## PROCEEDINGS OF SPIE

2019 International Conference on Optical Instruments and Technology

# Optoelectronic Imaging/Spectroscopy and Signal Processing Technology

Guohai Situ Xun Cao Wolfgang Osten Editors

26–28 October 2019 Beijing, China

Sponsored by CIS— China Instrument and Control Society (China)

Cosponsored and Published by SPIE

Volume 11438

Proceedings of SPIE 0277-786X, V. 11438

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

2019 International Conference on Optical Instruments and Technology: Optoelectronic Imaging/Spectroscopy and Signal Processing Technology, edited by Guohai Situ, Xun Cao, Wolfgang Osten, Proc. of SPIE Vol. 11438, 1143801 · © 2020 SPIE · CCC code: 0277-786X/20/\$21 · doi: 10.1117/12.2566203

Proc. of SPIE Vol. 11438 1143801-1

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 2019 International Conference on Optical Instruments and Technology: Optoelectronic Imaging/Spectroscopy and Signal Processing Technology, edited by Guohai Situ, Xun Cao, Wolfgang Osten, Proceedings of SPIE Vol. 11438 (SPIE, Bellingham, WA, 2020) Seven-digit Article CID Number.

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

ISBN: 9781510636545 ISBN: 9781510636552 (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 Copyright © 2020, 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 \$21.00 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/20/\$21.00.

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.



**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

- vii Authors
- ix Symposium Committee
- xi Conference Committee
- xiii Introduction
- xv Conference Organizers

#### OPTOELECTRONIC IMAGING/SPECTROSCOPY AND SIGNAL PROCESSING TECHNOLOGY

11438 02	Non-contact continuous blood pressure measurement based on imaging equipment [11438-5]
11438 03	Parylene-C diaphragm-based fiber-optic gas sensor based on photoacoustic spectroscopy [11438-6]
11438 04	Photoacoustic detection of glucose based on the pulsed laser induced ultrasonic combined with scanning position method [11438-10]
11438 05	Computer tomographic sounder with hyper-spectral resolution for OH radicals in the upper and middle atmosphere [11438-11]
11438 06	Research on high frame rate scene projection method based on digital micromirror device (DMD) [11438-15]
11438 07	Classification of common recyclable garbage based on hyperspectral imaging and deep learning [11438-16]
11438 08	Research on the color deviation detection for the satellite remote sensing image [11438-17]
11438 09	A super-resolution reconstruction method for remote sensing images based on Adam optimized depth convolution network [11438-21]
11438 OA	<b>3D</b> localization of point source based on light field imaging and deep learning [11438-23]
11438 OB	A compact visible bionic compound eyes system based on micro-surface fiber faceplate [11438-24]
11438 OC	Noninvasive object imaging with single-shot low-resolution speckle pattern through strongly- scattering turbid layers [11438-25]
11438 OD	Research on disturbance characteristics in high temperature DIC measurement due to heat flow and its correction method [11438-26]

11438 OE	Performance comparison of coded apertures in push-broom hyperspectral compressed sampling imaging [11438-29]
11438 OF	A new 3D imaging technology through a diffuser using structured illumination [11438-32]
11438 0G	High-quality imaging through scattering media with single-pixel photodetection [11438-35]
11438 OH	An adaptive window motion blurred star restoration based on energy equalization [11438-36]
11438 01	Dynamic detection system for thermocouple cable insulation defects based on line scan camera [11438-38]
11438 OJ	Segmentation for high spatial resolution remote sensing images by combining quadtree with minimum spanning tree [11438-40]
11438 OK	Thermocouple welding joint defects detection system based on computer vision [11438-41]
11438 OL	Undersampled phase retrieval by a lateral shearing and zooming approach [11438-45]
11438 OM	Multi-scale wavelet thresholding denoising algorithm of Raman spectrum [11438-46]
11438 ON	The influence analysis of reflectance anisotropy of canopy on the prediction accuracy of Cu stress based on laboratory multi-directional measurement [11438-49]
11438 00	Research on memory effects and recovery algorithm in imaging through scattering layers via speckle correlations [11438-50]
11438 OP	Differences in calculation methods of effective emissivity of blackbody cavity [11438-52]
11438 0Q	Multi-polarization parameter target detection method based on modulation contrast [11438-53]
11438 OR	Research on imaging spectrometer for contamination monitoring of waters and plants in rivers [11438-55]
11438 OS	Measurement method of noise characterization of highly coherent laser and its applications in coherent sensing and imaging (Invited Paper) [11438-58]
11438 OT	Multi-scale retinex image enhancement algorithm based on fabric defect database [11438-60]
11438 OU	A signal processing technology for simulated turbine blades [11438-63]
11438 OV	Study on non-negative matrix factorization based endmember extraction algorithm for ballistic missile [11438-65]
11438 OW	Color image enhancement algorithm based on edge extraction [11438-67]

11438 OX	Improved 3D imaging and measurement with fringe projection structured light field (Invited Paper) [11438-73]
11438 OY	A method of 3D light field imaging through single layer of weak scattering media basd on deep learning (Invited Paper) [11438-76]
11438 OZ	A mosaic method for multichannel sequence starry images via multiscale edge-preserving spatio-temporal context filtering [11438-77]
11438 10	A deeply-enforced method for extracting ships in remote sensing satellite video data [11438-78]
11438 11	An improved kernelized-correlation-filter spatial target tracking method using variable regularization and spatio-temporal context model [11438-79]
11438 12	Starry image matching method based on the description of multi-scale geometric invariant features [11438-80]
11438 13	Computational phase microscopy with modulated illumination (Invited Paper) [11438-81]
11438 14	Effect of temperature on CO <sub>2</sub> absorption spectrum near 1432nm [11438-83]
11438 15	Design of large-array CMOS real-time imaging system based on FPGA [11438-84]
11438 16	Influence of spectral characteristics of Cd and Fe elements in soil on laser-induced breakdown spectroscopy [11438-85]
11438 17	Pedestrian dead reckoning fusion positioning based on radial basis function neural network [11438-86]

### Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five 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.

Bi, Yanqiang, 08 Cai, Haiwen, OS Cai, Zewei, OX Cao, Jie, 0C Cao, Rui, 0A, 0O Chen, Ke, 03 Chen, Yewei, 03 Cheng, Xuemin, 0A, 0G, 0O Cui, Bolun, ON Di, Shuai, 14 Ding, Yu, 04 Ding, Zhidan, OS Dong, Liquan, 02 Du, Chunlin, OK Duan, Fajie, OT Duan, Ying, OU Fang, Lide, 14 Feng, Guojin, OP Feng, Lihui, 17 Gan, Fuping, ON Gao, Kun, 0Q, 0Z, 11, 12 Gao, Peng, 13 Gao, Shan, OU Gao, Tianli, 03 Gao, Yanze, 06 Gao, Ziqi, 0G Gong, Changmei, OF Gong, Zhenfeng, 03 Gou, Xueke, OU Guan, Jinge, 0M Guo, Yanfang, OE Guo, Ying, 02 Han, Jun, OF Han, Lu, OQ Han, Shaokun, 00 Hao, Qun, 0A, 0C, 0G, 0O He, Yongqiang, OJ Hu, Yao, 0A, 0G, 0O Hua, Zizheng, OQ Wang, Huang, OT Huang, Yichen, 16 Jia, Guorui, ON Jia, Yangin, 09 Jia, Yaqing, 14 Jiang, Fenggi, OH Jiang, Jie, OJ Jiang, Jing, OU Jiang, Yong, Ol Jiao, Mingxing, OL

Jiao, Yexiang, 03 Jin, Weiqi, OB Kang, Shasha, 16 Kong, Lingqin, 02 Li, Honglian, 14, 16 Li, Jitian, 06 Li, Lu, OM Li, Mengzhu, OE Li, Qiong, 0K Li, Xuan, OL Li, Xujian, OE Li, Ye, Ol Li, Zhiwei, 05 Li, Zhuo, 06 Liu, Chun, Ol Liu, Guodong, 04 Liu, Jiying, OE Liu, Likun, 10 Liu, Lixin, 13 Liu, Ming, 02 Liu, Shihua, OV Liu, Xiaohua, 02 Liu, Xiaoli, OX Liu, Xiaozheng, 0Z, 11, 12 Liu, Yun, OL Lu, Li, OV Luo, Haiyan, 05 Lv, Wenjing, 14 Ma, Chang, 0D Ma, Yuxuan, OP Mao, Yuxuan, 0Z, 11, 12 Peng, Xiang, 0X Qi, Junli, OE Qian, Beixing, Ol Qian, Chen, 17 Qian, Fang, 0M Qiu, Anmei, 0U Qiu, Su, OB Ren, Zhong, 04 Rui, Xiaobo, OD Shang, Yonghong, 08 Sheng, Wen, 0V Shi, Hailiang, 05 Shi, Qingfeng, 06 Shi, Yuzhang, OM Si, Lu, OL Song, Lipei, OY Song, Jian, 06 Song, Xin, OH

Sun, Peng, OM Tang, Mingyuan, OC Tang, Wusheng, OE Tao, Dongxing, 08 Tian, Ailing, OF Tian, Bingxin, OF Wang, Bang, OL Wang, Chao, OU Wang, Gao, 0M Wang, Hongbao, 16 Wang, Huang, OT Wang, Jing, 08 Wang, Lei, Ol Wang, Runze, OI, OK Wang, Wei, OE Wang, Weihao, OY Wang, Weizheng, OE Wang, Xia, OB Wang, Yingbo, 0C Wang, Zichuan, OY Wei, Jinyu, OL Wen, Kai, 13 Wen, Ya, OY Wu, Rui, 07 Wu, Rui, OS Xie, Hongjie, 16 Xing, Junhong, OL Xiong, Wei, 05 Xu, Chengqiang, 0A, 0C Xu, Ke, OK Xu, Xincheng, OK Xue, Jiaan, OB Yan, Zhenguo, OH Yang, Fei, OS Yang, Jufeng, OY Yang, Zhijia, 0Z, 11, 12 Yi, Wenjun, OE Yin, Zhongke, 08 Yu, Feihong, 15 Yu, Peifeng, OU Yu, Qingxu, 03 Yu, Yang, OM Yuan, Shizhu, OA Zeng, Lvming, 04 Zeng, Zhoumo, 0D Zhan, Chuxian, OL Zhang, Bin, 07 Zhang, Chao, 08 Zhang, Chuncheng, 04 Zhang, Haiqi, 17 Zhang, Linfeng, 0G Zhang, Shaohui, 00 Zhang, Ting, 15 Zhang, Tinghua, 0Z, 11, 12 Zhang, Xiaojie, OX Zhang, Xiaole, 06 Zhang, Yian, OR Zhang, Yutong, OQ Zhang, Zezhan, OU

Zhang, Zhichao, OL Zhao, Dong-e, 07 Zhao, Huijie, 0N Zhao, Jiejun, 0S Zhao, Xing, 0Y Zhao, Yuejin, 02 Zheng, Juanjuan, 13 Zhong, Yekui, 0U Zhou, Lang, 06 Zhou, Weiti, 0T Zhou, Yan, 0K Zhou, Yingjie, 0Q Zhu, Jubo, 0E Zhu, Mengjun, 0E Zou, Jingian, 0V

## Symposium Committees

#### Symposium Chairs

Zheng You, CIS (China), Tsinghua University (China) Jim M. Oschmann, Ball Aerospace (United States)

#### Symposium Committee

Tianchu Li, National Institute of Metrology (China)
Songlin Zhuang, University of Shanghai for Science and Technology (China)
Liwei Zhou, Beijing Institute of Technology (China)
Shenghua Ye, Tianjin University (China)
Yimo Zhang, Tianjin University (China)
Guangjun Zhang, Southeast University (China)

#### Technical Program Chair

Guofan Jin, Tsinghua University (China)

#### Technical Program Co-chairs

Jinxue Wang, SPIE Tiegen Liu, Tianjin University (China)

Local Organizing Committee Chair

Youhua Wu, China Instrument and Control Society (China)

Local Organizing Committee Co-chairs

**Guoqiang Ni**, Beijing Institute of Technology (China) **Qun Hao**, Beijing Institute of Technology (China)

**General Secretary** 

Tong Zhang, China Instrument and Control Society (China)

Administrative Vice General Secretaries

Yu-nan Sun, Beijing Institute of Technology (China) Liquan Dong, Beijing Institute of Technology (China) Vice General Secretaries

Yuejin Zhao, Beijing Institute of Technology (China) Cunlin Zhang, Capital Normal University (China)

Local Organizing Committee

Hongda Chen, Institute of Semiconductors, CAS (China)
Xuping Zhang, Nanjing University (China)
Shangzhong Jin, China Jiliang University (China)
Libo Yuan, Guilin University of Electronic Technology (China)
Yongcai Guo, Chongqing University (China)
Tian Lan, Beijing Institute of Technology (China)
Cuiling Li, Beijing Institute of Technology (China)

## **Conference Committee**

**Conference** Chairs

Guohai Situ, Shanghai Institute of Optics and Fine Mechanics, CAS (China) Xun Cao, Nanjing University (China) Wolfgang Osten, Universität Stuttgart (Germany)

Conference Program Committee

George Barbastathis, Massachusetts Institute of Technology (United States)
David Brady, Duke University (United States)
Qionghai Dai, Tsinghua University (China)
Byoungho Lee, Seoul National University (Korea, Republic of)
Cheng Liu, Shanghai Institute of Optics and Fine Mechanics (China)
Takanori Nomura, Wakayama University (Japan)
John T. Sheridan, University College Dublin (Ireland)
Guangming Shi, Xidian University (China)
Lei Tian, Boston University (United States)
Feng Wu, University of Science and Technology of China (China)
Ping Yu, Missouri University (United States)
Jingyi Yu, Shanghai Technology University (China)
Jianlin Zhao, Northwestern Polytechnic University (China)

#### Session Chairs

- Light Field and Complex Media
   Guohai Situ, Shanghai Institute of Optics and Fine Mechanics, CAS (China)
- Computational Imaging
   Guohai Situ, Shanghai Institute of Optics and Fine Mechanics, CAS (China)
- 3 Deep Learning Peng Gao, Xidian University (China)
- 4 Spectral Imaging **Xun Cao**, Nanjing University (China)
- 5 Image Processing **Kebin Shi**, Peking University (China)

## Introduction

This volume contains papers presented during the 2019 International Conference on Optical Instrument and Technology (OIT 2019) at the topical meeting of Optoelectronic Imaging/Spectroscopy and Signal Processing Technology. The focus of this meeting was especially directed to advancements in this field and related areas. The extended scope was honored by a great response to our call for papers. Scientists and engineers, in particular from China, offered more than 50 papers.

This enormous response demanded a strong review of the papers to select the best out of the overwhelming number of excellent papers. The strong limitation of the number of papers which could be presented orally and discussed effectively during a one-and-a-half day meeting without holding parallel sessions was again an important factor. The classification of all accepted papers into the five topical sessions listed above was also very difficult and it often required compromises. We hope that our decision will be accepted by the audience.

The editors would like to express their thanks to the international program committee for helping us to find a good solution to finalize the meeting. We would also like to thank all the authors who spent a lot of time and effort in the preparation of their papers. Our appreciation also goes to Prof. Liquan Dong and Mrs. Cuiling Li, and all the local staff from Beijing Institute of Technology (China). Without their help, it would not have been possible to make the meeting so successful.

> Guohai Situ Xun Cao Wolfgang Osten

## **Conference Organizers**

Opto-Electronic-Mechanic Technology and System Integration Chapter, CIS (China) Committee on Optoelectronic Technology, COS (China) Committee on Optics, China Ordnance Society (China) Optical Instrument Chapter, CIS (China) Beijing Institute of Technology (China) Tianjin University (China) Tsinghua University (China) Peking University (China) Nanjing University (China) Zhejiang University (China) Nankai University (China) Capital Normal University (China) Beijing University of Posts and Telecommunications (China) Chongging University (China) University of Shanghai for Science and Technology (China) Instrument Society of America (United States) Institute of Measurement and Control (United Kingdom) Hong Kong Institution of Engineers (Hong Kong, China) The Society of Measurement and Control (Japan)