

PROCEEDINGS OF SPIE

***Fourth International Conference  
on Mechanical Engineering,  
Intelligent Manufacturing,  
and Automation Technology  
(MEMAT 2023)***

**Wanmi Chen  
Xiaogang Liu**  
*Editors*

**20–22 October 2023  
Guilin, China**

*Organized by*  
Guilin University of Electronic Technology (*China*)

*Sponsored by*  
AEIC Academic Exchange Information Centre (*China*)

*Published by*  
SPIE

**Volume 13082**

Part One of Two Parts

Proceedings of SPIE 0277-786X, V. 13082

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Fourth International Conference on Mechanical Engineering, Intelligent Manufacturing, and Automation Technology  
(MEMAT 2023), edited by Wanmi Chen, Xiaogang Liu, Proc. of SPIE Vol. 13082, 1308201  
© 2024 SPIE · 0277-786X · doi: 10.1117/12.3027525

Proc. of SPIE Vol. 13082 1308201-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at [SPIDigitalLibrary.org](http://SPIDigitalLibrary.org).

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:  
Author(s), "Title of Paper," in *Fourth International Conference on Mechanical Engineering, Intelligent Manufacturing, and Automation Technology (MEMAT 2023)*, edited by Wanmi Chen, Xiaogang Liu, Proc. of SPIE 13082, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X  
ISSN: 1996-756X (electronic)

ISBN: 9781510674820  
ISBN: 9781510674837 (electronic)

Published by  
**SPIE**  
P.O. Box 10, Bellingham, Washington 98227-0010 USA  
Telephone +1 360 676 3290 (Pacific Time)  
[SPIE.org](http://SPIE.org)  
Copyright © 2024 Society of Photo-Optical Instrumentation Engineers (SPIE).

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center at [copyright.com](http://copyright.com). Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL LIBRARY**  
[SPIDigitalLibrary.org](http://SPIDigitalLibrary.org)

---

**Paper Numbering:** A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

# Contents

xi *Conference Committee*

## Part One

### ROBOT MODELING AND ELECTRICAL AUTOMATION

---

- 13082 02 **Design and kinematic simulation of ankle joint rehabilitation parallel robot** [13082-182]
- 13082 03 **Study on air distribution of GIS machine room based on CFD simulation** [13082-146]
- 13082 04 **A method of radar antenna azimuth conversion based on oscilloscope** [13082-53]
- 13082 05 **Furniture panel image edge extraction method based on HSV color space segmentation**  
[13082-14]
- 13082 06 **Real-time visual-inertial SLAM based on RGB-D image and point-line feature with loop closure  
constraint** [13082-12]
- 13082 07 **Improvement of modeling method for engine room ventilation system** [13082-8]
- 13082 08 **The flexible voltage layering and hierarchical regulation for distributed photovoltaics**  
[13082-110]
- 13082 09 **Research on position error measurement and offline compensation of a 5 DOF series robot**  
[13082-107]
- 13082 0A **Experimental study on potential energy recovery and generation current characteristics of  
heavy electric forklift** [13082-135]
- 13082 0B **Research on material transportation robot based on PSO-PID controller** [13082-4]
- 13082 0C **Modeling and simulation of a solar array deployment mechanism** [13082-22]
- 13082 0D **PLC control method for speed regulation of automatic frequency converter of high-voltage  
electrical equipment** [13082-37]
- 13082 0E **Simulation design and optimization of multi-robot production line based on RobotStudio**  
[13082-121]
- 13082 0F **A deep reinforcement learning-based fault diagnosis algorithm for unlabeled and imbalanced  
data** [13082-44]
- 13082 0G **Research on the fastening scheme of screw group of electronic components based on finite  
element simulation** [13082-40]

- 13082 OH **Improved RRT-based path planning algorithm for 2D mobile robots** [13082-3]
- 13082 OI **Research on transformer load forecasting based on deep learning** [13082-60]
- 13082 OJ **Map representations for mobile robot localization** [13082-122]
- 13082 OK **Research on biomimetic hexapod unmanned combat platform based on machine vision**  
[13082-84]
- 13082 OL **A fault diagnosis method based on multi-agent reinforcement learning for small sample data**  
[13082-45]
- 13082 OM **A review on integral evolution of electro-hydraulic actuation in three momentous domains:  
aerospace, engineering machinery, and robotics** [13082-87]
- 13082 ON **Applications of convolutional neural networks in fault diagnosis of mechanical-electrical-  
hydraulic systems: a review** [13082-88]
- 13082 OO **Research on a high-precision virtual scene generation algorithm** [13082-55]
- 13082 OP **A sensor fusion-based optimization method for indoor localization** [13082-171]
- 13082 OQ **Online monitoring system for the operation status of rotary kiln supporting rollers** [13082-90]
- 13082 OR **A fire detection algorithm based on improved YOLOv5** [13082-123]
- 13082 OS **Research and implementation of intelligent robot based on visual follow** [13082-141]
- 13082 OT **Object detection and pose estimation method by RGB-D camera for robotic grasping**  
[13082-152]
- 13082 OU **Mobile robot path planning based on improved dung beetle optimization algorithm**  
[13082-184]
- 13082 OV **SOC estimation and simulation verification of lithium battery based on COA-EKF** [13082-127]
- 13082 OW **Driving intention recognition based on COA-LSTM network** [13082-120]
- 13082 OX **Fault diagnosis of traction transformer based on improved deep belief network** [13082-124]
- 13082 OY **Research on convolutional neural networks in motor fault diagnosis** [13082-57]
- 13082 OZ **Prediction and simulation of state of charge of li-ion battery for electric vehicle based on  
data-driven method** [13082-148]

- 13082 10 **A novel multi-task transfer model to realize unsupervised fault diagnosis of newly constructed wind turbines under variable conditions** [13082-106]
- 13082 11 **Impedance matching design of magnetically coupled resonant wireless power transmission based on class E power amplifier** [13082-169]

---

**MECHANICAL STRUCTURE DESIGN AND DEVICE OPTIMIZATION**

---

- 13082 12 **Design of x-y-θz large-stroke uncoupled parallel piezoelectric positioning platform** [13082-24]
- 13082 13 **Research on digital assembly technology of spacecraft based on model and bill of materials** [13082-71]
- 13082 14 **Design and research of non-contact measurement system for aircraft liquid flow** [13082-86]
- 13082 15 **Analysis and optimization of the gap elimination connection between a light chassis girder and the subframe** [13082-92]
- 13082 16 **Vibration reduction based on bionic elytra structure** [13082-43]
- 13082 17 **Analysis of lateral compression performance of composite sandwich structure** [13082-172]
- 13082 18 **The design improvement for hardware configuration method during FPGA loading** [13082-157]
- 13082 19 **Strength and accuracy analysis of thin-walled structures in 3D printing** [13082-2]
- 13082 1A **Multi-objective optimization design of high-speed elevator car based on aerodynamic characteristic surrogate model** [13082-113]
- 13082 1B **Design of protection resistor for a certain type of integrated power operational amplifier based on TRIZ theory** [13082-26]
- 13082 1C **Modeling and thermal simulation of alumina ceramic encapsulated copper-coated substrate** [13082-104]
- 13082 1D **Optimization design and experimental verification of a high-precision wafer carrier with high and low temperatures** [13082-85]
- 13082 1E **Research on mechanical structure optimization based on topology theory** [13082-177]
- 13082 1F **Design of voiceprint recognition algorithm based on triplet-loss-optimized deep learning** [13082-151]
- 13082 1G **Design and research of energy management strategy for pure electric vehicles based on dynamic programming algorithm** [13082-105]
- 13082 1H **Design of x-ray digital imaging software for transmission line flaw detection robot** [13082-65]

- 13082 1I **Experimental study on the hydraulic design of pool pumps and the effect of impeller balance holes on pump performance** [13082-13]
- 13082 1J **Design and optimization of multistaged Tesla valves using response surface methodology** [13082-129]
- 13082 1K **Analysis of key points in strength design of LPG storage tank support structure** [13082-156]
- 13082 1L **Design and experimentation of virtual assembly system based on candy packing machine** [13082-59]
- 13082 1M **Design of automatic up-and-down system of transmission line hardware crimping quality inspection robot** [13082-34]
- 13082 1N **Research on the design of remote avatar robot based on mixed reality and teleoperation** [13082-139]
- 13082 1O **Design of circumferential temperature monitoring system for rotary kiln based on LoRa technology** [13082-66]
- 13082 1P **Parametric design system for building mortise and tenon structures based on solid works** [13082-19]
- 13082 1Q **Design of intelligent garbage classification system based on Internet of Things technology** [13082-178]
- 13082 1R **Multi-level assembly deviation prediction of aircraft structure based on grey prediction theory** [13082-166]
- 13082 1S **Design and research on automatic insertion and bending wire device for power socket and soft wire connections** [13082-149]
- 13082 1T **Study on the mechanical properties of composite hybrid bolted/bonded joints structure** [13082-181]
- 13082 1U **Vibration characteristics analysis and structural optimization of a small-scale fully mixed feed mixer based on finite element method** [13082-20]
- 13082 1V **Structure design of table tennis intelligent picking robot** [13082-173]
- 13082 1W **Structural design of pineapple peeling machine** [13082-140]
- 13082 1X **Design of closed-loop control system and key components for heavy-duty industrial robots** [13082-64]

## Part Two

### MECHANICAL DYNAMICS AND EQUIPMENT PERFORMANCE SIMULATION

---

- 13082 1Y **A parameter matching and performance evaluation method for vehicle power system** [13082-41]
- 13082 1Z **Load-spectrum-based high-cycle fatigue life assessment of the crane arms** [13082-137]
- 13082 20 **Aerodynamic characteristics analysis of the tailback shape of a flying car based on LBM** [13082-125]
- 13082 21 **Research on aerodynamic noise reduction of automobile front cover based on a simplified fluid model simulation method** [13082-155]
- 13082 22 **The current research status of heat transfer models for hot rolling strip** [13082-9]
- 13082 23 **Blade parameters optimization of pendulum mill based on discrete element analysis of particle kinematics** [13082-160]
- 13082 24 **Establishment of a geometric model for weld beads based on welding parameters** [13082-188]
- 13082 25 **Dynamics model and control strategy of powered catwalk** [13082-154]
- 13082 26 **Summary of intelligent fault diagnosis technology for vertical mills** [13082-189]
- 13082 27 **Defect prediction of large-size aluminum alloy wheel hub in low pressure die casting process** [13082-52]
- 13082 28 **Experimental study on steering wheel shimmy of the vehicle** [13082-39]
- 13082 29 **Weighted multi-source information fusion network-based framework for mechanical fault diagnosis** [13082-168]
- 13082 2A **Research on the heat dissipation method of space optical remote sensor with complex orbital heat flux** [13082-108]
- 13082 2B **Modeling and performance analysis of an integrated thermal management system for electric vehicle** [13082-50]
- 13082 2C **Experimental study on the performance of oscillating heat pipe with hybrid fluids of ammonia and liquid metal** [13082-102]
- 13082 2D **Experimental study on heat transfer characteristics of medium-temperature oscillating heat pipe with kerosene** [13082-101]
- 13082 2E **Research on strength and fatigue model of circuit breaker energy storage spring based on SVM algorithm** [13082-16]

- 13082 2F **Effect of liquid solder on shear strength of solder/Cu porous joint** [13082-100]
- 13082 2G **NVH performance optimization of trimmed body based on noise transfer function** [13082-15]
- 13082 2H **Visualization of flat-plate oscillating heat pipe by infrared thermal imaging** [13082-91]
- 13082 2I **Experimental study of vibration reduction based on the flexible damping gear** [13082-103]
- 13082 2J **Analysis and optimization of large fast reactor straight-pull hoists** [13082-97]
- 13082 2K **Measurement of hydrodynamic coefficient of underwater robotic arm based on vortex-induced vibration** [13082-81]
- 13082 2L **Discussion on interface fatigue damage of type IV composite hydrogen storage cylinder** [13082-115]
- 13082 2M **Thermal coupling analysis of axlebox bearing in high speed EMU** [13082-83]
- 13082 2N **Modal analysis of hydraulic excavator working device based on workbench** [13082-93]
- 13082 2O **Research on the failure and fracture factors of spring in high voltage circuit breakers** [13082-76]
- 13082 2P **Experimental and simulation study on dynamic stiffness characteristics of spring oscillator isolator model** [13082-162]
- 13082 2Q **Fault analysis and impact weight calculation of marine diesel engine unable to start based on fault tree and analytic hierarchy process** [13082-153]
- 13082 2R **Simulation and optimization of the effect of surface grooves on mineral particle separating behaviour of spiral concentrator** [13082-132]
- 13082 2S **Optimization of heat dissipation performance of engine compartment based on SSA-RBFNN-NSGA-II** [13082-134]
- 13082 2T **Research on global optimal matching of dynamic parameters of RSS pedestal-bearing rotor system** [13082-11]
- 13082 2U **Experimental study of leg member bolted joint slippage and its effects on mechanical behavior of lattice transmission tower** [13082-95]
- 13082 2V **Research on parameter identification method for the power transmission auxiliary system of tracked vehicles based on MOGA-LSTM** [13082-94]
- 13082 2W **Research on the performance improvement of MCR-WPT by hyperscatterers** [13082-147]

## MICROCOMPUTER INSPECTION AND AUTOMATION CONTROL

---

- 13082 2X **Construction of a knowledge graph for the full lifecycle data of customized furniture panel production** [13082-75]
- 13082 2Y **Research progress of cooling control systems after hot rolling** [13082-10]
- 13082 2Z **Automatic inspection technology of reservoir area using edge intelligence and UAV** [13082-165]
- 13082 30 **Clamping force control strategy of electromechanical brake system** [13082-48]
- 13082 31 **Automatic control method of diesel locomotive braking system based on PLC technology** [13082-36]
- 13082 32 **Local fisher formation identification method based on shield tunneling parameters** [13082-117]
- 13082 33 **Greenhouse monitoring system based on the Internet of Things** [13082-54]
- 13082 34 **Research on variable depth cutting simulation and grinding experiment of 18CrNiMo7-6 carburized steel** [13082-98]
- 13082 35 **Experimental research on water washing process of gas turbine blades** [13082-62]
- 13082 36 **Strong stabilized joint probabilistic data association method of autoregulatory gating in vehicle nonlinear multi-target tracking** [13082-96]
- 13082 37 **Research on a linear actuator with mechanical synchronous lifting** [13082-164]
- 13082 38 **MPC-based lane keeping for commercial vehicles with steering dead zone consideration** [13082-61]
- 13082 39 **Research on steady state drift control of unmanned vehicle based on model predictive control** [13082-118]
- 13082 3A **A PID algorithm based on convolutional neural network for pointing stabilization control of synchrotron radiation beams** [13082-23]
- 13082 3B **A label placement method based on the enhanced Fruchterman–Reingold algorithm for industrial parts inspection** [13082-183]
- 13082 3C **Optimizing maintenance strategies for reciprocating compressors using reliability-centered maintenance and on-line fault diagnosis system** [13082-186]
- 13082 3D **Research on control strategy of grid-connected multiple inverters in parallel under the transient condition** [13082-119]
- 13082 3E **Finite element analysis of axial stiffness of S-shaped welded metal bellows** [13082-180]

- 13082 3F **Simulation and optimization of furniture production line based on digital factory** [13082-63]
- 13082 3G **Sn-58Bi/Cu porous joint formation under air condition without pressure** [13082-99]
- 13082 3H **Wood texture detection based on optimized deep belief network model with multiple feature fusion** [13082-176]
- 13082 3I **Application of adaptive surrogate model in heat treatment production line of aviation manufacturing enterprise** [13082-35]
- 13082 3J **Dynamic contact finite element analysis of cycloidal wheel based on needle roller connection without cage** [13082-175]
- 13082 3K **Study on critical speed of four-pad tilting-pad bearing rotor system** [13082-27]
- 13082 3L **Development situation and application analysis of automatic loading and unloading technology in storage and logistics industry** [13082-30]
- 13082 3M **Modeling and simulation of aircraft siphoning fuel transfer system** [13082-89]
- 13082 3N **Active suspension PID control based on improved Honey Badger Algorithm** [13082-42]
- 13082 3O **Novel detection method for the balance coefficient of the traction elevator** [13082-46]
- 13082 3P **Study of evaporative cooling fins for rotary kiln pallet lubricant cooling system** [13082-67]
- 13082 3Q **Intelligent air conditioning control system based on human infrared thermal imaging** [13082-78]
- 13082 3R **Research on the measurement device of UAV firearm unlocking force** [13082-38]
- 13082 3S **Research on water cooling technology for hot spots in rotary kiln cylinder** [13082-68]
- 13082 3T **Real-time adaptive cruise control strategy based on linear variable parameter /H<sup>\*</sup> control** [13082-6]
- 13082 3U **Experimental and simulation study on chatter stability region of an integral impeller with continuous non-uniform allowance** [13082-79]
- 13082 3V **The hot deformation of c83600 tin bronze alloy based on Arrhenius constitutive models** [13082-32]
- 13082 3W **In-machine ultrasonic measurement of hollow blade wall thickness** [13082-5]
- 13082 3X **Simulation and analysis of ship rudder blade force based on finite element method** [13082-185]
- 13082 3Y **Analysis of multi-working conditions and unsteady cavitation flow characteristics of single-seat control valve** [13082-25]

# Conference Committee

## *General Conference Chairs*

**Kailin Pan**, Guilin University of Electronic Technology (China)  
**Eckart H. Meiburg**, University of California, Santa Barbara  
(United States)

## *Technical Program Committee Chair*

**Qixin Cao**, Shanghai Jiao Tong University (China)

## *Publication Chair*

**Xiaogang Liu**, Wuhan University of Technology (China)

## *Organizing Committee*

**Wanmi Chen**, Shanghai University (China)  
**Mingyang Chen**, Jiangsu University (China)  
**Ke Chen**, Hefei University of Technology (China)  
**Jing Zhao**, Xi'an Mingde Institute of Technology (China)  
**Rongyun Zhang**, Anhui Polytechnic University (China)  
**Hao Peng**, Yangtze Normal University (China)  
**Xue Han**, Chongqing Jiaotong University (China)

## *Technical Program Committee*

**Hamid Reza Karimi**, Politecnico di Milano (Italy)  
**Ziad Mounni**, ENSTA ParisTech (France)  
**Yue Zhang**, Georgia Southern University (United States)  
**Kuan Yew Wong**, Universiti Teknologi Malaysia (Malaysia)  
**Hazizan Md Akil**, Universiti Sains Malaysia (Malaysia)  
**Seeram Ramakrishna**, National University of Singapore (Singapore)  
**Yasuto Hijikata**, Saitama University (Japan)  
**Eckart H. Meiburg**, University of California, Santa Barbara  
(United States)  
**David Bassir**, French University of Technology (France)  
**Mohamed Kamal Ahmed Ali**, Wuhan University of Technology (China)  
**Gang Li**, University of Maryland, Baltimore County (United States)  
**Sajid Iqbal**, University of Engineering and Technology Lahore  
(Pakistan)  
**Ajay Kumar Agarwal**, JB Knowledge Park (India)  
**Xuegong Yu**, Zhejiang University (China)  
**Sheng-Rui Jian**, I-Shou University (China)

**Volkan Kahya**, Karadeniz Technical University (Turkey)  
**David E. Esezobor**, University of Lagos (Nigeria)  
**Nour F. Attia**, National Institute of Standards (Egypt)  
**Yipin Wang**, Chang'an University (China)  
**Mohamed Ahmed Ramadan**, Helwan University (Egypt)  
**Mukuna Patrick Mubiayi**, University of Johannesburg (South Africa)  
**Quah Hock Jin**, Universiti Sains Malaysia (Malaysia)  
**Alexander Lukin**, Western-Caucasus Research Center (Russian Federation)  
**R. Ranjith Kumar**, Viyen Biotech LLP (India)  
**Hicham Bakkali**, University of Cadiz (Spain)  
**Rusdi Nur**, Politeknik Negeri Ujung Pandang (Malaysia)  
**Ang Zi Yang Adrian**, Newcastle University in Singapore (Singapore)