PROCEEDINGS OF SPIE

AOPC 2017: Optical Storage and Display Technology

Byoungho Lee Yongtian Wang Xiaodi Tan Xiangping Li Editors

4–6 June 2017 Beijing China

Sponsored by
SPIE
Chinese Society for Optical Engineering (China)

Organized by
Chinese Society for Optical Engineering (China)
Photoelectronic Technology Committee, Chinese Society of Astronautics (China)
Department of Cooperation and Coordination for Industry, Academe and Research, CHIA (China)
Science and Technology on Low-light-level Night Vision Laboratory (China)
Science and Technology on Electro-Optical Information Security Control Laboratory (China)

Published by SPIE

Volume 10459

Proceedings of SPIE 0277-786X, V. 10459

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

AOPC 2017: Optical Storage and Display Technology, edited by Byoungho Lee, Yongtian Wang, Xiaodi Tan, Xiangping Li, Proc. of SPIE Vol. 10459, 1045901 © 2017 SPIE · CCC code: 0277-786X/17/\$18 · doi: 10.1117/12.2306537

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 AOPC 2017: Optical Storage and Display Technology, edited by Byoungho Lee, Yongtian Wang, Xiaodi Tan, Xiangping Li, Proceedings of SPIE Vol. 10459 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510613997

ISBN: 9781510614000 (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 © 2017, 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/17/\$18.00.

Printed in the United States of America.

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

- v Authors
- vii Conference Committee
- ix Introduction

OPTICAL STORAGE AND DISPLAY TECHNOLOGY

10459 02	Study of the traditional Chinese pigments by terahertz time-domain and Fourier-transform infrared spectroscopy [10459-1]
10459 03	Reconstruction of on-axis lensless Fourier transform digital hologram with the screen division method [10459-3]
10459 04	A smart bending sensor based on microstructured fiber [10459-4]
10459 05	Improved depth estimation with the light field camera [10459-5]
10459 06	A novel method of one-step reflection hologram [10459-6]
10459 07	Using spatial frequency index method to cull occlusion for computer generated hologram [10459-7]
10459 08	A wavelet filtering method for parasitic interference ring based on gradient wavefront [10459-9]
10459 09	The application of diffraction grating in the design of virtual reality (VR) system [10459-10]
10459 0A	Infrared dim small target segmentation method based on ALI-PCNN model [10459-11]
10459 OB	Methods of building dense multi-view autostereoscopic display and its hardware requirements [10459-12]
10459 OC	A method of LED free-form tilted lens rapid modeling based on scheme language [10459-13]
10459 OD	Studies on the trapped-mode resonant properties in asymmetric terahertz metamaterial [10459-14]
10459 OE	Increasing power and amplified spontaneous emission suppression for weak signal amplification in pulsed fiber amplifier [10459-16]
10459 OF	The research on multi-projection correction based on color coding grid array [10459-17]

10459 OG	Super multi-view three-dimensional display with small light intensity ripple and high spatial resolution [10459-18]
10459 OH	Influence of asymmetric structures on electromagnetic response characteristics of terahertz metamaterials [10459-19]
10459 01	Focus-tunable liquid cylindrical lens based on electrowetting [10459-20]
10459 OJ	A panoramic imaging system based on fish-eye lens [10459-21]
10459 OK	Research of real-time video processing system based on 6678 multi-core DSP [10459-22]
10459 OL	Real-time free-viewpoint DIBR for large-size 3DLED [10459-23]
10459 OM	Electronic sand table three-dimensional display with the wide field of view [10459-24]
10459 ON	Markerless client-server augmented reality system with natural features [10459-25]
10459 00	Integrated large view angle hologram system with multi-SLM [10459-26]
10459 OP	Analysis of the diffraction effects for a multi-view autostereoscopic three-dimensional display system based on shutter parallax barriers with full resolution [10459-28]
10459 OQ	Demonstration of arbitrary views based on autostereoscopic three-dimensional display system [10459-29]
10459 OR	Augmented reality glass-free three-dimensional display with the stereo camera [10459-32]
10459 OS	Fabrication and performance study of light guide plate for LCD backlight based on quantum-dot scattering microstructure array [10459-33]
10459 OT	A performance test system for medium-wave imaging system with large field of view [10459-34]
10459 OU	Direct design of achromatic lens for Lambertian sources in collimating illumination [10459-37]
10459 OV	Design of CMOS imaging system based on FPGA [10459-38]
10459 OW	Creating a dynamic color hologram through the coding method [10459-39]
10459 OX	Generation of Olympic logo with freeform lens array [10459-41]
10459 OY	Robust design study on the wide angle lens with free distortion for mobile lens [10459-42]
10459 OZ	Design of low noise imaging system [10459-43]
10459 10	Atomized scan strategy for high definition for VR application [10459-45]

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.

Bai, Baoxing, OF Chen, Duo, 05, 0M, 0N, 0R Chen, Enguo, 0S Chen, Jiekang, 09 Chen, Laura Di, 0B

Chen, Luiun (Laurence), OB, OP

Chen, Lujun (Laurence Chen, Michael M., 0B Chen, Wei, 0D Chen, Weijuan, 0X Chen, Wendong, 10 Chen, Xiaolai, 0V, 0Z Chen, Xiaomei, 0T Chen, Yibei, 06, 07 Chen, Zhu, 03 Dai, Yidan, 0C Du, Baolin, 0T Gan, Liang-qin, 0W Gu, A., 02

Guan, Min, 09 Guo, Nan, 05, 0L Han, Cheng, 0F Hao, Chenyang, 0J Hu, Bo, 0V, 0Z

Hu, Leili, 0T Huang, Jiamin, 0S Huang, Qilu, 0X Huang, Qitai, 09 Huang, Shuping, 10 Ji, Yuan, 10

Jia, Fangda, OB, OP

Jiang, Hongzhen, 03 Jiang, Xiaoyu, 07 Jiang, Yuan, 04 Jiang, Yurong, 0A Jiang, Zhaoguo, 0U Jiang, Zongfu, 0E Jie, Zhiwei, 04

Lei, Y., 02 Li, Chenyu, 02, 0D, 0H

Kim, Taeyoung, 0Y

Li, Dong, 03 Li, G. H., 02 Li, Lin, 0A Li, Xiangzhen, 0K Li, Xu, 0A Li, Yun, 0A Liao, Tingdi, 0X

Liu, Changxiang, 0D, 0H Liu, Boyang, 0G, 0Q Liu, Chengkun, 0X Liu, Juan, 0O Liu, Junhui, 07

Liu, Jorino, O7 Liu, Li, OG, OQ Liu, Xu, O3 Liu, Yong, O3, OY Liu, Yumin, OP Liu, Yuming, OB Luo, Yi, OE

Ma, Hua, 08 Ma, Pengfei, 0E Meng, Yang, 0B, 0P Ning, Shuangning, 0N

Pang, Bo, OR Peng, Runling, Ol Qiu, Yishen, OX Ran, Feng, 10 Ren, Huan, 08

 $Sang,\,Xinzhu,\,05,\,0G,\,0L,\,0M,\,0N,\,0Q,\,0R$

Shi, Lan, OD, OH Shi, N. C., O2 Shi, Zhengdong, 08 Song, Yong, OA Su, Jian, 06, 07 Su, Rongtao, OE Sun, Huijuan, OH Tan, Yanting, OI Wang, Hongshu, OU Wang, Huachun, O5

Wang, Kuiru, 05, 0G, 0L, 0Q, 0R

Wang, NengWen, OL Wang, Peng, 05 Wang, Xiaolin, 0E Wang, Ye, 0B, 0J, 0P Wu, Lei, 0M Xie, Hongxing, 0S Xie, Xiaodan, 0K Xing, Shujun, 0R

Xu, Qing, 0Y Xu, Sheng, 0S Xu, Xiping, 0U

Yan, Binbin, 05, 0G, 0Q, 0R Yan, Xingpeng, 06, 07 Yang, ChengWei, 0O Yang, Fan, 0F Yang, Le, 0Q

Yang, Shang-gong, OW

Yang, Yi, 08 Ye, Han, 0B, 0P

Ye, Yun, OS Yin, Peng, 0U Yin, Xiaoqiang, OK Yong, Liu, 0Y Yu, Chongxiu, 05, 0G, 0Q, 0R Yu, Degiang, 03 Yu, Xunbo, 05, 0G, 0Q, 0R Yu, Zhongyuang, OB, OP Yuan, Quan, 08 Zeng, Sheng-cai, OW Zhang, Chao, 0F Zhang, Chunyu, OB, OP Zhang, Cunlin, 02, 0D, 0H Zhang, Hanwei, 0E Zhang, Lin, 08 Zhang, Xiaodong, 04 Zhang, Z. W., 02 Zhao, Shangnan, 0A Zhao, Yufei, 0A Zhao, Yunxiu, 0F Zheng, Fanglan, 03 Zhi, Jiwei, 04 Zhou, Chengxian, 0W Zhou, Pu, 0E Zhou, Qingli, 0D, 0H Zhu, Xiaoliang, 04

Conference Committees

Conference Chairs

Guangjun Zhang, Beihang University (China) **Byoungho Lee**, Seoul National University (Korea, Republic of)

Conference Committee

Desheng Jiang, Wuhan University of Technology (China)

Hequan Wu, Chinese Academy of Engineering (China)

Jianguan Yao, Tianjin University (China)

Jianwei Pan, University of Science and Technology of China (China)

Junhao Chu, Shanghai Institute of Technical Physics, CAS (China)

Junen Yao, Beihang University (China)

Lijun Wang, Changchun Institute of Optics, Fine Mechanics and Physics, CAS (China)

Lin Li, The University of Manchester (United Kingdom)

Liwei Zhou, Beijing Institute of Technology (China)

Min Gu, RMIT University (Australia)

Shibin Jiang, AdValue Photonics Inc. (United States)

Toyohiko Yatagai, Utsunomiya University (Japan)

Wei Wang, Beijing Institute of Aerospace Control Devices, CASC (China)

Weidou Ni, Tsinghua University (China)

Zuyan Xu, Technical Institute of Physics & Chemistry, CAS (China)

Program Committee

Anand Krishna Asundi, Nanyang Technological University (Singapore)

Bing Zhao, Jilin University (China)

Byoungho Lee, Seoul National University (Korea, Republic of)

Carl Nardell, Terra Bella (United States)

Chunhua Shen, The University of Adelaide (Australia)

Haimei Gong, Shanghai Institute of Technical Physics, CAS (China)

Honghai Liu, University of Portsmouth (United Kingdom)

Huaidong Yang, Tsinghua University (China)

Huijie Zhao, Beihang University (China)

Jannick Rolland, Institute of Optics, University of Rochester (United States)

Jin Lu, Tianjin Jinhang Institute of Technical Physics (China)

Jin Yu, Université Claude Bernard Lyon 1 (France)

Jinxue Wang, SPIE

Lijun Wang, Changchun Institute of Optics, Fine Mechanics and Physics,

CAS (China)

Lin Li, The University of Manchester (United Kingdom)

Lan Jiang, Tsinghua University (China)

Long Zhang, Shanghai Institute of Optics and Fine Mechanics, CAS (China)

Mengxia Xie, Beijing Normal University (China)

Min Gu, RMIT University (Australia)

Min Qiu, Zhejiang University (China)

Shibin Jiang, AdValue Photonics Inc. (United States)

Suijian Xue, National Astronomical Observatories, CAS (China)

Tsutomu Shimura, The University of Tokyo (Japan)

Wei Hang, Xiamen University (China)

Wei Wang, Beijing Institute of Aerospace Control Devices of CASC (China)

Weibiao Chen, Shanghai Institute of Optics and Fine Mechanics, CAS (China)

Wolfgang Osten, Universität Stuttgart (Germany)

Xiandeng Hou, Sichuan University (China)

Xiangping Li, Jinan University (China)

Xiaocong Yuan, Shenzhen University (China)

Xiaodi Tan, Beijing Institute of Technology (China)

Yadong Jiang, University of Electronic Science and Technology of China (China)

Yanbiao Liao, Tsinghua University (China)

Yong Bi, Academy of Opto-Electronics, CAS (China)

Yongtian Wang, Beijing Institute of Technology (China)

Zhe Wang, Tsinghua University (China)

Zhiping Zhou, Peking University (China)

Session Chairs

- 1 **Yongtian Wang**, Beijing Institute of Technology (China)
- 2 **Xiaodi Tan**, Beijing Institute of Technology (China)
- 3 **Xiangping Li**, Jinan University (China)
- 4 **Qionghua Wang**, Sichuan University (China)
- 5 **Xinzhu Sang**, Beijing University of Posts and Telecommunications (China)
- 6 **Jun Xia**, Southeast University (China)

Introduction

Applied Optics and Photonics China (AOPC2017) is the annual conference of the CSOE, and one of the largest academic and industry activities in the field of optical and optoelectronic technology in China. The organization committee has built a platform of academic exchanges, industry exhibitions, and cooperation negotiations in one. There are 8 technical conferences, 7 themes of the Exhibition and approximately 600 technical presentations. We sincerely hope that the research and development of optoelectronic technology are promoted, and the international cooperation between industry and the optical and optoelectronic fields are enhanced.

AOPC2017 is technically co-sponsored by the Chinese Society for Optical Engineering, the Optical Society of Korea (OSK), Optics and Photonics Society of Singapore (OPSS), European Optical Society (EOS), Optical Society of Japan (OSJ) and SPIE. There are also 60 cooperative organizers to support the conference. We received over 1209 contributions from more than 15 countries, including the United States, the United Kingdom, Germany, France, Spain, Australia, Canada, Mexico, Brazil, Japan, Korea, Thailand, Singapore, the Russian Federation, China, and more. There are more than 700 presentations published in the Proceedings of SPIE. After careful discussion, we suggested four keynote speeches which are presented by famous scientists from Germany, Australia, Japan and China. 138 excellent invited talks were presented, 45 are from outside of China. Their presentations reflect first-class research in the field of optics and photonics technology. On behalf of the Organization Committee of AOPC, I express thanks to all the invited speakers and authors for their contributions and support of the conference.

Finally, on behalf of Prof. Zhuang Songlin, and other co-chairmen, and the Organization Committee of AOPC, I would like to heartily thank our sponsors and cooperating organizers for all they have done for the conference, the participants and friends for their interests and efforts in helping us to make the conference a success, the program committee for their effective work and valuable advice, and especially the AOPC2017 Secretariat and the staff of SPIE for their tireless effort and outstanding services in preparing the conference and publishing the Proceedings.

We wish AOPC2017 great success! Hope to see you next year!

Guofan Jin