## PROCEEDINGS OF SPIE

## Sensors and Systems for Space Applications XV

Genshe Chen Khanh D. Pham

**Editors** 

3–7 April 2022 Orlando, Florida, United States

6-12 June, 2022 ONLINE

Sponsored by SPIE

Cosponsored by Intelligent Fusion Technology, INC. (United States)

Published by SPIE

**Volume 12121** 

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 Sensors and Systems for Space Applications XV, edited by Genshe Chen, Khanh D. Pham, Proc. of SPIE 12121, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510651180

ISBN: 9781510651197 (electronic)

Published by

SPIF

P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) SPIE.org

Copyright © 2022 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**

vi Conference Committee

SESSION 1	AI/ML AND AUTONOMY TECHNOLOGIES
12121 02	S-KISS: semantic based knowledge and information sharing system for defense training and operations [12121-25]
12121 04	A distributed crawler for IoVT-based public safety surveillance exploring the spatio-temporal correlation [12121-3]
12121 05	Hybrid learning-based online high-accuracy pedestrian dead reckoning navigation system with Al-on-a-chip [12121-4]
SESSION 2	MODELING AND DIGITAL ENGINEERING
12121 06	Development of a nanosatellite attitude control simulator for ground-based research [12121-5]
12121 07	SatSim: a synthetic data generation engine for electro-optical imagery of resident space objects [12121-6]
SESSION 3	SPACE DOMAIN AWARENESS
12121 08	Towards jointly learned control policies and image recovery for distributed aperture telescopes (Sensors and Systems for Space Applications Best Student Paper Award) [12121-7]
12121 09	Autonomous dust detection and removal for space surface vehicles navigation and exploration awareness [12121-8]
12121 0A	Space track ontology elements for space domain awareness [12121-9]
12121 OB	Mie region radar cross-section of high-speed and rotational space debris [12121-10]
SESSION 4	COMMUNICATION AND NETWORKING
12121 0D	An online machine learning-based content caching scheme in mobile edge computing networks [12121-13]
12121 OE	Transmission control and optimization in next-generation hybrid wireless networks: an online reinforcement learning approach [12121-14]

SESSION 5	SENSOR AND DEVICE FOR SPACE APPLICATION
12121 OF	EMCCD for future SDA applications [12121-15]
12121 0G	High performance all metal telescope for satellite based laser communication terminals [12121-16]
SESSION 6	SPECTRAL REMOTE SENSING FOR SPACE SITUATIONAL AWARENESS: JOINT SESSION WITH CONFERENCES 12094 AND 12121
12121 OJ	Statistical characterization of multispectral infrared properties of the GEO belt debris population [12121-19]
12121 OK	Closely spaced object detection utilizing spatial information in spectroastrometric observations [12121-20]
	POSTER SESSION
12121 OL	Implementing the EKF using FPGA for aerospace application [12121-22]
12121 OM	A parallel readout circuit for a space-based non-dispersive infrared gas analyzer [12121-21]
12121 0N	Planetary exploration enabled by a compact adaptable, time-resolved, spatial-heterodyne Raman spectrometer [12121-23]