# Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXII

Miguel Velez-Reyes David W. Messinger Editors

18–21 April 2016 Baltimore, Maryland, United States

Sponsored and Published by SPIE

**Volume 9840** 

Proceedings of SPIE 0277-786X, V. 9840

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 Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXII, edited by Miguel Velez-Reyes, David W. Messinger, Proceedings of SPIE Vol. 9840 (SPIE, Bellingham, WA, 2016) Six-digit Article CID Number.

ISSN: 0277-786X ISSN: 1996-756X (electronic) ISBN: 9781510600812

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 © 2016, 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/16/\$18.00.

Printed in the United States of America Vm7 i ffUb 5 ggc WJUHY gž ₩Vži bXYf "JW bgY Zfca GD-9.

Publication of record for individual papers is online in the 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

### Authors ix

- Conference Committee xi
- xiii Introduction

### SESSION 1 **CLASSIFICATION**

- 9840 03 A study of neural network parameters for improvement in classification accuracy [9840-2]
- 9840 04 Tensor subspace analysis for spatial-spectral classification of hyperspectral data [9840-3]
- 9840 05 Classification performance of a block-compressive sensing algorithm for hyperspectral data processing [9840-4]

#### SESSION 2 SENSOR CHARACTERIZATION

- 9840 09 New applications of spectral edge image fusion [9840-9]
- 9840 OA Metamaterial based narrow bandwidth angle-of-incidence independent transmission filters for hyperspectral imaging [9840-62]

### **SESSION 3 APPLICATIONS**

9840 OC Developing a confidence metric for the Landsat land surface temperature product [9840-10] 9840 OD Detecting red blotch disease in grape leaves using hyperspectral imaging [9840-12] 9840 OE Spectral feature characterization methods for blood stain detection in crime scene backgrounds [9840-13] SESSION 4 INVITED SESSION: SOLID TARGET VARIABILITY I

- 9840 OH Ideal system morphology and reflectivity measurements for radiative-transfer model development and validation (Invited Paper) [9840-16]
- 9840 OI Experimental effects on IR reflectance spectra: particle size and morphology (Invited Paper) [9840-17]
- 9840 OJ A next generation field-portable goniometer system (Invited Paper) [9840-18]

# SESSION 5 INVITED SESSION: SOLID TARGET VARIABILITY II

9840 OL	NEFDS contamination model parameter estimation of powder contaminated surfaces (Invited Paper) [9840-20]
9840 OM	Radiative transfer modeling of surface chemical deposits (Invited Paper) [9840-21]
9840 ON	Hierarchical multi-scale approach to validation and uncertainty quantification of hyper- spectral image modeling (Invited Paper) [9840-22]
9840 00	Advancing the retrievals of surface emissivity by modeling the spatial distribution of temperature in the thermal hyperspectral scene (Invited Paper) [9840-23]
9840 OP	Modeling and analysis of LWIR signature variability associated with 3D and BRDF effects (Invited Paper) [9840-24]
9840 OQ	Solid target spectral variability in LWIR (Invited Paper) [9840-25]
9840 OR	Spectral BRDF modeling of vehicle signature observations in the VNIR-SWIR (Invited Paper) [9840-26]
9840 OS	Instance influence estimation for hyperspectral target signature characterization using extended functions of multiple instances (Invited Paper) [9840-27]
9840 OT	Graph-based and statistical approaches for detecting spectrally variable target materials (Invited Paper) [9840-28]
9840 OU	Identification of solid materials using HSI spectral oscillators (Invited Paper) [9840-29]
SESSION 6	TARGET DETECTION
9840 OV	Anomaly detection in hyperspectral imagery: statistics- vs. graph-based algorithms [9840-30]
9840 OW	Target detection in hyperspectral Imaging using logistic regression [9840-31]
9840 OX	Comparison of algorithms for blood stain detection applied to forensic hyperspectral imagery [9840-32]
9840 OY	Biased normalized cuts for target detection in hyperspectral imagery [9840-33]
9840 OZ	Methods and challenges for target detection and material identification for longwave infrared hyperspectral imagery [9840-34]

# SESSION 7 INVITED SESSION: NOVEL MATHEMATICALLY INSPIRED METHODS OF PROCESSING HYPERSPECTRAL IMAGERY

- 9840 11 Agile multi-scale decompositions for automatic image registration (Invited Paper) [9840-36]
- 9840 12 Schroedinger Eigenmaps with knowledge propagation for target detection (Invited Paper) [9840-37]
- 9840 15 Building robust neighborhoods for manifold learning-based image classification and anomaly detection (Invited Paper) [9840-39]
- 9840 16 A parametric study of unsupervised anomaly detection performance in maritime imagery using manifold learning techniques (Invited Paper) [9840-40]
- 9840 17 Use of high dimensional model representation in dimensionality reduction: application to hyperspectral image classification (Invited Paper) [9840-41]
- 9840 1A Analyzing hyperspectral images into multiple subspaces using Gaussian mixture models (Invited Paper) [9840-79]
- 9840 1B A nonlinear modeling framework for the detection of underwater objects in hyperspectral imagery (Invited Paper) [9840-44]

# SESSION 8 SPECTRAL SIGNATURE MODELING, MEASUREMENTS, AND APPLICATIONS

- 9840 1D A hyperspectral vehicle BRDF sampling experiment [9840-46]
- 9840 1E Calculation of vibrational and electronic excited-state absorption spectra of arsenic-water complexes using density functional theory [9840-47]
- 9840 1F Modeling of forest canopy BRDF using DIRSIG [9840-48]
- 9840 1G Imaging of gaseous oxygen through DFB laser illumination [9840-49]
- 9840 1H Towards an improved understanding of the influence of subpixel vegetation structure on pixel-level spectra: a simulation approach [9840-50]

### SESSION 9 DIMENSIONALITY REDUCTION

- 9840 11 How many spectral bands are necessary to describe the directional reflectance of beach sands? [9840-51]
- 9840 1J Simultaneously sparse and low-rank hyperspectral image recovery from coded aperture compressive measurements via convex optimization [9840-52]
- 9840 1K Manifold alignment with Schroedinger Eigenmaps [9840-53]

## SESSION 10 SPECTRAL CHARACTERIZATION, DETECTION, AND IDENTIFICATION

- 9840 1MChemical plume detection with an iterative background estimation technique [9840-55]
- 9840 1N Flag-based detection of weak gas signatures in long-wave infrared hyperspectral image sequences [9840-56]
- 9840 10 Temperature-emissivity separation for LWIR sensing using MCMC [9840-57]
- 9840 1P Polarimetric assist to HSI atmospheric compensation and material identification [9840-58]
- 9840 1Q A spectral climatology for atmospheric compensation of hyperspectral imagery [9840-59]
- 9840 1R Generation of remotely sensed reference data using low altitude, high spatial resolution hyperspectral imagery [9840-60]

# SESSION 11 SENSOR DESIGN AND DEVELOPMENT

- 9840 15 An imaging spectro-polarimeter for measuring hemispherical spectrally resolved downwelling sky polarization [9840-63]
- 9840 11 Compact hyperspectral camera in the mid-infrared for small UAVs [9840-64]
- 9840 1U Compact multispectral multi-camera imaging system for small UAVs [9840-65]
- 9840 1V Software defined multi-spectral imaging for Arctic sensor networks [9840-66]

### **INTERACTIVE POSTER SESSION**

- 9840 1W Lossless compression of hyperspectral images based on the prediction error block [9840-68]
- 9840 1Z Minimum removal and maximum normalization of VNIR hyperspectral image for shade and specular invariance [9840-71]
- 9840 21A generalized representation-based approach for hyperspectral image classification<br/>[9840-73]
- 9840 22 Multispectral image fusion based on diffusion morphology for enhanced vision applications [9840-74]
- 9840 23 **Compressive hyperspectral and multispectral imaging fusion** [9840-75]
- 9840 24 On validating remote sensing simulations using coincident real data [9840-76]
- 9840 25 Spectral signature verification using statistical analysis and text mining [9840-78]
- 9840 26 Toward prediction of hyperspectral target detection performance after lossy image compression [9840-80]

- 9840 27 Comparing performance of standard and iterative linear unmixing methods for hyperspectral signatures [9840-81]
- 9840 28 Middle infrared (wavelength range: 8 μm-14 μm) 2-dimensional spectroscopy (total weight with electrical controller: 1.7 kg, total cost: less than 10,000 USD) so-called hyperspectral camera for unmanned air vehicles like drones [9840-82]
- 9840 29 Tracking the on-orbit spatial performance of MODIS using ground targets [9840-7]
- 9840 2A Monitoring of urban heat island over Shenzhen, China using remotely sensed measurements [9840-83]