

PROCEEDINGS OF SPIE

# ***Autonomous Systems: Sensors, Processing, and Security for Vehicles and Infrastructure 2021***

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

12–16 April 2021  
Online Only, United States

*Sponsored and Published by*  
SPIE

**Volume 11748**

Proceedings of SPIE 0277-786X, V. 11748

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

Autonomous Systems: Sensors, Processing, and Security for Vehicles and Infrastructure 2021, edited by  
Michael C. Dudzik, Stephen M. Jameson, Theresa J. Axenson, Proc. of SPIE Vol. 11748, 1174801  
© 2021 SPIE · CCC code: 0277-786X/21/\$21 · doi: 10.1117/12.2598685

Proc. of SPIE Vol. 11748 1174801-1

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 *Autonomous Systems: Sensors, Processing, and Security for Vehicles and Infrastructure 2021*, edited by Michael C. Dudzik, Stephen M. Jameson, Theresa J. Axenson, Proc. of SPIE 11748, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510643338  
ISBN: 9781510643345 (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 © 2021 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

---

**SESSION 1      AUTONOMOUS SYSTEMS: SENSING AND CONTROL TECHNIQUES**

---

- 11748 02      **Improving visual terrain relative navigation for aerial systems at diverse altitudes [11748-1]**
- 11748 04      **RGB pixel-block point-cloud fusion for object detection [11748-3]**
- 11748 05      **A neuromorphic approach to LiDAR point cloud processing [11748-4]**
- 11748 06      **Drivable path detection using CNN sensor fusion for autonomous driving in the snow [11748-5]**
- 11748 07      **Evaluating performance of extended Kalman filter based adaptive cruise control using PID controller [11748-6]**

---

**SESSION 2      AUTONOMOUS GROUND VEHICLES: JOINT SESSION WITH VOLUMES 11748 AND 11758**

---

- 11748 09      **The Michigan Tech autonomous winter driving data set: year two [11748-8]**
- 11748 0A      **Real-time object detection and geolocation using 3d calibrated camera/LiDAR pair [11748-9]**
- 11748 0C      **Traversability mapping in off-road environment using semantic segmentation [11748-11]**

---

**SESSION 3      AUTONOMOUS SYSTEMS: SECURITY APPLICATIONS AND ISSUES**

---

- 11748 0F      **Intelligent management of constrained links for distributed autonomy (Invited Paper) [11748-14]**
- 11748 0G      **MUONS path planning performance for a vehicle with complex suspension in Unreal [11748-15]**
- 11748 0I      **Measuring robustness and resilience against counters on autonomous platforms [11748-17]**
- 11748 0J      **Human-in-the-loop extension to stream classification for labeling of low altitude drone imagery [11748-18]**
- 11748 0K      **FLARE network performance: automated on-demand calibration for space, airborne and UAV assets [11748-19]**

