

PROCEEDINGS OF SPIE

# ***Second International Conference on New Power System and Power Electronics (NPSPE 2025)***

**Fushuan Wen  
Jinfeng Wang**  
*Editors*

**26–28 December 2025  
Haikou, China**

*Organized by*  
Murdoch University (Australia)

*Sponsored by*  
School of Energy and Power Engineering, University of Shanghai for Science and Technology  
(China)  
College of Electric Power, Inner Mongolia University of Technology (China)  
Smart Energy Storage Institute (China)

*Published by*  
SPIE

**Volume 14129**

Proceedings of SPIE 0277-786X, V. 14129

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](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 *Second International Conference on New Power System and Power Electronics (NPSPE 2025)*, edited by Fushuan Wen, Jinfeng Wang, Proc. of SPIE 14129, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9798902322177

ISBN: 9798902322184 (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 © 2026 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

ix *Conference Committee*

---

## POWER SYSTEM ANALYTICS AND MARKET MECHANISMS

---

- 14129 02 **Research on intelligent charging and discharging management methods for electric vehicles based on user response modelling** [14129-17]
- 14129 03 **Operational characteristic analysis of renewable energy power systems with high penetration of grid-forming converters** [14129-19]
- 14129 04 **Structural optimization of ultra-high-head pumped-storage units for ensuring the safety of the new-type power system** [14129-30]
- 14129 05 **Research on knowledge graph-enhanced intelligent agent for distribution network fault processing** [14129-31]
- 14129 06 **Impact of large-scale distributed photovoltaic integration on distribution network voltage** [14129-40]
- 14129 07 **Optimization strategy for photovoltaic clusters based on cloud-edge collaboration** [14129-41]
- 14129 08 **Design of a multiagent simulation and game theory framework for intelligent decision-making in electricity trading** [14129-48]
- 14129 09 **Stability-aware forecasting of power-operation cost volatility under non-stationary data streams** [14129-58]
- 14129 0A **A cost-oriented coordinated method for resource allocation and scheduling in power grid emergency repair** [14129-78]
- 14129 0B **Source-storage coordinated configuration method for remote microgrids considering equipment non-smooth characteristics and scenario adaptability** [14129-3]
- 14129 0C **Stability analysis of an offshore float-over installation vessel for the new power system** [14129-5]
- 14129 0D **Construction method of power-to-ammonia integrated energy power system based on dynamic game protocol** [14129-9]
- 14129 0E **Multi-objective optimization study on operating parameters of hydrogenerator based on genetic algorithm** [14129-11]
- 14129 0F **Optimization method for microgrid operation control and relay settings considering harsh environmental conditions** [14129-18]

- 14129 OG **Transient stability analysis of grid-forming converters based on trajectory analysis method** [14129-20]
- 14129 OH **Optimization of electricity spot market trading mechanism and peak-shaving compensation under high proportion of renewable energy integration** [14129-47]
- 14129 OI **Research on optimal voltage regulation and control of distribution network stations considering the integration of photovoltaics and electric vehicles** [14129-71]
- 14129 OJ **A study on non-cooperative games in industrial park energy and power markets based on the Shapley method** [14129-10]
- 14129 OK **Cost of transmission-distribution network investment portfolios under demand uncertainty: tariff pass-through and robust constrained optimization** [14129-84]

---

**OPTICAL SENSING, NEW ENERGY FORECASTING, AND ENERGY STORAGE MANAGEMENT**

---

- 14129 OL **Optimization method for site selection and sizing of energy storage system based on improved PSO** [14129-6]
- 14129 OM **Anomaly detection in electric power metering based on data mining technology** [14129-39]
- 14129 ON **Multisource data fusion status sensing models for integrated photovoltaic-storage-charging systems** [14129-49]
- 14129 OO **SLPM: state of health prediction of li-ion power batteries using Mamba** [14129-50]
- 14129 OP **A 0.821 ppm/°C temperature coefficient, -88dB PSR, low noise bandgap reference for battery management system** [14129-62]
- 14129 OQ **Research and optimization of large-scale power load forecasting model based on transformer** [14129-72]
- 14129 OR **Research on stacking ensemble prediction of photovoltaic power fusing physical priors and spatiotemporal downscaling** [14129-75]
- 14129 OS **Physics-informed stacking ensemble with random forest for short-term photovoltaic power forecasting** [14129-76]
- 14129 OT **A wind power prediction method integrating multivariate decomposition and spatiotemporal modeling** [14129-77]
- 14129 OU **Probabilistic prediction of LCOE for pumped storage power stations based on XGBoost-KDE hybrid model** [14129-80]
- 14129 OV **A CNN-LSTM based carbon price forecasting model and its impact on green grid dispatch cost functions** [14129-2]

- 14129 0W **State of charge estimation for lithium-ion batteries based on impedance spectrum feature fusion extraction** [14129-8]
- 14129 0X **Analysis and evaluation of electric power metering data based on machine learning algorithms** [14129-26]
- 14129 0Y **Research on short-term prediction of carbon intensity in power systems based on multisource data fusion and deep learning** [14129-32]
- 14129 0Z **A method for evaluating the status of electric energy metering devices combining the Osprey Algorithm and Deep Belief Networks** [14129-35]
- 14129 10 **Research on the application of localized microenvironment satellite weather stations in power system risk assessment** [14129-55]
- 14129 11 **A dual-channel parallel physical-statistical coupling model with dynamic fusion for day-ahead photovoltaic power forecasting** [14129-59]
- 14129 12 **A photovoltaic power prediction method using backpropagation neural network with an improved osprey optimization algorithm** [14129-60]
- 14129 13 **Online impedance spectroscopy measurement and influencing factors analysis of PV module based on a two-phase boost converter** [14129-85]

---

#### OPTOELECTRONIC DEVICES, POWER EQUIPMENT CONDITION SENSING, AND DIAGNOSIS

- 14129 14 **Influence of PRTV coating thickness on aging characteristics under corona discharge** [14129-12]
- 14129 15 **Research on electrical parameter monitoring technology for agricultural scenarios based on fiber optic sensing** [14129-33]
- 14129 16 **Preparation and band structure study of PEDOT-MoS<sub>2</sub>/n-Si heterojunction** [14129-42]
- 14129 17 **The mutual inductance calculation between the loop coil and the grounding grid using the superposition theorem method** [14129-51]
- 14129 18 **Fault diagnosis of hydropower units based on a GNN-LSTM hybrid model** [14129-66]
- 14129 19 **A reliability-centered maintenance optimization model for wind turbines: strategy design and empirical validation** [14129-68]
- 14129 1A **Construction of a deep network-based insulation status assessment system for oil-paper capacitor-type bushings** [14129-70]
- 14129 1B **Research on temperature field and ampacity calculation for high-voltage AC submarine cables buried in deep sea and onshore environments** [14129-74]

- 14129 1C **Power system topology perception and fault identification method combining GNN and BERT [14129-81]**
- 14129 1D **Research on dynamic planning of operation and maintenance path of substation equipment based on deep learning and large model [14129-4]**
- 14129 1E **Temperature-enhanced Steinmetz modeling and multifactor interaction analysis of high-frequency magnetic core loss [14129-13]**
- 14129 1F **Neural network-based fault diagnosis for electric power meters [14129-14]**
- 14129 1G **Anisotropic buckling critical behavior prediction of power guy wires under backward bending based on lightgbm-gru-optical sensing hybrid algorithm [14129-24]**
- 14129 1H **Research on wind turbine blade modal identification method using joint excitation-response multivariate empirical mode decomposition [14129-27]**
- 14129 1I **Design of an intelligent identification algorithm for switchgear partial discharge signals in distribution automation [14129-38]**
- 14129 1J **Research progress on non-platinum-based catalysts for hydrogen evolution reactions [14129-46]**
- 14129 1K **Simulation and visualization method for loop control logic of controllable commutation converter valve [14129-52]**
- 14129 1L **A SVM-based method for electric field feature extraction and insulation condition characterization of deteriorating insulators [14129-56]**
- 14129 1M **Real-time monitoring and fault diagnosis system for new energy charging piles based on carrier communication [14129-61]**
- 14129 1N **Application of decision tree algorithm in carbon footprint identification of substation operation [14129-73]**
- 14129 1O **A TMR DC current sensor based on dual air-gaps and multistage magnetic ring [14129-25]**
- 14129 1P **Dynamic prediction of power-grid equipment retrofit time windows via driving-factor identification and coupled degradation with hidden operating-mode switching [14129-83]**
- 14129 1Q **Study on the dust coupling mechanism of cable terminations and laser surface cleaning technology [14129-86]**
- 14129 1R **Design of an intelligent electromagnetic simulation system for high-frequency circuits based on the optoelectronic coupling effect [14129-87]**
- 14129 1S **Edge-cloud collaborative large model for autonomous operation and maintenance in distribution substations [14129-88]**

## INTELLIGENT CONTROL, COMMUNICATION, AND SECURITY PROTECTION OF POWER SYSTEMS

---

- 14129 1T **Simulation study of a sensorless servo motor control algorithm based on the rotating high-frequency voltage injection method** [14129-1]
- 14129 1U **Power system intelligent control strategy based on improved particle swarm optimization algorithm** [14129-15]
- 14129 1V **Dynamic performance optimization techniques for Buck–Boost converters based on adaptive neural network control** [14129-16]
- 14129 1W **Research on adaptive communication security mechanisms for smart substations based on IPv6 networks** [14129-21]
- 14129 1X **Research on deep learning-based automated control for power system operation** [14129-29]
- 14129 1Y **Investigation of harmonic suppression control strategies for grid-connected inverters** [14129-34]
- 14129 1Z **Adaptive transformer disconnection control under disaster-induced uncertainty** [14129-37]
- 14129 20 **Preset position deviation correction method for pan-tilt cameras in substation intelligent inspection systems** [14129-44]
- 14129 21 **Design and implementation of adaptive online setting system for feeder automation based on reinforcement learning** [14129-45]
- 14129 22 **Design and implementation of an intelligent monitoring system for pumped storage power plants integrating image signal processing** [14129-53]
- 14129 23 **Quantum communication and anti-jamming signal transmission methods for power grid security** [14129-57]
- 14129 24 **An improved iForest-based method for electricity consumption anomaly detection** [14129-63]
- 14129 25 **Intelligent emergency information generation technology based on incremental fine-tuning of large-scale power grid control models** [14129-64]
- 14129 26 **Design of adaptive AI algorithms for power system security protection** [14129-7]
- 14129 27 **A multiobjective dynamic control method for enhancing distributed photovoltaic consumption capability** [14129-22]
- 14129 28 **Research on distribution network situation awareness and resilience enhancement strategies based on multiagent cooperative games** [14129-23]
- 14129 29 **Power grid user intent: key information extraction technology based on natural language processing** [14129-28]

- 14129 2A **Decision optimization of inspection, storage, and distribution of electric power materials based on deep reinforcement learning** [14129-36]
- 14129 2B **A multidimensional demand classification model for intelligent adaptation of power R&D organizational modes** [14129-54]
- 14129 2C **Energy-efficient automation of industrial surface pre-treatment processes using PLC and SCADA** [14129-65]
- 14129 2D **An intelligent microgrid scheduling method based on TCN-GRU state perception and proximal policy optimization** [14129-67]
- 14129 2E **Cross Layer collaborative active adaptive security framework for wireless distribution network protection system** [14129-69]
- 14129 2F **A multiscale intrusion detection model for new electricity system** [14129-79]
- 14129 2G **Alarm-evidence-driven risk assessment of power grid secondary equipment for retrofit decision-making** [14129-82]
- 14129 2H **A domain-enhanced large language model for intelligent risk analysis and autonomous decision support in distribution substations** [14129-89]