PROCEEDINGS OF SPIE

Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications XII

Daniel J. Henry
Gregory J. Gosian
Davis A. Lange
Dale Linne von Berg
Thomas J. Walls
Darrell L. Young
Editors

20–21 April 2015
Baltimore, Maryland, United States

Sponsored and Published by
SPIE

Volume 9460

Proceedings of SPIE 0277-786X, V. 9460

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

Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications XII, D. Henry, G. Gosian, D. Lange, D. Linne von Berg, T. Walls, D. Young, Eds. Proc. of SPIE Vol. 9460, 946001 · © 2015 SPIE · CCC code: 0277-786X/15/$18 · doi: 10.1117/12.2201094

The papers included 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. The papers published in these proceedings 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 this book:
Author(s), "Title of Paper," in *Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications XII*, edited by Daniel J. Henry, Gregory J. Gosian, Davis A. Lange, Dale Linne von Berg, Thomas J. Walls, Darrell L. Young, Proceedings of SPIE Vol. 9460 (SPIE, Bellingham, WA, 2015) Article CID Number.

ISSN: 0277-786X
ISBN: 9781628415766

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445
SPIE.org

Copyright © 2015, Society of Photo-Optical Instrumentation Engineers.

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 copying fees. The Transactional Reporting Service base fee for this volume is $18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online 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. The CCC fee code is 0277-786X/15/$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIE Digital Library
SPIEDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print. Papers are published as they are submitted and meet publication criteria. A unique citation identifier (CID) number is assigned to each article at the time of the first 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, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four 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. The complete citation is used on the first page, and an abbreviated version on subsequent pages.

Contents

v *Authors*

vii *Conference Committee*

ix *Introduction*

SESSION 1 ISR: VISION, MISSION, AND TACTICS

9460 03 **Hybrid consensus-based formation control of UAVs** [9460-2]

SESSION 2 ISR: PASSIVE AND ACTIVE SENSING

9460 06 **Results from an experiment that collected visible-light polarization data using unresolved imagery for classification of geosynchronous satellites** [9460-5]

9460 07 **Laser links for mobile airborne nodes** [9460-6]

9460 08 **Small SWAP 3D imaging flash ladar for small tactical unmanned air systems** [9460-7]

9460 09 **EM modeling of far-field radiation patterns for antennas on the GMA-TT UAV** [9460-8]

SESSION 3 ISR: IMAGE FUSION/ENHANCEMENT

9460 0B **Fusion of video and radar comparison to 3D ladar for activity recognition** [9460-10]

9460 0C **Real-time technology for enhancing long-range imagery** [9460-11]

9460 0D **Characterization of UAV hover patterns in support of super resolution research** [9460-12]

SESSION 4 ISR: IMAGE PROCESSING AND TRACKING

9460 0E **Aerial video mosaicking using binary feature tracking** [9460-13]

9460 0F **Background image understanding and adaptive imaging for vehicle tracking** [9460-14]

9460 0G **Enhanced performance for the interacting multiple model estimator with integrated multiple filters** [9460-15]

SESSION 5 ISR: CHANGE DETECTION

9460 0H **Improving change detection results with knowledge of registration uncertainty** [9460-16]

9460 0I **Change detection on UGV patrols with respect to a reference tour using VIS imagery** [9460-17]

SESSION 6 ISR: EXPLOITATION

9460 0J **Pressing the sparsity advantage via data-based decomposition** [9460-18]

SESSION 7 ISR: IMAGE SEQUENCES/FULL MOTION VIDEO

9460 0L **Context and quality estimation in video for enhanced event detection** [9460-20]

9460 0N **Automated FMV image quality assessment based on power spectrum statistics** [9460-22]

9460 0O **An automated analysis of wide area motion imagery for moving subject detection** [9460-24]

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Aboutanios, Elias, 0G
Anderson, Scott A., 08
Andress, Laura, 0J
Bird, Alan, 08
Bonnett, James, 0C
Budge, Scott E., 08
Chen, Bin, 0F
Chun, Francis, 06
Fox, Paul, 0C
Griethe, Wolfgang, 07
Grishin, Denis, 0J
Guzey, H. M., 03
Hoffman, Matthew J., 0F
Horwath, Joachim, 07
Irvine, John M., 0L
Kalukin, Andrew, 0N
Kelmelis, Eric, 0C
Knapek, Markus, 07
Kozacik, Stephen, 0C
Lingg, Andrew, 0H
Mackenzie, Anne I., 09
Marsh, Ronald, 0D
Matin, Mohammad, 06
Minnehan, Breton, 0E
Müller, Thomas, 0I
Paolini, Aaron, 0C
Riasati, Vahid R., 0J
Rigling, Brian, 0H
Sabordo, Madeleine G., 0G
Savakis, Andreas, 0E
Speicher, Andy, 06
Straub, Jeremy, 0D
Strong, David, 06
Tahmoush, Dave, 0B, 0O
Tippets, Roger, 06
Uzkent, Burak, 0F
Vodacek, Anthony, 0F
Wojcik, Michael, 08
Wood, Richard J., 0L

Conference Committee

Symposium Chair

Nils R. Sandell Jr., Strategic Technology Office, DARPA (United States)

Symposium Co-chair

David A. Logan, BAE Systems (United States)

Conference Chair

Daniel J. Henry, Rockwell Collins, Inc. (United States)

Conference Co-chairs

Gregory J. Gosian, L-3 Communications (United States)
Davis A. Lange, UTC Aerospace Systems (United States)
Dale Linne von Berg, U.S. Naval Research Laboratory (United States)
Thomas J. Walls, U.S. Naval Research Laboratory (United States)
Darrell L. Young, Raytheon Intelligence & Information Systems (United States)

Session Chairs

1 ISR: Vision, Mission, and Tactics
Dale Linne von Berg, U.S. Naval Research Laboratory (United States)

2 ISR: Passive and Active Sensing
Thomas J. Walls, U.S. Naval Research Laboratory (United States)

3 ISR: Image Fusion/Enhancement
Davis A. Lange, UTC Aerospace Systems (United States)

4 ISR: Image Processing and Tracking
Daniel J. Henry, Rockwell Collins, Inc. (United States)

5 ISR: Change Detection
Daniel J. Henry, Rockwell Collins, Inc. (United States)

6 ISR: Exploitation
Darrell L. Young, Raytheon Intelligence & Information Systems (United States)

7 ISR: Image Sequences/Full Motion Video
Darrell L. Young, Raytheon Intelligence & Information Systems (United States)

Introduction

This year's conference featured a wide range of papers related to Airborne ISR Systems and Applications. The conference was broken into multiple sessions that addressed several different parts of the ISR TCPED image chain (Tasking, Capture, Processing, Exploitation, and Dissemination):

1. Vision, Mission & Tactics
2. Passive and Active Sensing
3. Image Fusion/Enhancement
4. Image Processing and Tracking
5. Change Detection
6. Exploitation
7. Image Sequences/Full Motion Video

I would like to thank all the authors for their efforts to make our conference such a success. Their efforts to write and present their papers are greatly appreciated. Their innovations in this exciting field make our conference better each year, and I look forward to the 2016 conference to see what additional advances have been made in these areas, as well as the introduction of new technologies that have been developed.

See you at the meeting next year.

Daniel J. Henry
Dale Linne von Berg
Thomas J. Walls
Davis A. Lange
Darrell L. Young