

PROCEEDINGS OF SPIE

***Ground/Air Multisensor
Interoperability, Integration, and
Networking for Persistent ISR II***

**Michael A. Kolodny
Tien Pham
Kevin L. Priddy**
Editors

**26–28 April 2011
Orlando, Florida, United States**

Sponsored and Published by
SPIE

Volume 8047

Proceedings of SPIE, 0277-786X, v. 8047

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

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 *Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR II*, edited by Michael A. Kolodny, Tien Pham, Kevin L. Priddy, Proceedings of SPIE Vol. 8047 (SPIE, Bellingham, WA, 2011) Article CID Number.

ISSN 0277-786X
ISBN 9780819486219

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 © 2011, 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/11/\$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

SPIDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent 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. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

vii	<i>Conference Committee</i>
ix	<i>Introduction</i>

INTEROPERABILITY I: TERRA HARVEST

- 8047 04 **Terra Harvest: an open, integrated battlefield unattended ground sensors architecture** [8047-03]
R. Heathcock, U.S. Defense Intelligence Agency (United States); C. Brasch, The MITRE Corp. (United States)
- 8047 06 **Terra Harvest Open Source Environment (THOSE): a universal unattended ground sensor controller** [8047-06]
J. Gold, K. Klawon, Univ. of Dayton Research Institute (United States); D. Humeniuk, D. Landoll, L-3 Communications Nova Engineering (United States)

INTEROPERABILITY II

- 8047 09 **A packaged native data format for interoperability of unattended ground sensors with a SensorML-enabled controller** [8047-09]
J. Chambers, A. Brunck, Northrop Grumman Corp. Electronic Systems (United States)
- 8047 0A **Model-driven SOA for sensor networks** [8047-10]
J. Ibbotson, C. Gibson, IBM United Kingdom Ltd. (United Kingdom); S. Geyik, B. K. Szymanski, Rensselaer Polytechnic Institute (United States); D. Mott, D. Braines, T. Klapiscak, F. Bergamaschi, IBM United Kingdom Ltd. (United Kingdom)
- 8047 0B **Decentralized operating procedures for orchestrating data and behavior across distributed military systems and assets** [8047-11]
N. Peach, PB Partnership Ltd. (United Kingdom)

NEW TECHNOLOGY I

- 8047 0C **The acoustic vector sensor: a versatile battlefield acoustics sensor** [8047-13]
H.-E. de Bree, J. W. Wind, Microflown Technologies (Netherlands)
- 8047 0D **Attenuation of individual seismic wave types using various architectural enclosures for geophones** [8047-14]
S. Schumer, U.S. Army Armament Research, Development and Engineering Ctr. (United States)
- 8047 0E **Embedded real-time classifier for profiling sensors and custom detector configuration** [8047-15]
R. K. Reynolds, S. Chari, The Univ. of Memphis (United States); D. J. Russomanno, Indiana Univ.-Purdue Univ. Indianapolis (United States)

- 8047 OF **An assessment of a 360-degree profiling sensor for object classification** [8047-16]
J. B. Brown, S. K. Chari, E. L. Jacobs, The Univ. of Memphis (United States)

SIGNAL PROCESSING AND FUSION I

- 8047 OL **Semantically enriched data for effective sensor data fusion** [8047-22]
G. de Mel, Univ. of Aberdeen (United Kingdom); T. Pham, T. Damarla, U.S. Army Research Lab. (United States); W. Vasconcelos, T. Norman, Univ. of Aberdeen (United Kingdom)
- 8047 OM **A flexible data fusion architecture for persistent surveillance using ultra-low-power wireless sensor networks** [8047-23]
J. A. Hanson, K. L. McLaughlin, T. J. Sereno, SAIC (United States)
- 8047 ON **Knowledge-aided multisensor data fusion for maritime surveillance** [8047-24]
G. Battistello, M. Ulmke, W. Koch, Fraunhofer FKIE (Germany)
- 8047 OO **Sensor trustworthiness in uncertain time varying stochastic environments** [8047-25]
A. Verma, R. Fernandes, K. Vadakkevedu, Knowledge Based Systems, Inc. (United States)

SIGNAL PROCESSING AND FUSION II

- 8047 OQ **Implementation of a sensor guided flight algorithm for target tracking by small UAS** [8047-27]
G. E. Collins, C. Stankevitz, Toyon Research Corp. (United States); J. Liese, California Polytechnic State Univ., San Luis Obispo (United States)
- 8047 OR **Localization using ground- and air-based acoustic arrays** [8047-28]
G. H. Goldman, C. Reiff, U.S. Army Research Lab. (United States)
- 8047 OS **The integration of a tracker into SPADE** [8047-30]
A. S. Kondrath, R. L. Van Hook, Air Force Research Lab. (United States)

SENSOR NETWORKING AND COMMUNICATIONS

- 8047 OT **Open source layered sensing model** [8047-31]
T. V. Rovito, B. O. Abayowa, M. L. Talbert, Air Force Research Lab. (United States)
- 8047 OU **Operational information content capacity** [8047-32]
M. P. Johnson, A. Yener, T. F. La Porta, The Pennsylvania State Univ. (United States); R. Govindan, K. Psounis, The Univ. of Southern California (United States); R. Ramanathan, Raytheon BBN Technologies (United States)
- 8047 OV **Forecasting routes and self-adaptation in multi-hop wireless sensor networks** [8047-33]
T. Bourdenas, Imperial College London (United Kingdom) and IBM Thomas J. Watson Research Ctr. (United States); F. Bergamaschi, IBM United Kingdom Ltd. (United Kingdom); D. Wood, P. Zerfos, IBM Thomas J. Watson Research Ctr. (United States); M. Sloman, Imperial College London (United Kingdom)

- 8047 OW **Broadcast scheduling with data bundles** [8047-34]
F. Chen, The Pennsylvania State Univ. (United States); D. Pizzocaro, Cardiff Univ. (United Kingdom); M. P. Johnson, The Pennsylvania State Univ. (United States); A. Bar-Noy, The Graduate Ctr., CUNY (United States); A. Preece, Cardiff Univ. (United Kingdom); T. La Porta, The Pennsylvania State Univ. (United States)
- 8047 OX **Service-oriented reasoning architecture for resource-task assignment in sensor networks** [8047-35]
G. de Mel, Univ. of Aberdeen (United Kingdom); F. Bergamaschi, IBM United Kingdom Ltd. (United Kingdom); T. Pham, U.S. Army Research Lab. (United States); W. Vasconcelos, T. Norman, Univ. of Aberdeen (United Kingdom)

SENSOR NETWORKS AND WIDE-AREA PERSISTENT SURVEILLANCE: JOINT SESSION WITH CONFERENCE 8062

- 8047 OY **Bio-inspired UAV routing, source localization, and acoustic signature classification for persistent surveillance** [8047-36]
J. Burman, Teledyne Scientific Co. (United States); J. Hespanha, U. Madhoo, Univ. of California, Santa Barbara (United States); T. Pham, U.S. Army Research Lab. (United States)
- 8047 OZ **Sensor and information fusion for improved hostile threat situational awareness** [8047-39]
M. V. Scanlon, W. D. Ludwig, U.S. Army Research Lab. (United States)
- 8047 10 **A Bayesian formulation for auction-based task allocation in heterogeneous multi-agent teams** [8047-38]
C. E. Pippin, Georgia Tech Research Institute (United States); H. Christensen, Georgia Institute of Technology (United States)

Author Index

Conference Committee

Symposium Chair

William Jeffrey, HRL Laboratories, LLC (United States)

Symposium Cochair

Kevin P. Meiners, Office of the Secretary of Defense (United States)

Conference Chair

Michael A. Kolodny, U.S. Army Research Laboratory (United States)

Conference Cochairs

Tien Pham, U.S. Army Research Laboratory (United States)

Kevin L. Priddy, Air Force Research Laboratory (United States)

Program Committee

Jacques Bédard, Defence Research and Development Canada
(Canada)

Robert Heathcock, U.S. Defense Intelligence Agency (United States)

Jeff Houser, U.S. Army Research Laboratory (United States)

Gavin Pearson, Defence Science and Technology Laboratory (United
Kingdom)

Stephen G. Perry, MTC Services Corporation (United States)

Ronald B. Sartain, U.S. Army Research Laboratory (United States)

King K. Siu, U.S. Army Armament Research, Development and
Engineering Center (United States)

Raja Suresh, General Dynamics Advanced Information Systems (United
States)

Graeme P. van Voorthuisen, TNO Defence, Security and Safety
(Netherlands)

Rob Williams, Air Force Research Laboratory (United States)

Session Chairs

- 1 Interoperability I: Terra Harvest
Michael A. Kolodny, U.S. Army Research Laboratory (United States)
Tien Pham, U.S. Army Research Laboratory (United States)

- 2 Interoperability II
Jacques Bédard, Defence Research and Development Canada
(Canada)
- 3 New Technology I
King K. Siu, U.S. Army Armament Research, Development and
Engineering Center (United States)
Ronald B. Sartain, U.S. Army Research Laboratory (United States)
- 4 New Technology II
Rob Williams, Air Force Research Laboratory (United States)
Kevin L. Priddy, Air Force Research Laboratory (United States)
- 5 Signal Processing and Fusion I
Jacques Bédard, Defence Research and Development Canada
(Canada)
Graeme P. van Voorthuijsen, TNO Defence, Security and Safety
(Netherlands)
- 6 Signal Processing and Fusion II
Kevin L. Priddy, Air Force Research Laboratory (United States)
King K. Siu, U.S. Army Armament Research, Development and
Engineering Center (United States)
- 7 Sensor Networking and Communications
Graeme P. van Voorthuijsen, TNO Defence, Security and Safety
(Netherlands)
Tien Pham, U.S. Army Research Laboratory (United States)
- 8 Sensor Networks and Wide-Area Persistent Surveillance: Joint Session
with Conference 8062
Raja Suresh, General Dynamics Advanced Information Systems
(United States)
Tien Pham, U.S. Army Research Laboratory (United States)

Introduction

This was the second year of the conference on Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR, which ran 26–28 April 2011 in Orlando, Florida, and is part of the SPIE Defense, Security, and Sensing Symposium. The goal of this conference is to bring together the technical, operational (users), and policy community to provide a forum for discussion of problems, issues, and technology involving interoperability for persistent ISR.

The conference had about 40 technical papers with oral presentations and was highlighted by the DSS Hot Topic Panel session entitled “Data to Decision: Sensors are No Longer King.” The panelists included senior officials from the U.S. Army, U.S. Air Force, OSD, DIA, and the U.K. MoD. It was an open forum in which there was a no-holds-barred audience questioning of the panel members.

I hope you find the proceedings both provocative and informative. I am looking forward to an even more exciting conference at SPIE Defense, Security, and Sensing in 2012 in Baltimore, and hope that everyone will join us.

Michael A. Kolodny

