

PROCEEDINGS OF SPIE

Fourth International Conference on Testing Technology and Automation Engineering (TTAE 2024)

**Sumeet S. Aphale
Ajit Jha**
Editors

**27–29 September 2024
Xiamen, China**

Organized by
Fuzhou University (China)

Sponsored by
AEIC Academic Exchange Information Centre (China)

Published by
SPIE

Volume 13439

Proceedings of SPIE 0277-786X, V. 13439

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

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.

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 Testing Technology and Automation Engineering (TTAE 2024)*, edited by Sumeet S. Aphale, Ajit Jha, Proc. of SPIE 13439, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510686649

ISBN: 9781510686656 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

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. 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

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*

INTELLIGENT MECHANICAL DESIGN AND OPTIMIZATION TECHNOLOGIES

- 13439 02 **Research on the principle of dishwasher water efficiency device** [13439-65]
- 13439 03 **Static calibration device for portable braking performance tester based on bilateral laser digital display tilt box** [13439-43]
- 13439 04 **Dynamic measurement method for indoor large-scale standard device based on dual laser trackers** [13439-10]
- 13439 05 **Study on calibration of direct mercury analyzer** [13439-8]
- 13439 06 **Research on the array eddy current technology of thimble tube in reactor** [13439-86]
- 13439 07 **Design of a pulse-type ultrasonic Doppler fetal heart detection system** [13439-13]
- 13439 08 **Design and implementation of intelligent remote control system for natural gas valves** [13439-76]
- 13439 09 **Research on experimental testing method of motion characteristic parameters of projectile in bore** [13439-118]
- 13439 0A **TDLAS gas concentration retrieval application via SPFE-WV with deep learning** [13439-30]
- 13439 0B **Design and development of testing device for medical microwave therapeutic apparatus** [13439-45]
- 13439 0C **Study on electromagnetic ultrasonic thickness measurement echo processing method based on ChOA-adaptive VMD algorithm** [13439-11]
- 13439 0D **DPG-Unet for reflections removal on cigarette box surface** [13439-84]
- 13439 0E **Design of an autonomous obstacle-avoiding underground environment monitoring device based on STM32** [13439-110]
- 13439 0F **Optimization of indeterminate pressure leakage regulation and control in drainage networks based on attenuated hydroacoustic signal recognition algorithm** [13439-85]
- 13439 0G **Development of quality control materials (QCMs) for ruby color grading** [13439-21]

- 13439 OH **Research on the failure mechanism of closing resistance under impulse current** [13439-37]
- 13439 OI **Analysis of influence of porosity on electric field and temperature in pre-insertion resistors** [13439-93]
- 13439 OJ **Improved active disturbance rejection control-based research on trajectory tracking for multi-degree-of-freedom manipulators** [13439-15]
- 13439 OK **Fuzzy force control for industrial robots based on position inner loop** [13439-28]
- 13439 OL **Modeling and simulation of kinematics and dynamics of wire-driven robots** [13439-23]
- 13439 OM **Preparation of superhydrophilic/superoleophobic wettability on porous copper foam surface and oil and water separation** [13439-34]
- 13439 ON **AMI-based electric energy meter status assessment technology** [13439-114]
- 13439 OO **Research on dynamic path planning of UUV based on improved ant colony algorithm and dynamic collision avoidance strategy** [13439-39]
- 13439 OP **Development and application of remote sensing transformer winding deformation tester** [13439-123]
- 13439 OQ **Design of multifunctional tire mounting device for automobiles** [13439-138]
- 13439 OR **A software designed for automated measurement and control of digital multimeters** [13439-62]
- 13439 OS **Design of remote verification module of oscilloscope DC gain based on LabVIEW** [13439-106]
- 13439 OT **A transformer-based model for two-phase flow imaging by electrical resistance tomography** [13439-108]

MECHANICAL FAILURE MONITORING AND PROTECTION METHODS

- 13439 OU **Bearing condition monitoring and fault diagnosis based on parabolic acoustic mirror and blind source separation** [13439-52]
- 13439 OV **Fault diagnosis of rolling bearings based on parabolic acoustic mirror and support vector machine** [13439-48]
- 13439 OW **Bearing fault detection based on area equalization** [13439-141]
- 13439 OX **Simulation on detection of double cracks by resistance measurement for conductive concrete** [13439-17]

- 13439 0Y **Vehicle-vehicle collision test dummy injury research and analysis** [13439-83]
- 13439 0Z **A data-driven fault isolability analysis method for gas pressure regulators** [13439-97]
- 13439 10 **PLC failure program analysis and countermeasure research** [13439-77]
- 13439 11 **Measurement methods of mass property parameters of crash test dummies** [13439-92]
- 13439 12 **Fault diagnosis system for hydropower equipment based on expert knowledge base**
[13439-6]
- 13439 13 **Health monitoring of converter tilting reducer equipment based on stress wave technology**
[13439-7]
- 13439 14 **Research on energy efficiency statistics and online monitoring scheme of port fuel oil
equipment under dual carbon background** [13439-12]
- 13439 15 **Research on failure state identification method of wellhead device based on acoustic
emission technology** [13439-2]
- 13439 16 **Experimental study on vibration diagnosis of insulation faults in gas-insulated metal-
enclosed switchgear** [13439-90]
- 13439 17 **Deep learning-based belt conveyor roller fault detection research** [13439-36]
- 13439 18 **Analysis of influence factors of machine visual instrument in surface settlement monitoring
of open-cut station project** [13439-80]
- 13439 19 **Rapid power restoration technology for distribution network faults based on minimum
network loss** [13439-115]
- 13439 1A **Fault isolation technology for distribution network based on wide area information
processing** [13439-132]
- 13439 1B **Research on wafer warping monitoring based on digital twin** [13439-73]
- 13439 1C **Assessment of plastic damage of duplex X80 pipeline steel based on ultrasonic
longitudinal wave** [13439-98]
- 13439 1D **Fault detection based on locally linear embedding for traction systems in high-speed trains**
[13439-113]
- 13439 1E **Calibration error compensation technique for strain testing system** [13439-134]
- 13439 1F **Fault diagnosis of rolling bearings based on improved FMD and Autogram** [13439-60]
- 13439 1G **Intelligent monitoring method of bearings based on PCA-SOM** [13439-79]

- 13439 1H **Study on the influence of the difference of anti-corrosion coatings on CP potential in pipelines** [13439-100]
- 13439 1I **Research on fast analysis method for fault location of static VAR compensator** [13439-54]

INTELLIGENT OPTOELECTRONIC DETECTION AND TECHNOLOGY RESEARCH

- 13439 1J **Comparative study on penetration and eddy current testing for welding defects in aluminum alloy** [13439-42]
- 13439 1K **Research on flexible intelligent testing technology and engineering application of substation switch** [13439-26]
- 13439 1L **Automatic atrial fibrillation detection based on feature engineering and deep learning** [13439-3]
- 13439 1M **Deep learning model for rice disease detection** [13439-38]
- 13439 1N **Ground-based cloud detection using mixture losses** [13439-75]
- 13439 1O **Lean quality inspection and control technology for key components in high-end equipment manufacturing** [13439-56]
- 13439 1P **Maximum power point tracking (MPPT) techniques in distributed photovoltaic generation systems** [13439-133]
- 13439 1Q **Multilayer fuzzy detection of substation operation risk based on PSO optimised BP neural network** [13439-71]
- 13439 1R **Research and implementation of key intelligent detection technologies based on deep learning** [13439-18]
- 13439 1S **Feasibility study on measuring jitter of moving plane with dial indicator** [13439-20]
- 13439 1T **Visual inspection technology for substation insulator sweeping robot** [13439-128]
- 13439 1U **Research on debris detection technology for aerospace electrical connectors** [13439-81]
- 13439 1V **Lightweight improvements to detection models based on synthetic samples** [13439-126]
- 13439 1W **Application and detection of generative adversarial network-based surface defect generation on blade surface** [13439-88]
- 13439 1X **Analysis of water inflow from diversion tunnel of hydropower station based on computer vision technology and 3D spatial modeling** [13439-129]

- 13439 1Y **Detection of ice-melting from ice bottom interface based on transmissive fiber optic sensor** [13439-57]
- 13439 1Z **EEG fatigue detection method based on attention mechanism and multifeature fusion convolutional neural network** [13439-53]
- 13439 20 **Research on detection method of textile fiber composition based on CNN** [13439-24]
- 13439 21 **Research on online inspection technology for wellhead equipment based on phased array ultrasonic testing** [13439-33]
- 13439 22 **Enhancing temperature measurement accuracy in thermostatic metal bath through heat conduction optimization** [13439-49]
- 13439 23 **Quantification of crack in-pipe detection signals in steel pipelines based on differential eddy current detection technique with incremental permeability extraction** [13439-67]
- 13439 24 **Research on rapid localization of radiation sources based on single detector** [13439-31]
- 13439 25 **Precision uncertainty analysis and correction of thru-reflect-match calibration technology in vector network analyzer measurement** [13439-124]
- 13439 26 **Research on zero-value insulator detection method based on infrared imaging characteristics** [13439-27]
- 13439 27 **Research progress on yarn tension detection and control technology** [13439-19]
- 13439 28 **Fusion of visible light and EEG signals for a driving distraction and road rage detection system** [13439-136]
- 13439 29 **Stress detection experiment and simulation of oil and gas pipelines under geomagnetism** [13439-64]
- 13439 2A **Defect detection of CNG cylinders based on ultrasonic pulse echo method and improved HRNet** [13439-89]
- 13439 2B **Measurement of water content of oil-water emulsions under shear conditions** [13439-139]

INTELLIGENT SYSTEM SECURITY AND AUTOMATION CONTROL

- 13439 2C **Design of dishwasher energy and water efficiency detection system based on Siemens PLC and configuration king** [13439-66]
- 13439 2D **Research on intelligent mooring safety monitoring technology based on ship networking** [13439-61]
- 13439 2E **Application of big data analysis technology in industrial intelligent inspection system** [13439-99]

- 13439 2F **Research on mural damage recognition method based on deep reinforcement learning**
[13439-69]
- 13439 2G **Intelligent identification algorithm for safety risks of transmission line maintenance operations based on deep learning** [13439-46]
- 13439 2H **The infusion monitoring system based on LabVIEW and contact switch** [13439-140]
- 13439 2I **New scheme for performance evaluation of digital acquisition medical devices** [13439-32]
- 13439 2J **Adaptive complex illumination image enhancement algorithm based on Retinex**
[13439-16]
- 13439 2K **Electric power personnel safety monitoring method based on intelligent image processing**
[13439-103]
- 13439 2L **Research on image recognition technology based on improved YOLOv5** [13439-51]
- 13439 2M **A method of providing synthetic dataset for robotic arm grasping an object** [13439-120]
- 13439 2N **Recognition of voids in pavement based on GPR time-frequency features and sparse autoencoder** [13439-70]
- 13439 2O **A zero-shot image denoising pipeline for space target detection** [13439-14]
- 13439 2P **Applications of visual navigation and intelligent recognition technology** [13439-94]
- 13439 2Q **Rapid search methods for UAVs in space launch missions** [13439-111]
- 13439 2R **CA-TimeMixer-based action recognition and scoring** [13439-109]
- 13439 2S **Improved object detection networks for internal oil and gas pipeline inspection** [13439-72]
- 13439 2T **Research on fuzzy control algorithm of intelligent washing machine** [13439-87]
- 13439 2U **A novel in-motion initial alignment method for SINS assisted by DVL** [13439-117]
- 13439 2V **LFD-SLAM: improved point line combination feature algorithm based on ORB-SLAM2**
[13439-40]
- 13439 2W **Two-stage workpiece recognition algorithm based on Mask-RCNN and template matching**
[13439-101]
- 13439 2X **Metaverse of intelligent distribution system for rail transit** [13439-47]

- 13439 2Y **Demonstration project of energy management system based on cloud platform for rail transit** [13439-58]
- 13439 2Z **Driver physiological condition assessment system based on image-based photoplethysmography** [13439-105]
- 13439 30 **Development and application of weld seam detection robot weld recognition technology based on machine vision** [13439-74]
- 13439 31 **Research on automatic driving scene object detection algorithm based on improved YOLOv8** [13439-55]
- 13439 32 **SpectralNet-based soil structure characterization** [13439-135]
- 13439 33 **Research on low power control of coal mine roof and floor wireless sensor networks** [13439-82]
- 13439 34 **Research on interface recognition technology for drilled concrete pile based on PSO-GA-BP neural network** [13439-121]