

PROCEEDINGS OF SPIE

***Algorithms, Technologies, and  
Applications for Multispectral and  
Hyperspectral Imagery XXV***

**Miguel Velez-Reyes  
David W. Messinger**  
*Editors*

**16–18 April 2019  
Baltimore, Maryland, United States**

*Sponsored and Published by*  
SPIE

**Volume 10986**

Proceedings of SPIE 0277-786X, V. 10986

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 [SPIDigitalLibrary.org](http://SPIDigitalLibrary.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, Technologies, and Applications for Multispectral and Hyperspectral Imagery XXV*, edited by Miguel Velez-Reyes, David W. Messinger, Proceedings of SPIE Vol. 10986 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510626379

ISBN: 9781510626386 (electronic)

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](http://SPIE.org)

Copyright © 2019, 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](http://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/19/\$18.00.

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.

**SPIE. DIGITAL LIBRARY**

[SPIDigitalLibrary.org](http://SPIDigitalLibrary.org)

---

**Paper Numbering:** *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article 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

ix	<i>Authors</i>
xi	<i>Conference Committee</i>
xiii	<i>Introduction</i>

---

## **SESSION 1      HYPERSPECTRAL IMAGING STANDARDS**

---

10986 02	<b>IEEE P4001: progress towards a hyperspectral standard (Invited Paper) [10986-1]</b>
----------	--

---

## **SESSION 2      LWIR AND MWIR SPECTRAL SENSING**

---

10986 03	<b>LWIR change detection using robustified temperature emissivity separation and alpha residuals [10986-2]</b>
10986 04	<b>Applications of spectral image quality equation for longwave infrared hyperspectral imagery [10986-3]</b>
10986 05	<b>Assessments of MODIS thermal emissive bands on-orbit calibration performance using Dome C observations [10986-4]</b>
10986 06	<b>Observations on passive polarimetric imaging across multiple infrared wavebands [10986-5]</b>

---

## **SESSION 3      CLASSIFICATION AND DIMENSIONALITY REDUCTION**

---

10986 07	<b>Analysis of spectral data using spatial context [10986-6]</b>
10986 08	<b>A comparison of adaptive and template matching techniques for radio-isotope identification [10986-7]</b>
10986 09	<b>Semi-supervised discriminant feature selection for hyperspectral imagery classification [10986-8]</b>
10986 0A	<b>Unsupervised hyperspectral band selection in the compressive sensing domain [10986-9]</b>

---

**SESSION 4      SENSOR SYSTEMS AND CHARACTERIZATION**

---

- 10986 0E      **Simplified measurement of point spread functions of hyperspectral cameras for assessment of spatial coregistration** [10986-13]
- 10986 0F      **Solar-induced fluorescence retrievals in the context of physiological, environmental, and hardware-based sources of uncertainty** [10986-14]
- 10986 0G      **Stray light characterization in a high-resolution imaging spectrometer designed for solar-induced fluorescence** [10986-15]
- 10986 0H      **SAGE IV Pathfinder multi-spectral imaging spectrometer telescope paves the way for semi-custom CubeSat imaging missions** [10986-16]
- 10986 0I      **Extended characterization of multispectral resolving filter-on-chip snapshot-mosaic CMOS cameras** [10986-17]

---

**SESSION 5      CHEMICAL AND EXPLOSIVES DETECTION**

---

- 10986 0J      **Advances in active infrared spectroscopy for trace chemical detection** [10986-18]
- 10986 0K      **Active LWIR hyperspectral imaging and algorithms for rapid standoff trace chemical identification** [10986-19]
- 10986 0N      **Understanding polynomial distributed lag models: truncation lag implications for a mosquito-borne disease risk model in Brazil** [10986-101]
- 10986 0O      **Algorithm development with on-board and ground-based components for hyperspectral gas detection from small satellites** [10986-22]

---

**SESSION 6      MODELS AND MATHEMATICAL METHODOLOGIES**

---

- 10986 0P      **A universal sensing model for compressed hyperspectral image analysis** [10986-23]
- 10986 0Q      **Parametric modeling of surface-distributed-scatterer ensembles for inverse analysis of diffuse-reflectance spectra** [10986-24]

---

**SESSION 7      MACHINE LEARNING IN SPECTRAL SENSING I**

---

- 10986 0R      **Initial investigation into the effect of image degradation on the performance of a 3-category classifier using transfer learning and data augmentation** [10986-25]
- 10986 0S      **Spatially regularized multiscale graph clustering for electron microscopy** [10986-26]

- 10986 0V **Analysis of long-wave infrared hyperspectral classification performance across changing scene illumination** [10986-28]
- 10986 0W **Unraveling low abundance intimate mixtures with deep learning** [10986-29]
- 10986 0X **Sheared multi-scale weight sharing for multi-spectral superresolution** [10986-30]

---

**SESSION 8 APPLICATIONS OF SPECTRAL SENSING**

---

- 10986 0Y **Multispectral camera design and algorithms for python snake detection in the Florida Everglades** [10986-31]
- 10986 0Z **Stellar background rendering for space situational awareness algorithm development** [10986-32]
- 10986 10 **Hyperspectral nondestructive evaluation of early damage and degradation in metallic materials** [10986-33]
- 10986 11 **Hyperspectral pigment analysis of cultural heritage artifacts using the opaque form of Kubelka-Munk theory** [10986-34]
- 10986 14 **Evaluation of target detection methods and the study of accuracy improvement toward the application to MDA with hyperspectral imaging** [10986-36]

---

**SESSION 9 TARGET AND CHANGE DETECTION**

---

- 10986 15 **Multi-sensor anomalous change detection at scale** [10986-37]
- 10986 16 **Change detection using Landsat and Worldview images** [10986-38]
- 10986 17 **Comparison of longwave infrared hyperspectral target detection methods** [10986-39]
- 10986 18 **Coupled atmospheric surface observations with surface aerosol particle counts for daytime sky radiance quantification** [10986-40]
- 10986 19 **Object detection and classification in aerial hyperspectral imagery using a multivariate hit-or-miss transform** [10986-41]

---

**SESSION 10 MACHINE LEARNING IN SPECTRAL SENSING II**

---

- 10986 1A **Machine learning for better trace chemical detection** [10986-43]
- 10986 1B **Blended learning for hyperspectral data** [10986-45]

- 10986 1C **An application of CNNs to time sequenced one dimensional data in radiation detection**  
[10986-46]
- 10986 1D **Optimizing deep learning model selection for angular feature extraction in satellite imagery**  
[10986-47]

---

**SESSION 11 SPECTRAL IMAGING**

---

- 10986 1F **High speed VNIR/SWIR HSI sensor for vegetation trait mapping** [10986-49]
- 10986 1G **Frequency analysis and optimization of the diffractive plenoptic camera** [10986-50]
- 10986 1H **Assessment of residual fixed pattern noise on hyperspectral detection performance** [10986-51]
- 10986 1I **Optimized algorithm for processing hyperspectral push-broom data from multiple sources**  
[10986-52]
- 10986 1J **Development of a pipeline for generating high resolution multispectral Mastcam images**  
[10986-53]

---

**POSTER SESSION**

---

- 10986 1L **Iterative constrained energy minimization convolutional neural network for hyperspectral image classification** [10986-54]
- 10986 1M **Unsupervised iterative CEM-clustering based multiple Gaussian feature extraction for hyperspectral image classification** [10986-55]
- 10986 1N **A novel image registration method based on geometrical outlier removal** [10986-56]
- 10986 1O **An iterative SIFT based on intensity and spatial information for remote sensing image registration** [10986-57]
- 10986 1R **Case-study analysis of apparent camouflage-pattern color using segment-weighted spectra**  
[10986-60]
- 10986 1S **Dried red chili peppers pungency assessment by visible and near infrared spectroscopy**  
[10986-61]
- 10986 1T **Robust iterative estimation of material abundances based on spectral filters exploiting the SVD**  
[10986-63]
- 10986 1U **Feature extraction and scene classification for remote sensing image based on sparse representation** [10986-64]
- 10986 1V **Hyperspectral anomaly detection algorithm based on non-negative sparsity score estimation**  
[10986-66]

- 10986 1W **Tracking long-term stability of MODIS thermal emissive bands response versus scan-angle using Dome C observations** [10986-67]
- 10986 1X **Defect detection based on monogenic signal processing** [10986-68]