

PROCEEDINGS OF SPIE

Fifth Conference on Frontiers in Optical Imaging Technology and Applications (FOI 2018)

**Junhao Chu
Wenqing Liu
Huilin Jiang**
Editors

**25–27, July 2018
Hefei, China**

Organized by

Chinese Society for Optical Engineering (China)
Photoelectronic Technology Committee, CSA (China)
The Key Laboratory of Polarization Imaging Detection Technology (China)

Sponsored by

Chinese Society for Optical Engineering (China)
Chinese Academy of Engineering (China)
National Natural Science Foundation of China (China)

Published by
SPIE

Volume 10832

Proceedings of SPIE 0277-786X, V. 10832

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

Fifth Conference on Frontiers in Optical Imaging Technology and Applications (FOI 2018), edited
by Junhao Chu, Wenqing Liu, Huilin Jiang, Proc. of SPIE Vol. 10832, 1083201 · © 2018 SPIE
CCC code: 0277-786X/18/\$18 · doi: 10.1117/12.2515574

Proc. of SPIE Vol. 10832 1083201-1

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 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 *Fifth Conference on Frontiers in Optical Imaging Technology and Applications (FOI 2018)*, edited by Junhao Chu, Wenqing Liu, Huilin Jiang, Proceedings of SPIE Vol. 10832
(SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

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

ISBN: 9781510622890
ISBN: 9781510622906 (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 © 2018, 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/18/\$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. 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	<i>Authors</i>
xi	<i>Conference Committee</i>
xiii	<i>Introduction</i>

FIFTH CONFERENCE ON FRONTIERS IN OPTICAL IMAGING TECHNOLOGY AND APPLICATIONS

10832 02	An adaptive restoration method for motion-blurred image based on Wiener filtering [10832-1]
10832 03	High quality coherent imaging of the object behind the scattering media with one accurate power spectrum pattern [10832-3]
10832 04	A scheme to realize super-resolution by push-broom compressive sampling multi-spectral image system [10832-4]
10832 05	Test for dynamic range of scientific CCD imaging system [10832-5]
10832 06	Research on SIFT polarization image registration method based on matching optimization [10832-6]
10832 07	Neural network non-uniformity correction for eliminating low frequency noise [10832-7]
10832 08	Research of infrared digital camouflage design and generation [10832-8]
10832 09	Multi fields application of wide-band imaging spectrometer data of Tiangong-2 Space Laboratory [10832-9]
10832 0A	Distribution characteristics of lower troposphere atmospheric CO₂ in Hefei Science Island [10832-11]
10832 0B	Extending the depth-of-field and ranging the scene with a shifted phase mask [10832-12]
10832 0C	Retrieving atmospheric water vapor content based on absolute brightness of sky background spectral radiation [10832-13]
10832 0D	Design of compact freeform off-axis TMA system [10832-14]
10832 0E	Generating stereoscopic videos of realistic 3D scenes with ray tracing [10832-15]

10832 0F	The experiment analysis of LWIR thermal camera's imaging under the influence of integrate time [10832-16]
10832 0G	High efficient linearly polarized light emission from InGaN/GaN LED with patterned nanostructures [10832-17]
10832 0H	Single-band spectral light field images reconstruction based on compressed sensing [10832-18]
10832 0I	Low altitude polarization hyperspectral target detection based on CNN method [10832-19]
10832 0J	External cavity quantum cascade laser based gas sensor for chemical detection [10832-20]
10832 0K	Super-resolution imaging in thick scattering samples by structured illumination microscopy with dual nonlinear effects [10832-21]
10832 0L	Influence of femtosecond laser pulse width on performance of terahertz time domain spectrometer [10832-22]
10832 0M	Implementation of pupil location system based on bright pupil effect [10832-23]
10832 0N	Distance-weighted modulation transfer function measurement method [10832-24]
10832 0O	The numerical analysis and application of camouflage target DOLP under low illumination [10832-25]
10832 0P	Rotorcraft UAV laser charging target center location algorithm [10832-26]
10832 0Q	Simulation of laser ranging system for LEO non-cooperative targets based on Monte Carlo method [10832-29]
10832 0R	Bone organ printing based on surface structure light projection 3D contour measurement [10832-30]
10832 0S	A none-blind deblurring algorithm for noisy images via distributed gradient prior [10832-32]
10832 0T	The study of multi-beam interference effect [10832-33]
10832 0U	Image denoising algorithm based on adversarial learning using joint loss function [10832-34]
10832 0V	Research on measurement method of characteristics infrared small light points beam [10832-35]
10832 0X	Blind tone-mapped image quality assessment based on clustering perception [10832-37]
10832 0Y	A survey of detector technology in laser ranging system [10832-38]
10832 0Z	Rotary infrared tomography system design [10832-39]

- 10832 10 **Reprojection-based method for camera arrays of refocusing onto arbitrary focal surfaces**
[10832-40]
- 10832 11 **Polarization analysis and correction for space-borne grating spectrometers** [10832-41]
- 10832 12 **Study on the temporal and spatial distribution of atmospheric SO₂ and NO₂ in Huainan
observed by Lidar** [10832-44]
- 10832 13 **Design of a mid-wavelength infrared optical system based on high frame rate measuring**
[10832-45]
- 10832 14 **Long wave infrared optical system design based on fast and small target detection** [10832-46]
- 10832 15 **Single image enhancement using dual boundaries** [10832-47]
- 10832 16 **Study on the echo of the optical imaging system under different extent of damage to CCD**
[10832-48]
- 10832 17 **Infrared and visible image fusion method based on saliency detection and target-
enhancement** [10832-49]
- 10832 18 **Microscopic imaging improvement combining gradient constraint model and multi-fields of
view analysis** [10832-50]
- 10832 19 **Cascaded constant modulus equalization algorithm in wireless optical communication systems**
[10832-51]
- 10832 1A **Wavelet-based approach for the fusion of low-light image pairs** [10832-52]
- 10832 1B **Fast r_0 estimation for atmosphere turbulence via structural function** [10832-53]
- 10832 1C **Polarization characteristics of full-field and full-pupil in refraction and reflection telephoto
system** [10832-55]
- 10832 1D **Baseline correction method for Raman spectra based on piecewise polynomial fitting**
[10832-58]
- 10832 1E **Infrared radiation characteristics of solid rocket engine plume at high altitude** [10832-63]
- 10832 1F **Design and simulation of first-photon 3D lidar** [10832-66]
- 10832 1G **Uncertainty of measurement for testing sensitivity of low light level image intensifier** [10832-68]
- 10832 1H **Design of a semi-active laser/active radar/infrared common aperture compound optical
system** [10832-73]
- 10832 1I **Research on ghost image reconstruction algorithm based on photons simulation with doubly
Poisson stochastic process** [10832-74]

10832 1J	Numerical simulation of infrared spectrum and radiance characteristics of rocket engine exhaust plume [10832-75]
10832 1K	Characterization and detection of spectral polarization information for ballistic target recognition [10832-79]
10832 1L	Extinction ratio of the Glan-Taylor prism with deviated optical axes [10832-80]
10832 1M	Study on the applications of space-based polarization detection technique [10832-81]
10832 1N	Multi-touching imaging via sparse sensing [10832-82]
10832 1O	The technology of multi-mode tracking algorithm fusion decision based on background complexity perception [10832-83]
10832 1P	The analysis of radiometric calibration based on long-wave infrared hyperspectral imaging spectrometer [10832-84]
10832 1Q	Background radiation response evaluation of InGaAs detectors [10832-85]
10832 1R	Design and simulation of single-photon three-dimensional compressive imaging system based on TCSPC [10832-86]
10832 1S	Research on real-time NUC method of infrared TDI detector based on bi-directional scanning-imaging mechanism [10832-87]
10832 1T	Low-light image enhancement based on joint convolutional sparse representation [10832-88]
10832 1U	Vision method of vehicle localization based on the roadside landmark [10832-94]
10832 1V	Snapshot diffractive computational imaging spectroscopy [10832-95]
10832 1W	Imaging detection system based on optical fiber faceplate coupling [10832-96]
10832 1X	Impact of observation angle and radiance on LWIR polarimetric images [10832-97]
10832 1Y	High resolution perspective views extraction based on light field imaging theory [10832-98]
10832 1Z	Advances and prospects of thin film phosphor for high resolution field emission displays [10832-99]
10832 20	Study on the quality of jujube in Southern Xinjiang with hyperspectral near-surface remote sensing [10832-101]
10832 21	Design of infrared APD detector for lidar [10832-102]

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.

An, Wei, 10	He, Yulan, 0D
Bai, J., 1D	Hong, Jin, 1Q
Bai, Wei-ning, 1K	Hu, Feng, 0Z
Bai, Xiaofeng, 1G	Hu, H.B., 1D
Bai, Xin, 1L	Hu, Jie, 08
Bao, Xingdong, 1E, 1J	Hu, Qiuping, 1O
Bo, Tiezhu, 1Z	Hu, Shunxing, 0A, 12
Cai, Hua, 1Z	Hu, Xiande, 02
Cai, Lei, 1L	Hu, Xian-zhe, 1L
Cao, Bing, 0G	Hu, Xiao-li, 1K
Cao, Fei, 0Y	Hua, Wei-ping, 18
Cao, Yu-jian, 0I	Huang, Jian, 0A, 12
Chang, Jin-yong, 1L	Huang, Jiazi, 0S
Chang, Meng, 0U, 15, 1A	Huang, Kangsheng, 1Z
Chen, Chao, 1M	Huang, Wujun, 1G
Chen, Chong, 20	Huang, Yanhua, 0O
Chen, Chunyi, 0E	Jia, Jinsheng, 1W
Chen, Lei, 0O	Jia, Nan, 05
Chen, Pengbo, 0H	Jia, Wenwu, 1O
Chen, Q., 0T	Jia, Yizhen, 0Z
Chen, Xulang, 1G	Jiang Bie Ke, 0R
Chen, Yu-dan, 0P	Jiang, Gangyi, 0X
Chen, Yueting, 0N, 0S, 0U, 17	Jiang, Hao, 0X
Chong, Xin, 1N	Jiang, Kai, 13, 14
Chu, YuFei, 21	Jiang, Shurong, 0K
Cui, Guang-mang, 18	Jiang, Zengbo, 1O
Deng, Qian, 21	Jiao, Jianchao, 1V
Dong, Hao, 1Q	Jin, Xin, 0G
Dong, Yanbing, 1J	Kang, Wenli, 0D
Dong, Zhaoyong, 1M	Kong, Xianglong, 1M
Dou, Xianan, 16	Kuang, ZhiQiang, 21
Du, Mengzhu, 0H	Lei, Hao, 0F
Duan, Jing, 13, 14	Lei, Zhenggang, 1P
Fan, Xiaoli, 0F	Li, Baosheng, 0Z
Feng, Bin, 1X	Li, Dan, 1F, 1I, 1R
Feng, Huajun, 0N, 0S, 0U, 15, 17, 1A	Li, Guo-chao, 0L, 0V
Feng, Yuechong, 1W	Li, H., 0T
Fu, Meicheng, 03, 04	Li, Hui, 1Y
Fu, Yang, 1W	Li, Jianxin, 1V
Ge, Peng, 18	Li, Jingsong, 0J
Gong, Jingzhu, 0D	Li, Junwei, 1H
Guo, Hui, 1G	Li, Leijuan, 09
Guo, Ling, 20	Li, Lingxiao, 17
Guo, Yanfang, 03	Li, Mengzhu, 03, 04
Han, Yusheng, 1T	Li, Ou, 0R
Han, Zhong, 11	Li, Qi, 0N, 0S, 0U, 15, 17, 1A
He, Suhong, 0O	Li, Qian, 07
He, Tianbo, 0J	Li, Qingru, 0K
He, Yingping, 1G	Li, Shengyang, 09

Li, Song, 0Q
 Li, Ting, 1H
 Li, Xilong, 1N
 Li, Xiujian, 03, 04
 Li, Yan, 0D
 Li, Yingchao, 1C
 Li, Yuan, 0D
 Liang, Shaolin, 05
 Liang, Weidong, 0E
 Lin, Yu, 0G
 Liu, Chang, 0F
 Liu, Chuanming, 07
 Liu, Dong, 21
 Liu, Fan, 0K
 Liu, HaiZheng, 1X
 Liu, Hong-yuan, 0L, 0V
 Liu, Hui, 1Z
 Liu, Hui-Qiang, 0R
 Liu, Kai, 13, 14
 Liu, Kang, 09
 Liu, Lidong, 07
 Liu, Linlin, 12
 Liu, Rui, 0Q
 Liu, Xiaomin, 0H
 Liu, Yanli, 1V
 Liu, Yunbiao, 0E
 Liu, Yunfei, 09
 Liu, Zhaohui, 0B
 Liu, Zhenghai, 1Q
 Liu, Zhi, 19
 Long, Chao, 1L
 Lu, Qiang, 1B
 Lu, Yuan, 08
 Luan, Ze-Ming, 0R
 Luo, Huaping, 20
 Lv, Qiming, 0J
 Ma, Feng, 1S
 Ma, Hudlin, 0X
 Ma, Xiao, 0C
 Ma, Y., 1D
 Ma, Yue, 0Q
 Ma, Zhibang, 0H
 Mao, Hongxia, 1E, 1J
 Mao, Jinghua, 05
 Mei, Haiping, 0C
 Meng, Ce, 19
 Meng, Qingyun, 1G
 Mu, Lingli, 09
 Ni, Xiaolong, 19
 Nie, Jinsong, 16
 Nie, Qianwen, 03, 04
 Peng, Jing, 1Y
 Qi, Lin, 0Y
 Qi, Xin, 0H
 Qian, Kun, 1H
 Qin, Bangyong, 09
 Quan, Jing, 0Z
 Ran, Jian, 0Y
 Rao, Ruizhong, 0C
 Ren, G., 0T
 Rong, Xiao-long, 1K
 Shan, Qiusha, 0B, 13, 14
 She, Wenji, 0B
 Shi, Entao, 05
 Shi, Haodong, 1C
 Shi, ZeLin, 1X
 Song, Runsheng, 06
 Song, Xinbo, 17, 1A
 Su, Bida, 0F
 Su, Junbo, 07
 Su, Yun, 1V
 Sun, Ke, 16
 Sun, Peiyu, 0A
 Sun, Quansen, 1V
 Sun, Quan-she, 11
 Sun, Yong, 1Z
 Tang, Shuai, 1S
 Tang, Wusheng, 03, 04
 Tang, Zili, 1O
 Tao, Huirong, 0M
 Tao, Ling, 1I
 Tian, Jinge, 03, 04
 Wang, Chen, 1Z
 Wang, Chinhua, 0G
 Wang, Feng, 06
 Wang, Guangxia, 15, 1A
 Wang, Hong-chao, 0L, 0V
 Wang, Jianfeng, 0G
 Wang, Jiayu, 1C
 Wang, Jing, 0F
 Wang, Jiuwang, 1W, 1Z
 Wang, Kun, 0R
 Wang, Lei, 04
 Wang, Miao, 0G, 14
 Wang, Nanxi, 0D
 Wang, Ping, 03, 04
 Wang, Qiancheng, 0H
 Wang, Shao-shui, 11
 Wang, Wei, 03
 Wang, Xiaodong, 07
 Wang, Xing-shu, 1U
 Wang, Y., 0T
 Wang, Yanhui, 0K
 Wang, Yifan, 1F, 1I, 1R
 Wang, Yingqian, 10
 Wang, YinJian, 21
 Wang, Yi-xue, 1U
 Wang, Yongmei, 05
 Wang, Yun, 1W
 Wang, Ze-hong, 0V
 Wang, Zhenghua, 1J
 Wang, Zhenhua, 1E
 Wang, Zhiqiang, 1F
 Wu, Bin, 0L, 0V
 Wu, Chengguo, 0O
 Wu, Dong-sheng, 0P
 Wu, Hai-Ying, 1K
 Wu, Shun-Hua, 0R
 Wu, Yiqiang, 1R
 Xia, Fei, 1P

Xia, G., 1D
 Xia, Zongze, 1P
 Xiao, Chao, 10
 Xie, ChenBo, 21
 Xie, Yuntao, 16
 Xu, Guoming, 02, 06, 0I
 Xu, Ke, 0G
 Xu, Meng-en, 0I
 Xu, Yanglei, 1Z
 Xu, Ying, 0F, 1J
 Xu, Zhi-guang, 1U
 Xu, Zhihai, 0N, 0S, 0U, 15, 17, 1A
 Xue, Mogen, 1T
 Xue, Xinsong, 19
 Yan, Peipei, 13, 14
 Yan, Qiurong, 1F, 1I, 1R
 Yang, Bo, 07
 Yang, Chaozhi, 0E
 Yang, Hailong, 1M
 Yang, Huamin, 0E
 Yang, Jie, 0A, 12
 Yang, Jungang, 10
 Yang, Senlin, 1N
 Yang, Shuning, 1G
 Yang, Xing, 08
 Yang, Yan-zhao, 0L
 Yang, Yibing, 1F, 1I, 1R
 Yang, Zhi-xiong, 1P
 Yao, Haifeng, 19
 Yi, Wenjun, 03, 04
 Yin, Guoping, 1S
 Yin, Kaixin, 12
 Ying, Cheng-ping, 0V
 Ying, Jia-ju, 0P
 Yu, Mei, 0X
 Yu, Chunchao, 1P
 Yu, Jing, 0J
 Yu, Yongyi, 0U
 Yuan, Hongwu, 06
 Yuan, Ke'e, 0A, 12
 Zeng, Haomin, 0Q
 Zhang, Chengwen, 03
 Zhang, Han, 0K
 Zhang, Jiang, 18
 Zhang, Jie, 1T
 Zhang, Li-Xia, 0R
 Zhang, Mengzi, 02
 Zhang, Mingxin, 16
 Zhang, Quan, 0M
 Zhang, San-Xi, 1K
 Zhang, W.D., 1D
 Zhang, Wenhao, 0Q
 Zhang, Xian, 1W
 Zhang, Xing, 0Y
 Zhang, Xue-Liang, 0R
 Zhang, Yanhou, 1T
 Zhang, Yao-kai, 1L
 Zhang, Yazhou, 0F
 Zhang, ZhanYe, 21
 Zhang, Zheng, 0N

Zhang, Zhiyu, 0Q
 Zhao, Fa-cai, 11
 Zhao, Haibo, 1V
 Zhao, Ju-feng, 18
 Zhao, Ran, 1W
 Zhao, Xiao, 1M
 Zhao, YaoHong, 1X
 Zhao, Ying-wei, 1U
 Zheng, Wei-jian, 1P
 Zheng, Xiang-liang, 11
 Zhou, Bing, 0P
 Zhou, Dongzhan, 1Z
 Zhou, Liang, 0B
 Zhou, Pucheng, 1T
 Zhou, Taofei, 0G
 Zhou, X., 0T
 Zhou, Yuanyuan, 1O
 Zhou, Zhuang, 09
 Zhu, Mengjun, 03, 04
 Zhu, R., 0T
 Zhu, Shasha, 1M
 Zhu, Yunfei, 0H
 Zou, Peng, 1Q

Conference Committee

Conference Chairs

Junhao Chu, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China)
Wenqing Liu, Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences (China)
Huilin Jiang, Changchun University of Science and Technology (China)

Program Committee Chairs

Weiqi Jin, Beijing Institute of Technology (China)
Jin Lu, Tianjin Jinhang Institute of Technical Physics (China)
Shensheng Han, Shanghai Institute of Optics and Fine Mechanics (China)

Program Committee Co-chairs

Yadong Jiang, University of Electronic Science and Technology of China (China)
Guangcan Liu, Nanjing University of Information Science and Technology (China)

Introduction

We had the great honor of organizing The Fifth Conference on Frontiers in Optical Imaging Technology and Applications (FOI 2018). It was a great pleasure for us to greet more than 300 participants from the many different countries who attended. We firmly believe this conference will become an important international event in the field of optical imaging technology.

The Fifth Conference on Frontiers in Optical Imaging Technology and Applications (FOI 2018) was sponsored by the Chinese Society for Optical Engineering, Chinese Academy of Engineering, and National Natural Science Foundation of China, and was organized by the Chinese Society for Optical Engineering, Photoelectronic Technology Committee, CSA, (China) and the Key Laboratory of Polarization Imaging Detection Technology (China).

The purpose of this conference is to provide a forum for the participants to report and review innovative ideas and up-to-date progress and developments and discuss novel approaches to applications in the optical imaging field. It is sincerely hoped that, as a result, research and development in optical imaging field will be promoted, and international cooperation will be enhanced.

On behalf of the other Co-chairmen, and the Organization Committee, I would like to heartily thank our sponsors and cooperating organizers for all they have done for the conference. Thanks also to all the authors for their contributions to the proceedings, to all of the participants and friends for their interests and effort in helping us to make the conference possible, to the Program Committee for its effective work and valuable advice, especially the Secretariat, and to SPIE staff for their tireless efforts and outstanding service in preparing and publishing the proceedings.

Junhao Chu

