube Liner Pipe of Steam Generators .....	ZHANG Meng-jin, LIU Xiao-yang, RU Jing (140)
Defect Classification Algorithm for Industrial Products Based on Squeeze Excitation Module .....	LIU Rui-zhen, WANG Guan-cheng, GUO Biao (143)
Optimization Measures of DC Resistance Test of Cable Conductor .....	MA Yu-cui, YANG Teng-fei, MA Bao-jun, LI Zheng (146)
Analysis of Abnormal Corrosion on Surface of 6063 Aluminum Roller .....	DENG Pan-lin, WU Bing-bing, FAN Shen-teng, ZHANG Wen-bin, ZENG Zhi-wei (148)
Analysis of Factors Influencing Cleaning Effect of Polarizer Cleaner .....	SHI Peng-fei, WANG Rong-xin, JIA Jian, HU Wen-ping, SONG Jun-yao, MA Rui-xue (150)
Implementation of Laboratory Access Control System Based on Tengine .....	GUO Yi, ZHAN Peng-yan, REN Yi-chao (153)
Design of Control System for Stacking Overhead Travelling Crane Based on Ethernet/IP Bus .....	ZHANG Hua-long (155)
Application of Servo Control in Upsetting Equipment of Tube End .....	DU Xue-bin, MA Hui, GAO Guo-jie, MA Hai-kuan, GAO Shang-hui, GAO Lu (159)
Voltage Method-Based Error Measurement Method of Combined Transformer .....	ZHOU Tong, ZHENG Yong-jie (162)
Design of Thermostat System for BOD Measurement .....	CHEN Yi-yuan, LIU Chang-yu, GUO Xun, LI Yu-ying, LONG Wen-chang, LIN Hui-zhen (164)
Development of Intelligent Fabric Air-Tightness Tester .....	HE Xiang (167)
Optimization and Application of Winch Lifting Signal System .....	WANG Min (169)
Design of Frequency Conversion Speed Control System for Mine Hoist .....	ZHENG Hai-feng (172)
Design of Air Detection System for Purifying and Sealing Cabin Based on LiOH .....	SHI Zhen-yu, JIANG Wei-bin (174)
Intelligent Measurement Practical Training of Automotive Panel Inspection Tools Based on Task-Oriented Method .....	LI Gang, NIU Wei-jing (177)
Application of EBH315Q Roadheader in Zhaozhuang Coal Mine .....	WANG Xiao-long (180)
Technical Improvement of Pressurization System for Non Metal Shell Hydrostatic Testing Equipment .....	HONG Yuan-long, LI Jun-hui, KOU Yong-le, MA Hai-kuan (182)
Research on Control Technology for Forming Large and Complex Frames .....	LI Chen-da, GAO Yang, JIA Jiang-peng, LI Zhi-min, CUI Wei-ze, JIA Yan-kui (185)
Research and Application of Commissioning Scheme for Roller Reducer (Loading) .....	ZHU Hai-peng, SHI Xiao-hu, MEI Xue, SUN Wan-xi (187)
Application of 110kV Backup Automatic Switching Device in Intelligent Substation .....	LU Jun-yi (189)
Research and Application of IT Service Management System in Enterprise Construction .....	GUO Zhi-gang (192)
Discussion on Development Method of Force Measuring Coupler for EMU .....	MA Li-ying, ZHANG Pei-sheng (194)
Engineering Design Method of Mountain Rack Rail Traffic Contact Rail Protective Cover .....	QIAN Ke-yuan, YANG Yang, ZHANG Mao-fan (197)
Remote Intelligent Transformation of Low Voltage Power Shutdown and Delivery System in Coal Preparation Plant of Xiegou Coal Mine .....	YANG Zheng-dong (199)
Research and Application Analysis of Mine Local Ventilation Control System .....	WU Xiao-bin (202)
Transformation and Operation of Dynamic Separator Equipment Based on Coal-Fired Power Plant .....	WU Xiao-ming (204)
Application of Dispatching Automation Technology in Smart Grid .....	SUN Xiao-yu (207)
Research on Mine Intrinsically Safe Switching Power Supply .....	CAI Hui (209)
Reason Analysis and Optimization of Insulation Resistance Anomalies in Positioning Node .....	HAO Tao-guang (211)
Design and Verification of Multifunctional Mine Lamp Based on STM32 .....	DUAN Hai-bei (213)
Overview of Intelligent Color-Changing Coating .....	JIANG Zhi-wei, HU Jing-guang, YANG Pei, WEI Lei (215)
Research on Network Security Technology of Internet of Things .....	MU Li-sha, XIA Jing-wen (218)
Research Progress on Performance Evaluation Methods of Vehicle Engine Oil .....	ZENG Zhen-hao, YANG Fei-hui, JIANG Zhi-wei, WEI Lei (221)
Research Progress on Preparation Technology of Silicon Nitride Ceramic Balls .....	XU Huan (224)

**Sponsored by** Shanxi Design and Research Institute of Mechanical and Electrical Engineering Co., Ltd.  
Machine Engineering Society of Shanxi Province

**Edited and Published by** Editorial Department of Magazine MECHANICAL ENGINEERING & AUTOMATION

**Add No.** 228 Shengli Street, Taiyuan, Shanxi, China

**Postcode** 030009 **Tel** (0351) 3084269

**Chief Editor** Zhao Yitao

**E-mail** jxgcbj8@163.com

**Unified Number of Print** ISSN 1672-6413  
CN 14-1319/TH



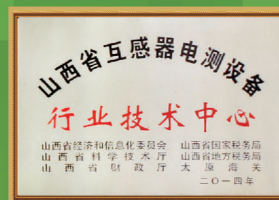
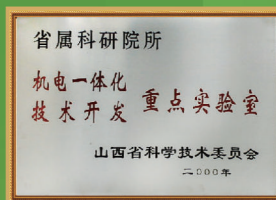
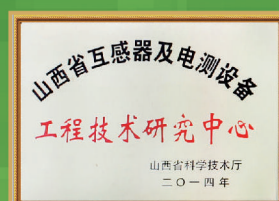
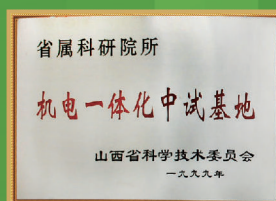
# 山西互感器电测设备有限公司

Shanxi transformer electrical measuring equipment co., LTD

山西互感器电测设备有限公司成立于1999年4月，是山西省机电设计研究院有限公司独资控股的国有企业，设有管理部、技术部（研发中心）、生产部、销售部、供应部、财务部和技术服务部，是一家集科研、开发、生产、销售、维护于一体的高新技术先进企业。二十多年来，主要服务于国家电网有限公司各省电能计量中心、各市地县供电分公司，以及各省市计量技术科学研究所；为全国60多家互感器生产厂家、工矿企业单位提供了600多种规格型号、10000多台套互感器标准及校验检测设备，产品销售遍布全国各地。

目前建有省级科研和技术服务平台4个：

- ◎ 山西省科技厅省属科研院所“机电一体化中试基地”
- ◎ 山西省科技厅省属科研院所“机电一体化技术开发实验室”
- ◎ 山西省科技厅“山西省互感器及电测设备工程技术研究中心”
- ◎ 山西省经信委“山西省互感器电测设备行业技术中心”



机电一体化重点实验室



技术开发重点实验室

地址：山西省太原市胜利街228号  
 邮编：030009  
 电话：0351-3185443    0351-3045332  
 传真：0351-3045332  
 网址：<http://www.sxhgq.com>  
 邮箱：[sxhgq2000@163.com](mailto:sxhgq2000@163.com)