PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 7699

, "Front Matter: Volume 7699," Proc. SPIE 7699, Algorithms for Synthetic Aperture Radar Imagery XVII, 769901 (7 May 2010); doi: 10.1117/12.865614

SPIE.

Event: SPIE Defense, Security, and Sensing, 2010, Orlando, Florida, United States

PROCEEDINGS OF SPIE

Algorithms for Synthetic Aperture Radar Imagery XVII

**Edmund G. Zelnio
Frederick D. Garber**
Editors

**8–9 April 2010
Orlando, Florida, United States**

Sponsored and Published by
SPIE

Volume 7699

Proceedings of SPIE, 0277-786X, v. 7699

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 *Algorithms for Synthetic Aperture Radar Imagery XVII*, edited by Edmund G. Zelnio, Frederick D. Garber, Proceedings of SPIE Vol. 7699 (SPIE, Bellingham, WA, 2010) Article CID Number.

ISSN 0277-786X

ISBN 9780819481634

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 © 2010, 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/10/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the 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 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	Conference Committee
ix	Introduction

SESSION 1 ADVANCED IMAGE FORMATION I

7699 02	A beamforming algorithm for bistatic SAR image formation [7699-01] C. V. Jakowatz, Jr., D. E. Wahl, D. A. Yocky, Sandia National Labs. (United States)
7699 03	Doppler synthetic aperture hitchhiker imaging [7699-02] L. Wang, Nanjing Univ. of Aeronautics and Astronautics (China); C. E. Yarman, Houston Technology Ctr. (United States); B. Yazıcı, Rensselaer Polytechnic Institute (United States)
7699 04	Tutorial on Fourier space coverage for scattering experiments, with application to SAR [7699-03] R. W. Deming, Air Force Research Lab. (United States)
7699 05	Dual format algorithm for monostatic SAR [7699-04] L. A. Gorham, Air Force Research Lab. (United States); B. D. Rigling, Wright State Univ. (United States)
7699 06	SAR image formation toolbox for MATLAB [7699-05] L. A. Gorham, L. J. Moore, Air Force Research Lab. (United States)
7699 07	An analytical expression for the three-dimensional response of a point scatterer for circular synthetic aperture radar [7699-06] L. J. Moore, U. K. Majumder, Air Force Research Lab. (United States)
7699 08	An analysis of 3D SAR from single pass nonlinear radar platform trajectories [7699-07] D. André, Defence Science and Technology Lab. (United Kingdom)
7699 09	Autofocus for 3D imaging with multipass SAR [7699-32] N. Boss, E. Ertin, R. Moses, The Ohio State Univ. (United States)

SESSION 2 ADVANCED IMAGE FORMATION II

7699 0A	Superresolution inverse synthetic aperture radar (ISAR) imaging using compressive sampling [7699-08] S. K. Gunnala, S. Tjuatja, The Univ. of Texas at Arlington (United States)
7699 0B	Bayesian SAR imaging [7699-09] Z. Chen, X. Tan, M. Xue, J. Li, Univ. of Florida (United States)

- 7699 0C **Experimental validation of a microwave tomographic approach for through-the-wall radar imaging** [7699-10]
F. Soldovieri, Institute for Electromagnetic Sensing of the Environment, National Research Council (Italy); R. Solimene, Seconda Univ. degli Studi di Napoli (Italy); F. Ahmad, Villanova Univ. (United States)
- 7699 0D **Contourlet domain hidden Markov tree based detection algorithm for DRDC through-wall SAR (TWSAR) system applications** [7699-11]
B. Chan, Defence Research and Development Canada (Canada)
- 7699 0E **A videoSAR mode for the x-band wideband experimental airborne radar** [7699-12]
A. Damini, B. Balaji, C. Parry, Defence Research and Development Canada (Canada); V. Mantle, MacDonald, Dettwiler and Associates Ltd. (Canada)
- 7699 0G **Synthetic aperture radar data visualization on the iPod Touch** [7699-14]
A. Fouts, Wright State Univ. (United States); R. Vickery, High Performance Technologies, Inc. (United States); U. Majumder, T. Burchett, Air Force Research Lab. (United States); T. Klein, Set Corp. (United States); M. Minardi, Air Force Research Lab. (United States)

SESSION 3 **ADVANCED MOTION PROCESSING**

- 7699 0H **SAR based adaptive GMTI** [7699-15]
D. Vu, B. Guo, L. Xu, J. Li, Univ. of Florida (United States)
- 7699 0I **Detection/tracking of moving targets with synthetic aperture radars** [7699-16]
G. E. Newstadt, Univ. of Michigan (United States); E. Zelnio, L. Gorham, Air Force Research Lab. (United States); A. O. Hero III, Univ. of Michigan (United States)
- 7699 0J **Analysis of motion disambiguation using multi-channel circular SAR** [7699-17]
A. R. Fasih, C. W. Rossler, J. N. Ash, R. L. Moses, The Ohio State Univ. (United States)
- 7699 0K **Verification of target motion effects on SAR imagery using the Gotcha GMTI challenge dataset** [7699-18]
D. E. Hack, Air Force Institute of Technology (United States) and Dynetics, Inc. (United States); M. A. Saville, Air Force Institute of Technology (United States)
- 7699 0L **Estimation of vibration spectra including vibrating direction with synthetic aperture radar** [7699-19]
M. Pepin, M. M. Hayat, The Univ. of New Mexico (United States)
- 7699 0M **Analysis of focused dismount signatures** [7699-34]
T. L. Lewis, Air Force Research Lab. (United States); B. Rigling, Wright State Univ. (United States)

SESSION 4 **ADVANCED EXPLOITATION**

- 7699 0N **A comparison of spatial sampling techniques enabling first principles modeling of a synthetic aperture RADAR imaging platform** [7699-20]
M. Gartley, A. Goodenough, S. Brown, Rochester Institute of Technology (United States); R. P. Kauffman, Lockheed Martin Information Systems and Global Services (United States)

- 7699 0O **Comparison of real and simulated SAR imagery of ships for use in ATR** [7699-21]
N. Ødegaard, A. O. Knapskog, Norwegian Defence Research Establishment (Norway);
C. Cochín, B. Delahaye, Direction Générale de l'Armement (France)
- 7699 0P **Civilian vehicle radar data domes** [7699-22]
K. E. Dungan, C. Austin, The Ohio State Univ. (United States); J. Nehrbass, High-Performance Technologies, Inc. (United States); L. C. Potter, The Ohio State Univ. (United States)
- 7699 0Q **Classifying sets of attributed scattering centers using a hash coded database (Best Student Paper Award)** [7699-23]
K. E. Dungan, L. C. Potter, The Ohio State Univ. (United States)
- 7699 0R **Application of sparse dictionaries to SAR speckle reduction** [7699-24]
T. R. Braun, J. B. Greer, National Geospatial-Intelligence Agency (United States)
- 7699 0S **Target detection in SAR images using codifference and directional filters** [7699-25]
K. Duman, A. E. Çetin, Bilkent Univ. (Turkey)
- 7699 0U **A challenge problem for SAR change detection and data compression** [7699-27]
S. M. Scarborough, L. Gorham, M. J. Minardi, U. K. Majumder, M. G. Judge, L. Moore, Air Force Research Lab. (United States); L. Novak, Scientific Systems Co., Inc. (United States); S. Jaroszewski, L. Spoldi, A. Pieramico, Technology Service Corp. (United States)
- 7699 0V **FOPEN change detection experiments using a CARABAS public release data set** [7699-33]
L. Novak, Scientific Systems Co., Inc. (United States)
- 7699 0W **Classification of canonical scattering through sub-band analysis** [7699-28]
D. F. Fuller, M. A. Saville, Air Force Institute of Technology (United States)
- 7699 0X **The effect of synthetic aperture radar image resolution on target discrimination** [7699-29]
J. E. McGowan, S. C. Gustafson, J. A. Jackson, A. J. Terzuoli, Jr., Air Force Institute of Technology (United States)
- 7699 0Y **Depth-based image registration** [7699-30]
B. Han, C. Paulson, J. Wang, D. Wu, Univ. of Florida (United States)

Author Index

Conference Committee

Symposium Chair

Michael T. Eismann, Air Force Research Laboratory (United States)

Symposium Cochair

William Jeffrey, HRL Laboratories, LLC (United States)

Conference Chairs

Edmund G. Zelnio, Air Force Research Laboratory (United States)

Frederick D. Garber, Wright State University (United States)

Program Committee

Bir Bhanu, University of California, Riverside (United States)

Mujdat Cetin, Sabanci University (Turkey)

Dan E. Dudgeon, BAE Systems (United States)

Gil J. Ettinger, BAE Systems Advanced Information Technologies
(United States)

Robert A. Hummel, Booz Allen Hamilton (United States)

Charles V. Jakowatz, Jr., Sandia National Laboratories (United States)

Eric R. Keydel, SAIC (United States)

Jian Li, University of Florida (United States)

Randolph L. Moses, The Ohio State University (United States)

Lee C. Potter, The Ohio State University (United States)

Brian D. Rigling, Wright State University (United States)

Timothy D. Ross, Air Force Research Laboratory (United States)

Gerard W. Titi, BAE Systems Advanced Information Technologies
(United States)

Stephen P. Welby, Consultant (United States)

Session Chairs

- 1 Advanced Image Formation I
 Charles V. Jakowatz, Jr., Sandia National Laboratories (United States)
- 2 Advanced Image Formation II
 Lee C. Potter, The Ohio State University (United States)
- 3 Advanced Motion Processing
 Michael Minardi, Air Force Research Laboratory (United States)

- 4 Advanced Exploitation
 Eric R. Keydel, SAIC (United States)

Introduction

This year's Algorithms for Synthetic Aperture Radar Imagery conference distinguished itself with a significant number of high quality papers including very promising research presented by exceptional students. The Advanced Image Formation I session chaired by Dr. Charles V. Jakowatz featured papers outlining various approaches to SAR image formation including bistatic backprojection, passive multi-static, k-space perspectives, and even computer-code modules for fundamental backprojection algorithms. These provide a nice compendium of tutorial papers on SAR.

In the Advanced Image Formation II session chaired by Dr. Lee C. Potter, the papers provided a nice mix of advanced imaging algorithms based on compressive sensing principles and of applications including through wall imaging and airborne imaging and display.

The Advanced Motion Processing session was chaired by Dr. Michael Minardi. It was encouraging to see the fundamental and initial efforts on the moving target challenge problem introduced at the conference last year. The four papers attacking this challenge problem focused on different aspects of this difficult scenario with each providing invaluable insight. The remainder of the papers investigated other important motion problems including the detection of vibrating objects in the SAR scene and the analysis of radar dismount signatures.

In the Advanced Exploitation session chaired by Eric R. Keydel, various aspects of SAR exploitation were presented. Two papers investigated the important problem of SAR simulation including its use in automatic target recognition. Other papers addressed the important problems of speckle reduction, target detection, and SAR automatic target recognition.

The 2010 challenge problem was introduced with two objectives. The first aspect is to develop SAR coherent change detection (CCD) algorithms applicable to X-band SAR imagery collected in an urban environment. The second relates to effective data compression of complex SAR images, where efficacy of the SAR CCD is the performance metric. A collection of X-band SAR imagery has been provided to support this development. To focus research onto specific areas of interest to AFRL, a number of challenge problems are defined. To request a copy of the data set, visit the AFRL/RYA Sensor Data Management System (SDMS) Public website <https://www.sdms.afrl.af.mil/main.php>.

The 2010 Best Student Paper Award goes to Mr. Kerry E. Dungan of The Ohio State University for his paper "Classifying sets of attributed scattering centers using a hash coded database." This is the first research effort that investigated ATR with "Gotcha" circular SAR type radars. As a first, the student demonstrated significant

resourcefulness as well as ingenuity in developing the data base, conceiving of an efficient and effective feature extraction approach, adapting his approach to the geometric distortions in wide-area circular SAR, and demonstrating a fast algorithm with high performance. Congratulations, Kerry!

Edmund G. Zelnio
Frederick D. Garber