

PROCEEDINGS OF SPIE

Autonomous Systems: Sensors, Processing, and Security for Ground, Air, Sea, and Space Vehicles and Infrastructure 2026

**Michael C. Dudzik
Stephen M. Jameson
Theresa J. Axenson**
Editors

**27–28 April 2026
National Harbor, Maryland, United States**

Sponsored and Published by
SPIE

Volume 14044

Proceedings of SPIE 0277-786X, V. 14044

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 *Autonomous Systems: Sensors, Processing, and Security for Ground, Air, Sea, and Space Vehicles and Infrastructure 2026*, edited by Michael C. Dudzik, Stephen M. Jameson, Theresa J. Axenson, Proc. of SPIE 14044, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9798902320449

ISBN: 9798902320456 (electronic)

Published by

SPIE

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

Telephone +1 360 676 3290 (Pacific Time)

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. 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

v *Conference Committee*

NOVEL CONCEPTS AND TECHNIQUES FOR AUTONOMOUS CONTROL

- 14044 02 **Pragmatic autonomy directions for multiplatform capabilities** [14044-1]
14044 03 **Earthling logic: a benchmark-based framework for humanlike reasoning** [14044-2]

NOVEL SENSOR AND COMMUNICATION TECHNIQUES FOR AUTONOMOUS SYSTEMS I

- 14044 04 **Vision-based uncrewed aerial system for real-time stream assessment and environmental monitoring** [14044-4]
14044 05 **Error ellipse convolving for geolocating scanning RF emitters using multiagent particle dynamics** [14044-5]
14044 07 **Comparative study of underground tunnel detection using two ground penetrating radar systems** [14044-7]

NOVEL SENSOR AND COMMUNICATION TECHNIQUES FOR AUTONOMOUS SYSTEMS II

- 14044 09 **Energy budget analysis of SWaP-constrained UAV-deployable water-level sensors with varying sampling intervals and idle currents** [14044-9]
14044 0A **Efficient pointing, acquisition, and tracking without external feedback using opposing spiral scanning** [14044-8]
14044 0B **Accurate aerial geolocation under extreme uncertainty** [14044-10]

NOVEL SENSOR AND COMMUNICATION TECHNIQUES FOR AUTONOMOUS SYSTEMS III

- 14044 0C **Long range vehicle detection and tracking using acoustic arrays** [14044-12]
14044 0D **Methods to enhance the resiliency of the sensors driving autonomous vehicles** [14044-13]
14044 0E **Doppler-modulated terahertz communication for micro and nano swarm robots** [14044-14]

- 14044 OF **Validating satellite-based communications sources under degraded radiation conditions using specific emitter identification** [14044-15]
- 14044 OG **Celestial navigation for autonomous systems in GPS contested environments** [14044-16]

SENSING, PROCESSING, AND SAFETY FOR UNMANNED GROUND VEHICLES I

- 14044 OH **COMPASS: a controllable multivehicle platform for cooperative perception and cross-modal consistency analysis** [14044-35]
- 14044 OI **Design considerations for an auto lidar** [14044-17]

SENSING, PROCESSING, AND SAFETY FOR UNMANNED GROUND VEHICLES II

- 14044 OK **Using multiple sensing modalities for autonomous cars (Invited Paper)** [14044-34]
- 14044 OL **Lane centering using reinforcement Learning and model predictive control** [14044-21]

POSTER SESSION

- 14044 OO **Particle dynamics modeling of autonomous multiagent clusters** [14044-24]
- 14044 OQ **Radar-thermal fusion for navigation in low-visibility conditions** [14044-25]
- 14044 OR **Multimodal rover platform for sensor fusion and situational awareness** [14044-26]