

PROCEEDINGS OF SPIE

# ***International Symposium on Renewable Energy and Smart Environmental Monitoring (RESEM 2025)***

**Wei Xu**  
**Chengbin Ma**  
*Editors*

**12–14 December 2025**  
**Xi'an, China**

*Organized by*

Institute of Electrical Engineering, Chinese Academy of Sciences (China)  
University of Regina (Canada)  
Shaanxi Normal University (China)  
Northwest A&F University (China)

*Sponsored by*

Zhejiang University (China)  
Shanghai Jiao Tong University (China)  
Central Queensland University (Australia)  
University of Patras (Greece)  
King Mongkut's University of Technology North Bangkok (Thailand)

*Published by*  
SPIE

**Volume 14125**

Proceedings of SPIE 0277-786X, V. 14125

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 *International Symposium on Renewable Energy and Smart Environmental Monitoring (RESEM 2025)*, edited by Wei Xu, Chengbin Ma, Proc. of SPIE 14125, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9798902322092

ISBN: 9798902322108 (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

v *Conference Committee*

---

## RENEWABLE ENERGY TECHNOLOGY

---

- 14125 02 **Intelligent optimization and performance prediction of lattice-based protective structures for photovoltaic power stations** [14125-1]
- 14125 03 **Numerical prediction of ice thickness of transmission line based on weather research and forecasting model coupled with Makkonen model** [14125-6]
- 14125 04 **Study on stability and regulation optimization of coupling system with high proportion of renewable energy access** [14125-7]
- 14125 05 **Low-carbon optimization of crushed gravel mix proportions for green infrastructure using simulated annealing** [14125-9]

---

## INTELLIGENT ENVIRONMENTAL MONITORING

---

- 14125 06 **Risk assessment of urban flooding under climate change: a coupled GIS and machine learning approach** [14125-2]
- 14125 07 **Satellite-based GHG emission monitoring and flux inversion in upstream and midstream natural gas projects** [14125-3]
- 14125 08 **Prediction of constant-current charging curves for lithium batteries based on fragmented data** [14125-4]
- 14125 09 **Adaptive quantification of marginal energy value via denoising autoencoder and online learning** [14125-5]
- 14125 0A **Environment-aware and sustainable design of crushed gravel bridge piers based on deep learning monitoring models** [14125-8]