



中文核心期刊·科技核心期刊  
主办单位：中国机械工程学会、北京机床研究所有限公司

ISSN 1005-2402  
CODEN ZYJIE8

# 制造技术与机床<sup>®</sup>

邹家华

# 7

ZHIZAO JISHU YU JICHUANG

MANUFACTURING TECHNOLOGY & MACHINE TOOL

# 2022



QK2225664



ISO9001:2015质量体系认证

ISO14001:2015 环境管理体系认证

ISO10012-2003 测量管理体系认证 (AAA)



**首批制造业单项  
冠军培育企业**



南京工艺官方微信



阿里巴巴官方网店

**南京工艺装备制造有限公司**

NANJING TECHNICAL EQUIPMENT MANUFACTURE CO., LTD.

地址：南京市江宁区滨江开发区飞鹰路79号

邮编：211178

电话：86-86561707 86586220

传真：86-25-86519408 86513814

http://www.njyigong.cn

E-mail: jm@njyigong.com

◆广告

ISSN 1005-2402



9 771005 240210

万方数据

# 目次

# CONTENTS

《制造技术与机床》2022年第07期(总第721期) No.07.2022 Total Issue No.721

## 1 | 国内外动态 / Information at Home and Abroad

### 工业机器人 / Industrial Robot

- 5 | 基于数字孪生的机器人实验平台设计/赵俊英 李云龙 邵欣 胡成琳 邓玖**  
Design of robot experiment platform based on digital twin/ZHAO Junying, LI Yunlong, SHAO Xin, HU Chenglin, DENG Jiu
- 11 | 基于改进粒子群算法的避障轨迹规划/马东阳 库祥臣 米显 杨星涛 赵欢乐**  
Obstacle avoidance trajectory planning based on improved particle swarm optimization algorithm/MA Dongyang, KU Xiangchen, MI Xian, YANG Xingtao, ZHAO Huanle
- 18 | 基于混合摩擦模型的机器人关节摩擦建模与仿真/董雅文 王鸿飞 张宝锋 宋栓军**  
Modeling and simulation of robot joint friction based on mixed hybrid friction model/DONG Yawen, WANG Hongfei, ZHANG Baofeng, SONG Shuanjun
- 23 | 多机器人协作的灵活性分析与仿真/陶平 邹成文 王天瑞**  
Flexibility analysis and simulation for multi-robot collaboration/TAO Ping, ZOU Chengwen, WANG Tianrui
- 28 | 基于多元策略改进的灰狼算法机器人路径规划/齐鹏飞 丁鑫**  
Based on multi-strategy improved grey wolf algorithm for robot path planning/QI Pengfei, DING Xin

### 重大应用需求 / Major Application Requirement

- 34 | 薄壁壳体结构狭小空间组合加工技术/杨凯 刘汉良 胡兴平 冯常喜 王鹏 吴迪**  
Narrow space combination machining technology for thin-walled shell structure/YANG Kai, LIU Hanliang, HU Xingping, FENG Changxi, WANG Peng, WU Di
- 40 | 一种大口径薄壁不锈钢风洞收缩段曲面加工方法/杨晓峰 江水 马东平 韩勇 李多 周荣田**  
A method for machining the curved surface of the contraction section of large-diameter thin-wall stainless steel wind tunne/YANG Xiaofeng, JIANG Shui, MA Dongping, HAN Yong, LI Duo, ZHOU Rongtian
- 45 | A286 高温合金十二角法兰面螺栓多工位冷镦成形工艺/郑鹏辉 关悦 许吉星 付建建 赵文龙 高程 刘乐**  
Multi station cold heading process of A286 superalloy twelve point flange bolt/ZHENG Penghui, GUAN Yue, XU Jixing, FU Jianjian, ZHAO Wenlong, GAO Cheng, LIU Le

### 特种加工 / Non-traditional Machining

- 51 | 模具钢表面超声辅助激光熔覆 Ni60 合金涂层的仿真与实验分析/李传钰 李金华 姚芳萍**  
Simulation and experimental analysis of ultrasonic assisted laser cladding Ni60 alloy coating on die steel/LI Chuanyu, LI Jinhua, YAO Fangping

- 58** | 短电弧放电凹坑形成的分子动力学仿真与实验研究/秦曹阳 周建平 许燕 汪兵兵 季玉 唐伟  
Molecular dynamics simulation and experimental research on crater formation in short electric arc milling/QIN Caoyang, ZHOU Jianping, XU Yan, WANG Bingbing, JI Yu, TANG Wei
- 65** | SiC 纳米介质电火花线切割高速低损加工研究/马秀丽 滕凯 孙涛 张磊  
Research on high efficiency and low loss machining of WEDM based on SiC nano working fluid medium/MA Xiuli, TENG Kai, SUN Tao, ZHANG Lei

### 综述 / Special Reports

- 69** | 制造企业工业物联网的发展与智能制造转型分析——基于三一重工的案例研究/和征 李彦妮 杨小红  
Analysis on the development of industrial internet of things and the transformation of intelligent manufacturing in manufacturing enterprises——based on the case study of Sany Heavy Industry/HE Zheng, LI Yanni, YANG Xiaohong
- 75** | 高档机床数控技术知识产权分析研究/刘萌 陈剑峰 何无为 赵涵卓  
Research on intellectual property of CNC technology for high-grade machine tools/LIU Meng, CHEN Jianfeng, HE Wuwei, ZHAO Hanzhuo

### 设计与研究 / Design and Research

- 81** | 外激波摆动活齿传动齿形设计与分析/李建宏 王士军 李家鹏 王剑 徐传法 王冉  
Design and analysis of the tooth profile of external shock wave swing movable teeth transmission/LI Jianhong, WANG Shijun, LI Jiapeng, WANG Jian, XU Chuanfa, WANG Ran
- 85** | 基于 LabVIEW 的大功率海上风电机组增速箱轴承试验机测控系统设计/秦永晋 郭亮 付力扬 陈志勇  
Design of measurement and control system of bearing tester for speed increase box of high-power offshore wind turbine based on LabVIEW/QIN Yongjin, GUO Liang, FU Liyang, CHEN Zhiyong
- 91** | 熔融沉积成型筒形件的尺寸收缩特征研究/王永周 刘健 南思豪 习大润 刘善慧  
Dimensional shrinkage of cylindrical parts fabricated by fused deposition modeling/WANG Yongzhou, LIU Jian, NAN Sihao, XI Darun, LIU Shanhuai
- 96** | 一种伺服压力机主传动机构的设计/姜利 朱灯林  
Design of main drive mechanism of servo press/JIANG Li, ZHU Denglin

### 工艺与制造 / Technology and Manufacture

- 101** | 面向低能耗高质量的数控加工参数优化与决策方法/武煜航 张华 鄢威  
Optimization and decision-making method for low energy consumption and high quality of NC machining parameters/WU Yuhang, ZHANG Hua, YAN Wei
- 109** | 深冷处理对抗氢钢薄壁构件初始残余应力及变形的影响/尚逢祥 孔金星 李昀桦  
Effect of cryogenic treatment on the initial residual stress and deformation of hydrogen-resistant steel thin-walled components/SHANG Fengxiang, KONG Jinxing, LI Yunhua
- 116** | 带肩衬套冷缩装配孔径收缩量仿真与试验研究/袁田 李小兵 陈保林 张安顺 张利  
Simulation and experimental study on shrinkage of diameter in cold shrink assembly of shoulder bushing/YUAN Tian, LI Xiaobing, CHEN Baolin, ZHANG Anshun, ZHANG Li

- 121** | 基于模面工程的侧围外板全工序成形仿真研究/蒋磊 李十全 王龙  
王大鹏 张雄飞 沈军奇  
Research on full process forming simulation of side outer panel based on die surface engineering/JIANG Lei, LI Shiquan, WANG Long, WANG Dapeng, ZHANG Xiongfei, SHEN Junqi
- 129** | 五轴数控系统的旋转轴速度规划方法/黎永杨 刘远凯 王科 葛鹏遥  
黄国辉  
Rotation axis velocity planning method for five-axis CNC system/LI Yongyang, LIU Yuankai, WANG Ke, GE Pengyao, HUANG Guohui

### 检测与质量 / Test and Quality

- 134** | 微量润滑对超精密加工固溶和时效马氏体钢的加工性能影响研究/郑中鹏  
金鑫 郭啸天 高瑞麟 李朝将  
Research on the effect of minimal quantity lubrication on the machining properties of ultra-precision machining solid solution and aging maraging steel/ZHENG Zhongpeng, JIN Xin, GUO Xiaotian, GAO Ruilin, LI Chaojiang
- 141** | 双摆台五轴磁流变机床结构参数标定方法研究/曾靖超 伍剑波  
Research on the calibration method of structural parameters of five-axis magnetorheological machine tool with double swing table/ZENG Jingchao, WU Jianbo
- 147** | 基于机器视觉的微电机摩擦片残缺检测/李玉萍 谢俊 王子贤 赵宇凡  
杨启志  
Defect detection of micromotor friction plate based on machine vision/LI Yuping, XIE Jun, WANG Zixian, ZHAO Yufan, YANG Qizhi
- 152** | 齿面硬化层对重载齿轮力学性能的影响研究/沈益晨 陈启东  
Influence of gear surface hardened layer on mechanical performance of heavy-duty gears/SHEN Yichen, CHEN Qidong

### 管理信息化 / Management and Informatization

- 158** | 麻雀搜索算法解决柔性作业车间调度问题/杨红雄 王惠酪  
Sparrow search algorithm to solve flexible job shop scheduling problem/YANG Hongxiong, WANG Huiming
- 165** | 基于等级邻域策略的偏序柔性车间优化调度/李长云 林多 何频捷  
谷鹏飞  
Optimal scheduling of partially ordered flexible job shop based on hierarchical neighborhood strategy/LI Changyun, LIN Duo, HE Pinjie, GU Pengfei
- 173** | 基于自适应遗传模拟退火算法的多目标车间布局优化/卢义桢 李西兴  
朱传军 吴锐  
Multi-objective workshop layout optimization based on adaptive genetic simulated annealing algorithm/LU Yizhen, LI Xixing, ZHU Chuanjun, WU Rui

更正 | 74

投稿须知 | 180



中文核心期刊·科技核心期刊  
主办单位：中国机械工程学会、北京机床研究所有限公司

ISSN 1005-2402  
CODEN ZYJIE8

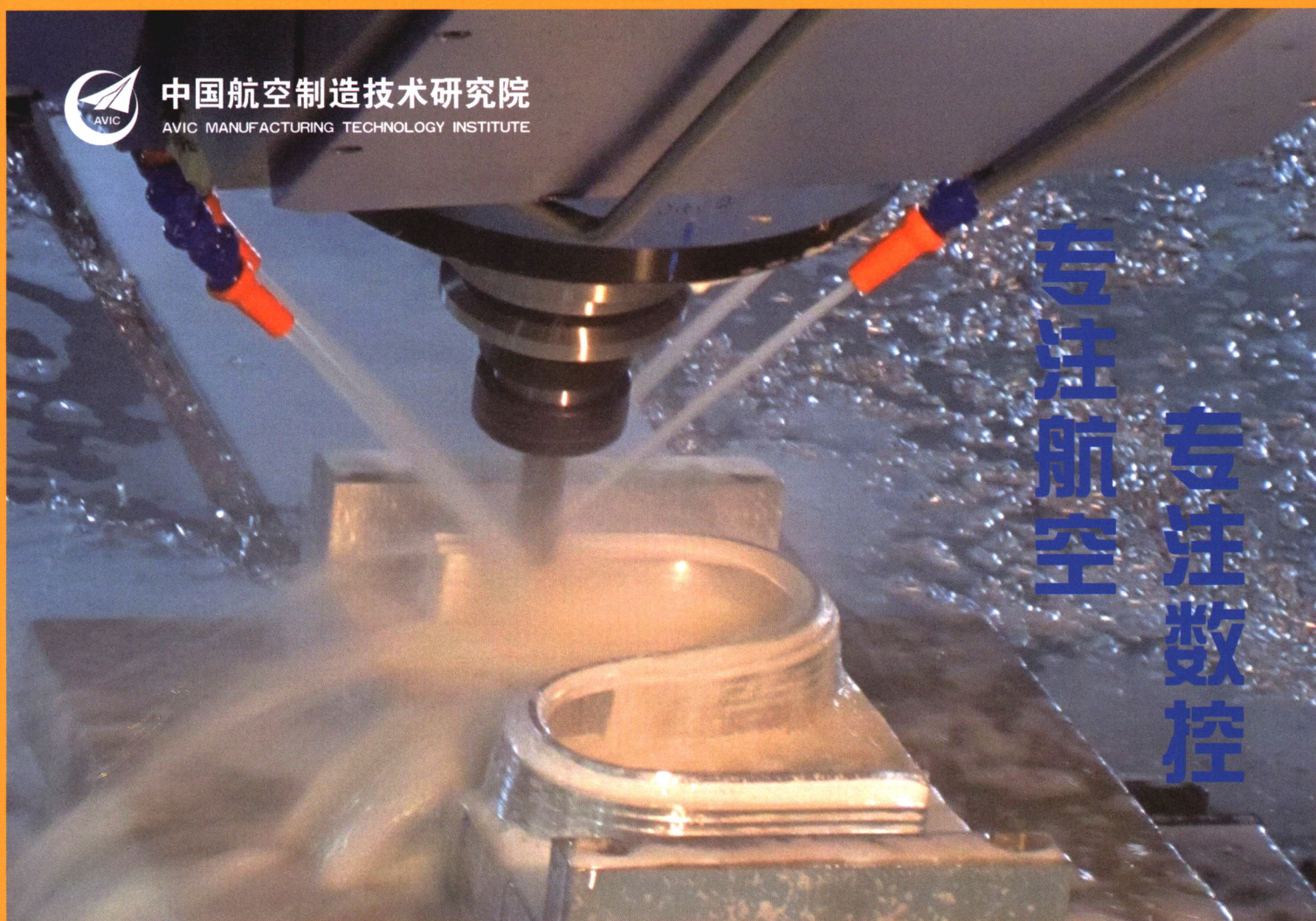
# 制造技术与机床<sup>®</sup> 7

ZHIZAO JISHU YU JICHUANG  
MANUFACTURING TECHNOLOGY & MACHINE TOOL

邵家华  
2022



中国航空制造技术研究院  
AVIC MANUFACTURING TECHNOLOGY INSTITUTE



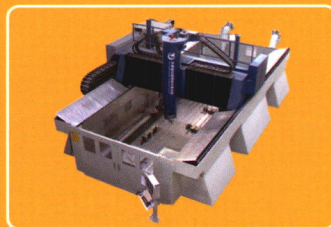
专注航空  
专注数控



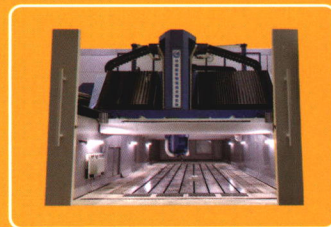
五坐标立式加工中心



五坐标卧式加工中心



桥式五坐标高速铣床



五坐标复材加工中心

◆广告

地址：北京市朝阳区朝阳路1号院 邮编：100024  
信箱：北京市340信箱(智能制造装备中心)  
网址：www.avicmti.avic.com

电话：010-85701247 85701436  
传真：010-85701615  
Email：market\_avicmti@163.com

