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.

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 SPIEDigitalLibrary.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 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. 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.



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 OC	Traversability mapping in off-road environment using semantic segmentation [11748-11]
SESSION 3	AUTONOMOUS SYSTEMS: SECURITY APPLICATIONS AND ISSUES
11748 OF	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 Ol	Measuring robustness and resilience against counters on autonomous platforms [11748-17]
11748 OJ	Human-in-the-loop extension to stream classification for labeling of low altitude drone imagery [11748-18]
11748 OK	FLARE network performance: automated on-demand calibration for space, airborne and UAV assets [11748-19]