## PROCEEDINGS OF SPIE

# AOPC 2015: Optical and Optoelectronic Sensing and Imaging Technology

Haimei Gong Nanjian Wu Yang Ni Weibiao Chen Jin Lu Editors

5–7 May 2015 Beijing, China

Organized by Chinese Society for Optical Engineering (China) Photoelectronic Technology Committee, Chinese Society of Astronautics (China) Science and Technology on Low-light-level Night Vision Laboratory (China)

Sponsored by Chinese Society for Optical Engineering (China)

Technical Cosponsor and Publisher SPIE

Volume 9674

Proceedings of SPIE 0277-786X, V. 9674

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

AOPC 2015: Optical and Optoelectronic Sensing and Imaging Technology, edited by Haimei Gong, Nanjian Wu, Yang Ni, Weibiao Chen, Jin Lu, Proc. of SPIE Vol. 9674, 967401 · © 2015 SPIE CCC code: 0277-786X/15/\$18 · doi: 10.1117/12.2217167 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 2015: Optical and Optoelectronic Sensing and Imaging Technology, edited by Haimei Gong, Nanjian Wu, Yang Ni, Weibiao Chen, Jin Lu, Proceedings of SPIE Vol. 9674 (SPIE, Bellingham, WA, 2015) Six-digit Article CID Number.

ISSN: 0277-786X ISSN: 1996-756X (electronic) ISBN: 9781628418996

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 © 2015, 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/15/\$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 six-digit CID article numbering system structured as follows:

• 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.

## Contents

- ix Authors
- xiii Conference Committee
- xvii Introduction

#### OPTICAL AND OPTOELECTRONIC SENSING AND IMAGING TECHNOLOGY

- 9674 02 An error compensation method of laser displacement sensor in the inclined surface measurement [9674-2]
- 9674 03 White light upconversion emissions in Er<sup>3+</sup>/Tm<sup>3+</sup>/Yb<sup>3+</sup> tridoped oxyfluoride glass [9674-3]
- 9674 04 Novel interframe phase-correlated registration scene-based nonuniformity correction technology [9674-6]
- 9674 05 A lithological classification method from fully polarimetric SAR data using Cloude-Pottier decomposition and SVM [9674-10]
- 9674 06 Simulate the volcanic radiation features in medium wave infrared channels [9674-13]
- 9674 07 Study on an improved wavelet shift-invariant threshold denoising for pulsed laser induced glucose photoacoustic signals [9674-15]
- 9674 08 The optical detection in turbid water by range-gated imaging system with HPRF laser [9674-16]
- 9674 09 Clutter discrimination algorithm simulation in pulse laser radar imaging [9674-17]
- 9674 0A Experiment of coherent lidar using light at 1.55 µm [9674-18]
- 9674 0B Modeling and simulation method of target echo energy detection in laser simulation system [9674-21]
- 9674 0C Performance of a long-wave infrared Fourier Transform imaging spectrometer using a corner-cube Michelson interferometer and an uncooled microbolometer array [9674-22]
- 9674 0D Experiment of polarization transmission characteristics and polarization imaging in simulation smoke/fog environment [9674-25]
- 9674 OE **Research of lidar compounded with visible imaging topographic mapping in space** [9674-26]
- 9674 OF Research on the superimposed frame number of terahertz digital holograms in double-exposed phase retrieval algorithm [9674-29]

- 9674 0G A new x-ray framing camera with picoseconds time resolution [9674-30]
- 9674 0H Research of IRFPAs' reliability evaluation by bad pixel [9674-33]
- 9674 01 A practical distributed Fiber Bragg grating temperature sensor system based on STM32 processor platform [9674-35]
- 9674 0J Infrared face recognition based on binary particle swarm optimization and SVM-wrapper model [9674-36]
- 9674 0K A new method of real-time signal extraction for diffuse reflection laser ranging based on Genetic Algorithm [9674-38]
- 9674 OL A propagation method with adaptive mesh grid based on wave characteristics for wave optics simulation [9674-39]
- 9674 0N Virtual Hartmann-shack image applied in laser beam wavefront correction and numerical simulation method [9674-42]
- 9674 00 Comparison between dust and haze aerosol properties of the 2015 Spring in Beijing using ground-based sun photometer and lidar [9674-45]
- 9674 OP The design of high dynamic range ROIC for IRFPAs [9674-46]
- 9674 0Q Design of light-small high speed image data processing system [9674-49]
- 9674 OR A high-performance and cost-effective grating coupler for ultraviolet light [9674-51]
- 9674 0S An estimation of distribution method for infrared target detection based on Copulas [9674-52]
- 9674 OT High performance pyroelectric infrared detector [9674-53]
- 9674 0U A new architecture of current-mode CMOS TDI sensor [9674-57]
- 9674 0V Application of Monte Carlo method to laser coding detection [9674-62]
- 9674 0W Design, fabrication and testing of 17um pitch 640x480 uncooled infrared focal plane array detector [9674-64]
- 9674 0X A portable direct view configuration prism spectrometer using a double Amici prism [9674-65]
- 9674 0Y Research of detecting technique of low light in optic fiber's cladding [9674-66]
- 9674 0Z Study on the annular vortex beams with limited apertures and their propagation characteristics in the turbulent atmosphere [9674-67]
- 9674 10 Imaging simulation for scanning sensors with wide vision field and long scan-line [9674-68]
- 9674 11 The influence of thermal treatment on the passivation of SiN<sub>x</sub> film and the dark current of p-i-n InGaAs detector [9674-72]

- 9674 12 CMOS buried multi-junction (BMJ) detector for bio-chemical analysis (Invited Paper) [9674-74]
- 9674 13 An image registration algorithm of calculating angle error in star check [9674-80]
- 9674 14 Research on reconstruction algorithms for 2D temperature field based on TDLAS [9674-76]
- 9674 15 Application of tunable diode laser absorption spectroscopy in the detection of oxygen [9674-79]
- 9674 16 The development of large-aperture test system of infrared camera and visible CCD camera [9674-83]
- 9674 17 Simulation of signal-to-noise ratio for the laser range-gated imaging system [9674-84]
- 9674 18 Experimental research on range gating laser imaging radar [9674-85]
- 9674 19 Modulated pulse bathymetric lidar Monte Carlo simulation [9674-86]
- 9674 1A On-line measurement of contents in compound fertilizer and application research using VIS-NIR spectroscopy [9674-87]
- 9674 1B Tensile strained Ge<sub>0.90</sub>Sn<sub>0.10</sub> photodiode integrated with Si<sub>3</sub>N<sub>4</sub> liner stressor for mid-infrared applications [9674-89]
- 9674 1C Research on the evaluation method for modelling and simulation of infrared imaging sensor [9674-90]
- 9674 1D Enhancement of external quantum efficiency of GaAs light emitting diodes on GaAs substrate with photonic crystal structures [9674-91]
- 9674 1E Design and implementation of a high-performance readout circuit for uncooled infrared detector [9674-92]
- 9674 1F Infrared imaging simulation and detection of ship wake [9674-93]
- 9674 1G Earth observation and atmospheric sounding based on a high spectral resolution lidar [9674-94]
- 9674 1H The observations of aerosol optical and microphysical properties by using a multi-wavelength lidar [9674-96]
- 9674 11 Sub-100ps single photoelectron time resolution of a strip silicon photomultiplier for time-resolved optical spectroscopy [9674-98]
- 9674 1J Design of a ROIC with 15um pitch for MWIR FPAs [9674-99]
- 9674 1K Fast detection method for AOTF infrared spectrometer [9674-100]
- 9674 1L Modeling simulation of the thermal radiation for high-speed flight vehicles' aero-optical windows [9674-103]

- 9674 1M A small-size pulsed lidar designed for obstacles detection in natural underwater environment [9674-104]
- 9674 1N Study of high speed quenching circuits in photon counting imaging lidar system [9674-106]
- 9674 10 Consistency analysis on laser signal in laser guided weapon simulation [9674-107]
- 9674 1P Application of Terahertz Time-Domain Spectroscopy in nondestructive testing of adhesion quality [9674-110]
- 9674 1Q Multichannel photonic mixing based on cascade carrier suppression [9674-113]
- 9674 1R Echo scintillation index affected by cat-eye target's caliber with Cassegrain lens [9674-114]
- 9674 1S A design of digital processing circuit for the duo-lateral PSD [9674-116]
- 9674 10 Retrieval of high-spectral-resolution lidar for atmospheric aerosol optical properties profiling [9674-119]
- 9674 1V The implementation method and the development tendency of infrared stealth technology [9674-120]
- 9674 1W Improved photon counting efficiency calibration using superconducting single photon detectors [9674-121]
- 9674 1X Study of photoemission mechanism for varied doping GaN photocathode [9674-123]
- 9674 1Y Dynamic simulation of infrared signature of deep groove ball bearing based on ANSYS/LS-DYNA [9674-124]
- 9674 1Z **10<sup>-14</sup>W** weak light readout for quantum photodetector array at 300K [9674-125]
- 9674 20 Research of mesa type extended wavelength 64x64 In<sub>0.83</sub>Ga<sub>0.17</sub>As detector [9674-126]
- 9674 21 Research into the usage of integrated jamming of IR weakening smoke-screen resisting the IR imaging guided missiles [9674-127]
- 9674 22 Research on spaceborne low light detection based on EMCCD and CMOS [9674-128]
- 9674 23 Approach jamming effectiveness evaluation for surface-type infrared decoy in network centric warship formation [9674-129]
- 9674 24 Constant peak-power single-frequency linearly-polarized all-fiber laser for coherent detection based on closed-loop feedback technology [9674-131]
- 9674 25 Research on measurable distance extending technology of laser radar [9674-134]
- 9674 26 **Research on the system scheme and experiment for the active laser polarization imaging** [9674-135]

- 9674 27 The design of nanosecond high-voltage ultra wide band bipolar pulse generator [9674-136]
- 9674 28 Experimental study of high-speed imaging detection system for small bubbles in water [9674-138]
- 9674 29 Design of acid-lead battery stage-of-charge detection system based on refractive index detection technology [9674-139]
- 9674 2A Spot detection accuracy analysis in turbulent channel for free space optical communication [9674-140]
- 9674 2B The correction model and error analysis of infrared radiation temperature measurement of semitransparent object [9674-141]
- 9674 2C Aerodynamic distortion propagation calculation in application of high-speed target detection by laser [9674-143]
- 9674 2D Simulation and optimization of p-i-n In0.53Ga0.47As/InP photodetector [9674-144]
- 9674 2E Detailed analysis on the responsivity of InP/InGaAs HPTs for near-IR optoelectronic applications [9674-145]
- 9674 2F A highly-sensitive NaCl concentration sensor based on a compact silicon-on-insulator micro-ring resonator [9674-146]
- 9674 2G The algorithm and implementation of EMCCD automatic gain adjustment based on fixed gray level [9674-147]
- 9674 2H Comparison between highly doped semiconductor and metal infrared antenna [9674-149]
- 9674 2J Infrared image enhancement based on human visual properties [9674-152]
- 9674 2K A silicon photonics circuit based on micro-ring resonators in the instantaneous frequency measurement system [9674-153]
- 9674 2L Simulation of semiconductor nanowire photodetectors with high photoconductive gain [9674-154]
- 9674 2M A 16-channel CMOS preamplifier for laser ranging radar receivers [9674-155]
- 9674 2N Research on the mutual correlation function of statistical characteristics of laser beam scattering fields from the target [9674-160]
- 9674 20 Study on the recognition of camouflage targets with hyper-spectral detection [9674-163]
- 9674 2P Modeling and simulation research on infrared characteristics of tubular target on the air-sea interface [9674-165]
- 9674 2Q Sparse representation based on multiscale bilateral filter for infrared image using compressed sensing [9674-167]
- 9674 2R Colorimetric calibration of coupled infrared simulation system [9674-168]

- 9674 2S Back-side-illuminated 1.4µm pixel with a vertically pinned photodiode based on hole collection, PMOS readout chain and active side-wall passivation [9674-170]
- 9674 21 Study on feasibility of laser reflective tomography with satellite-accompany [9674-171]
- 9674 20 Experiments of ghost imaging with pseudo-thermal light for remote sensing applications [9674-173]
- 9674 2V Design of multiband metamaterial absorber based on artificial magnetic conductor [9674-174]
- 9674 2W Design and realization of a contact-less interaction system based on infrared reflection photoelectric detection array [9674-175]
- 9674 2X Free space optical communication experiments on the vibration platform [9674-176]
- 9674 2Y Radiation characteristic inversion of space point source target based on infrared imagery [9674-179]
- 9674 22 Spreading of radial stochastic electromagnetic Gaussian Schell-model array beams in non-Kolmogorov turbulence [9674-180]
- 9674 30 Novel image processing method study for a label-free optical biosensor [9674-182]
- 9674 31 Locally adaptive regression filter-based infrared focal plane array non-uniformity correction [9674-183]
- 9674 32 Multiple-input multiple-output 3D imaging laser radar [9674-184]
- 9674 33 Multi-element double ring infrared detector based on InSb [9674-187]
- 9674 34 Design of 128×128 two-color IRFPA readout circuit [9674-188]
- 9674 35 A fake defect phenomenon in defect detection of thermographic NDT: a three-dimensional numerical analysis [9674-196]
- 9674 36 Detectability of the infrared surface features of the wake behind a moving underwater body [9674-197]
- 9674 37 Reconstruction of color images via Haar wavelet based on digital micromirror device [9674-190]
- 9674 38 The optimal extraction of feature algorithm based on KAZE [9674-191]
- 9674 39 A stereo matching handling model in low-texture region [9674-192]

### Authors

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

Ahmed, Nayera, 2S Ai, Yong, 2A, 2X Aimez, Vincent, 12 An, Wei, 10 Bai, Lianfa, 39 Bai, Xiaohona, OG Bai, Yonglin, OG Cai, Ying, 25 Cao, Gaogi, 11 Cao, Hanging, 2L Cao, Weiwei, 0G Chang, Benkang, 1X Chang, Shengli, OR Chang, Shizheng, 1F Chao, Chujie, 2X Charette, Paul G., 12 Che, Haozhao, 24 Chen, Changhong, 2H, 2L Chen, Chuan, 2Y Chen, Dingbo, OR Chen, Guang-hao, OF Chen, Guanghui, 24 Chen, Honglei, OH, OP, 1J Chen, Hongyu, 2J Chen, Jian, 1W Chen, Jianbiao, 2C Chen, Jing, 2A, 2X Chen, Jun, 2D, 2E Chen, Junyao, 1M, 29 Chen, Lei, 1L Chen, Qian, 2G Chen, Qianrong, 17 Chen, Shanqiu, ON Chen, Shengbo, 05 Chen, Shijun, 1E Chen, Xiaowen, 1K Chen, Xing, 0H Chen, Xingfeng, 00 Chen, Xuan, 1F Chen, Yongping, 0U, 1E Chen, Zong-sheng, 20 Cheng, Chuxiong, 10 Cheng, Jifeng, 11 Cheng, Ye, 0B Cheng, Yongxin, 01 Cheng, Zao, 1M Cheng, Zhongtao, 1U Chi, Jiguana, OW Courcier, Thierry, 12

Cui, Wenyu, 2Y Dai, Yong-Hong, 2A, 2X Dang, Kezheng, 2V Deng, Shuangyan, 20 Ding, Ruijun, OP, 1J Dina, Yaqian, 24 Ding, Yuxing, 1N Dong, Yantao, OE Du, Jian, 2R Du, Peng, 19, 1M, 28 Du, Yongchen, 1F Duan, Jin, 0D, 26 Duan, Lulin, 1U En, Yunfei, OH Fan, Chunli, 1F, 35 Fan, Donggian, OA Fan, Zhe, OC Fei, Jindong, 2R Feng, Chen, 13 Feng, Guojin, 1W Feng, Junbo, 2F, 2K Feng, Xue, 0Q Feng, Ying, 2W, 30 Feruglio, Sylvain, 12 Fu, Qiang, 0D, 26 Fu, Shiyou, OX Gan, Haiyong, 1W Gan, Lin, 10 Gao, Jiaobo, OC Gao, Yang, 2R Gao, Youtang, 1X Geng, Anbing, 16 Gong, Cailan, 06 Gong, Haimei, 11, 20 Gong, Yan-jun, 2N Gou, Yongsheng, 0G, 27 Gu, Guohua, 37, 38 Gu, You-lin, 2T Gu, Yu, 2T Guan, Xiaoping, 03 Guan, Yu, 34 Guo, Baoling, 24 Guo, Fangmin, 1Z Guo, Hai-chao, 09 Guo, Hao, 17, 10 Guo, Jin, 2F, 2K Guo, Li, 33 Guo, Mingjiang, 1L Guo, Yuan Yuan, 2P

Han, Dejun, 11 Han, Genquan, 1B Han, Hong-wei, 08 Han, Jiaojiao, 2Q Han, Jing, 39 Han, Xiang'e, 2Z, 32 Hao, Lichao, OH Hao, Mingming, OH Hao, Shi-qi, 2T Hao, Yongwang, 17 Hao, Yue, 1B He, Wei-Ji, 2G, 37 He, Yan, 25 He, Zhiping, 1K He, Zijian, 2V Hong, Yixun, 1Y Hou, Weizhen, 0O Hu, Jia-qi, OF Hu, Xu, OT Hu, Yi-hua, 2T Hu, Yong, 06 Hua, Liang-hong, 08 Huang, Aibo, OH Huang, Genghua, 1N Huang, He, 31 Huang, Jingtao, 13 Huang, Ying, 2L Huang, Yun, OH Hui, Bin, 2J Ji, Cheng, 0U Ji, Yulong, OT Jia, Honghui, OR Jiang, Dazhao, OP, 1J Jiang, Hui-Lin, 26 Jiang, Lijun, OW Jiang, Ning, 21 Jiang, Shan, 06 Jiang, Yan, 2M Jin, Xing, 15 Jin, Yi, 14 Jing, Chen, 2A, 2X Jing, Youliang, 1D Kang, Lin, 1W Kang, Yan, 2U Kang, Zhihua, 2U Ke, Xi-zheng, 2N Kou, Wei, 1F, 1Y Lai, Canxiong, 0H Lai, Jianjun, 2H, 2L Lei, Bing, 2W Lei, Yi, OD Leng, Hanbing, 2Q Li, Bin, 02 Li, Caitao, 00 Li, Dong, 24 Li, Donghui, 00 Li, Fei, OQ Li, Feng, 02 Li, Feng, 2M Li, Guijuan, 2P Li, Hongjun, 2X

Li, Hongwei, 2H, 2L Li, Huan, 09 Li, Jia, 2Q, 31 Li, Jianjun, OC Li, Jianwei, 1W Li, Ji-cheng, 36 Li, Jun, 10 Li, Lei, 1M, 29 Li, Li, 00 Li, Liang, 1D Li, Lijuan, 1P Li, Meng-lin, 2M Li, Mengyao, 1D Li, Mo, 33 Li, Ning, 1D Li, Ping, 20 Li, Qi, OF Li, Qingfa, 11 Li, Sining, OA, 18 Li, Tao, 11, 20 Li, Wei, OV Li, Wei, 28 Li, Xin, OZ Li, Xue, 11, 20, 2D Li, Ying-le, 2N Li, Yingwen, 16 Li, Yu, OC Li, Zhaolong, 1C Li, Zheng, 26 Li, Zhengqiang, 0O Li, Zhigang, 2V Liang, Kun, 11 Liang, Qinghua, OP, 1J Liang, Weiwei, 17 Liang, Yanbing, 1S Lin, Ya-jun, OY Lin, Yandong, 1W Lin, Zhi-dan, 1A, 2O Liu, Baiyu, 0G, 27 Liu, Chunbo, 32 Liu, Dong, 1G, 1U Liu, Fei, 2W Liu, Fengyi, 06 Liu, Guodong, 07, 0J Liu, Hailong, 03 Liu, Haitao, OW Liu, Hao, 2V Liu, Huan Ying, 2P Liu, Jing, 1A Liu, Jinguo, 22 Liu, Jinjun, Ol Liu, Liang, 1C Liu, Ning, 04 Liu, Rongdan, 11 Liu, Ru-qing, 2M Liu, Wenjin, ON Liu, Xiang, OW Liu, Xingjiong, 37 Liu, Yan, 1B Liu, Yan-Fei, 2A, 2X Liu, Yanyang, 1G

Liu, Zhu, 33 Lou, Shuli, 1C Lu, Cuipina, 1A Lu, Fang, 2Z Lu, Guoguang, OH Lu, Guo-Neng, 12, 2S Lu, Haidong, 1Z Lu, Jianhua, 1V Lu, Wei, 0A, 18 Lu, Zhen-Xi, 2G Luan, Xingun, 25 Luo, Haiying, 1G Luo, Haosu, OT Luo, Jing, 1U Luo, Le, 2G Luo, Tao, 19 Lv, Deliang, 25 Lv, Hui, 33 Lv, Jiabing, 2D, 2E Lv, Ming-shan, 21, 23 Lv, Pin, OB, OL Lv, Shuai, 2P Lv, Yang, 00 Ma, Chong, 1W Ma, Dejun, 34 Ma, Lin, 2U Ma, Yi, 39 Ma, Yuechao, 0A Ma, Yun-liang, 0Y Mamdy, Bastien, 12, 2S Mao, Jiandong, 1H Mei, Xiaodong, 00 Meng, Hemin, 0C Miao, Lei, 2V Mu, Wei, 0Y Niu, Jun, 1X Pan, Feng, OW Peng, Dong, 14 Peng, Jie, 0D Peng, Xu, 0G Pittet, Patrick, 12 Qao, Xiaoli, 1P Qi, Yi, 2P Qian, Liangshan, OW Qian, Weiping, OK Qian, Weixian, 38 Qiao, Jianliang, 1X Qin, Hanlin, 2Q, 31 Qin, Juniun, 0G Qin, Xiage, 1K Ren, Jiancun, 1C Ren, Jiaojiao, 1P Ren, Xiuyun, OX Ren, Zhong, 07 Romain, Olivier, 12 Roy, François, 2S Shan, Cong-miao, 1R Shan, Guohang, 0A Shao, Jiangfeng, 1H Shao, Xiumei, 11, 20 Shi, Jia-ming, 20

Shi, Jincheng, 27 Shi, Zhi-guang, 36 Shu, Rong, 1N Si, Xu, OY Song, Chengying, 24 Song, Qiutong, 03 Song, Xiao-tong, OV Su, Lin, 10 Su, Xuan, 09 Sun, Fengrui, 35 Sun, Hua-yan, 1R, 2C Sun, Lanjun, OX Sun, Quan, OB, OL Sun, Ruoduan, 1W Sun, Zhen-hai, OZ Tang, Hengjing, 11, 20, 2D Tang, Qiuyan, OL Tao, Kunyu, OE Tian, Zhaoshuo, OX Tu, Zhipeng, 18 Wang, Bo, OG Wang, Bo, 16 Wang, Dapeng, 24 Wang, Guangyu, Ol Wang, Hailiang, 35 Wang, Haitao, 16 Wang, Han, 1D Wang, Hua, OZ Wang, Jia-chun, 20 Wang, Jiao, 2N Wang, Jinchun, 34 Wang, Jing, OL Wang, Jun, 2K Wang, Li, 0E Wang, Liusan, 1A Wang, Long-tao, 21 Wang, Ming-jun, 2N Wang, Nan, OC Wang, Pengcheng, 38 Wang, Qi-chao, 20 Wang, Rong, 19 Wang, Rui, 11 Wang, Rui, 24 Wang, Ruifeng, 1V Wang, Rujing, 1A Wang, Sheng-qi, OZ Wang, Shenyuan, 11 Wang, Shuai, ON Wang, Shuo, OS Wang, Wanjun, 2F, 2K Wang, Wei, OV Wang, Wei, 18 Wang, Wei, 1Z Wang, Xiaoyang, 1S Wang, Xingyu, 1F Wang, Xueying, 10 Wang, Yabo, 19 Wang, Yanfei, 1W Wang, Yang-yang, 2T Wang, Ye, 1F Wang, Yiqun, 2F

Wang, Yubing, 1A Wang, Yun Ying, 2P Wang, Zhengzi, 07 Wei, Li'an, 30 Wu, Chao, 32 Wu, Hui-yun, OZ Wu, Jianghui, OC Wu, Peiheng, 1W Wu, Xijun, 03 Wu, Xingxing, 22 Wu, Yanying, 16 Wu, Yu, 1K Xia, Min, 19, 1M, 28, 29 Xiao, Chun, OY Xiao, Rui, OZ Xie, Jun, 04 Xie, Minghui, 05 Xie, Yi Song, 00 Xie, Zhihua, OJ Xin, Shan, 2A, 2X Xiong, Zhongxing, 02 Xu, Bing, ON Xu, Cheng-lin, 0Y Xu, Enchi, 1F Xu, Fangxing, 1Q Xu, Hu, OT Xu, Hua, 00 Xu, Nan, 1W Xu, Peng, 1Z Xu, Wei, 03 Xu, Xianmei, 18 Xu, Xie-gu, OZ Xu, Yuan, 1X Yan, Xiang, 2Q, 31 Yan, Xu, 18 Yang, Chenhao, 30 Yang, Chunli, OT Yang, Jinbao, OQ Yang, Junbo, OR Yang, Kecheng, 1M, 28, 29 Yang, Li, 1F, 1Y, 2B, 35 Yang, Ru, 11 Yang, Rusong, 30 Yang, Shaoqing, 13 Yang, Yanxiang, 2H Yang, Yongying, 1G, 1U Yao, Yinping, 2U Yao, Zheyi, 38 Yi, Weining, 2Y Yin, Ruiguang, 10 Yu, Sheng-Lin, 2A Yu, Tao, OV Yuan, Honghui, 1E Zeng, Xianjiang, 1M, 29 Zha, Fengli, 05 Zhai, Chao, 14 Zhai, Houming, 1E Zhan, Juntong, 0D, 26 Zhang, Boyan, 22 Zhang, Chunfu, 1B Zhang, Dayong, 18

Zhang, Ding, 25 Zhang, Guo, OE Zhang, Guojin, 25 Zhang, Hailiang, OR Zhang, Jingjing, OR Zhang, Junwei, 18 Zhang, Labao, 1W Zhang, Lin, 35 Zhang, Liqin, 1L Zhang, Mingxuan, OC Zhang, Qi, 05 Zhang, Qingfang, 1B Zhang, Qiwen, OP, 1J Zhang, Renzhong, 24 Zhang, Shuhua, 1Z Zhang, Su, 0D, 26 Zhang, Tongyi, 2U Zhang, Wanchun, 00 Zhang, Wenpan, 17, 10 Zhang, Xiang, 24 Zhang, Xiao-hui, 08 Zhang, Yan, OK Zhang, Yanchao, OX Zhang, Yanjun, Ol Zhang, Yan-mei, 09 Zhang, Yi, 39 Zhang, Ying, 00 Zhang, Ying, 2R Zhang, Yiqun, OS Zhang, Yupeng, 1U Zhao, Changxia, 0D Zhao, Dan, 2Z Zhao, Da-peng, 20 Zhao, Duo, 1P Zhao, Nan-xiang, 2T Zhao, Peng, OK Zhao, Rui, 26 Zhao, Xiaolong, 1F, 2B Zhao, Yan-zhong, 1R, 2C Zhao, Yingjuan, 31 Zhen, Honglou, 1D Zheng, Xiangyang, 1N Zheng, Yong-hui, 1R, 2C Zhou, Haotian, 2X Zhou, Huaide, 22 Zhou, Huixin, 2Q, 31 Zhou, Jie, 2F, 2K Zhou, Weixiang, 1S Zhou, Xin, 15 Zhou, Yanchao, ON Zhou, Yudi, 1U Zhu, Bingli, OG Zhu, Fule, 09 Zhu, Ji, 2L Zhu, Jing-guo, 2M Zhu, Min, 2D, 2E Zhu, Shuang, 03 Zhu, Yong, 26

## **Conference Committee**

#### **Conference** Chairs

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

#### Conference Co-Chairs

Desheng Jiang, Wuhan University of Technology (China)
Hequan Wu, Chinese Academy of Engineering (China)
Huitao Fan, Aviation Key Laboratory of Science and Technology on Infrared Detector (China)
Junhao Chu, Shanghai Institute of Technical Physics, CAS (China)
Jannick Rolland, University of Rochester (United States)
Lin Li, The University of Manchester (United Kingdom)
Lijun Wang, Changchun Institute of Optics, Fine Mechanics and Physics, CAS (China)
Min Gu, Swinburne University of Technology (Australia)
Qiming Wang, Institute of Semiconductors, CAS (China)
Wei Wang, Beijing Institute of Aerospace Control Devices of CASC (China)
Yue Hao, Xidian University (China)
Zheng You, Tsinghua University (China)

#### Program Committee

Andreas Tünnermann, Friedrich-Schiller-Universität Jena (Germany) Baiou Guan, Jinan University (China) Bin Xiangli, Shanghai Engineering Center for Microsatellites (China) Byoungho Lee, Seoul National University (Korea, Republic of) Buwen Cheng, Institute of Semiconductors, CAS (China) Chun Tang, Institute of Applied Electronics, CAEP (China) Chunhua Shen, The University of Adelaide (Australia) **Chueh Tina**, Tianiin Jinhana Institute of Technical Physics (China) Daniel Jaque, Universidad Autónoma de Madrid (Spain) Dae Wook Kim, The University of Arizona (United States) Dawei Zhana, University of Shanahai for Science and Technology (China) Honghai Liu, University of Portsmouth (United Kingdom) Haimei Gong, Shanghai Institute of Technical Physics, CAS (China) Jannick Rolland, University of Rochester (United States) Jinxue Wang, SPIE Jin Lu, Tianjin Jinhang Institute of Technical Physics (China)

Jianping Chen, Shanghai Jiaotong University (China) Junpeng Guo, The University of Alabama in Huntsville (United States) Kevin P. Thompson, Synopsys, Inc. (United States) Lan Jiang, Beijing Institute of Technology (China) Lin Li, Beijing Institute of Technology (China) Ligong Zheng, Changchun Institute of Optics, Fine Mechanics and Physics, CAS (China) Lijun Wang, Changchun Institute of Optics, Fine Mechanics and Physics, CAS (China) Lin Li, The University of Manchester (United Kingdom) Min Gu, Swinburne University of Technology (Australia) Minghui Hong, National University of Singapore (Singapore) Minlin Zhong, Tsinghua University (China) Nanjian Wu, Institute of Semiconductors, CAS (China) Satoshi Kawata, Osaka University (Japan) Shibin Jiang, AdValue Photonics, Inc. (United States) Sen Han, University of Shanghai for Science and Technology (China) Suijian Xue, National Astronomical Observatories, CAS (China) Tsutomu Shimura, The University of Tokyo (Japan) Weibiao Chen, Shanghai Institute of Optics and Fine Mechanics, CAS (China) Wei Wang, Beijing Institute of Aerospace Control Devices of CASC (China) Weiping Yang, National University of Defense Technology (Ching) Xiaocong Yuan, Shenzhen University (China) Yang Ni, New Imaging Technologies (France) Yanbiao Liao, Tsinghua University (China) Yongcai Guo, Chongging University, Ministry of Education (China) Yongchun Xie, China Academy of Space Technology (China) Yong Bi, Academy of Opto-electronics, CAS (China) Yong Cheng, Wuhan Ordnance Non-Commissioned Officers Academy (China) Zhiping Zhou, Peking University (China)

#### Session Chairs

- 1 Nanjian Wu, Institute of Semiconductors, CAS (China)
- 2 Haimei Gong, Shanghai Institute of Technical Physics, CAS (China)
- 3 Libin Yao, Kunming Institute of Physics (China)
- 4 Yang Ni, New Imaging Technologies (France)

- 5 **Weibiao Chen**, Shanghai Institute of Optics and Fine Mechanics, CAS (China)
- 6 Jin Lu, Tianjin Jinhang Institute of Technical Physics (China)

## Introduction

Applied Optics and Photonics, China (AOPC2015) is the annual conference of the Chinese Society for Optical Engineering, and it is also the largest academic and industrial event in the field of optical and optoelectronic technology in China. The AOPC2015 organization committee intended to build a cohesive platform for academic exchanges, industry exhibitions, and corporate negotiations. The conference had 7 themes, which included 22 technical conferences and 600 technical presentations. We sincerely hope that the research and development of optoelectronic technology was promoted, and that the international cooperation of the optical and optoelectronic industry was enhanced.

AOPC2015 was sponsored by the Chinese Society for Optical Engineering; SPIE, the Optical Society, the European Optical Society, and the Optical Society of Korea were technical co-sponsors. There were also 28 cooperating organizations that supported the conference. We received a total of 1,219 contributions from more than 15 countries, including: the United States, the United Kingdom, Germany, France, Spain, Australia, Canada, Mexico, Brazil, Japan, Republic of Korea, Thailand, Singapore, Russian Federation, and China. Nearly 700 submissions were accepted for the *Proceedings of SPIE*, and over 150 invited talks and papers were suggested to be published in Journals indexed by SCI and Ei. After careful discussion, we selected five plenary speeches, which were presented by famous scientists from the United States, the United Kingdom, Republic of Korea, Japan, and China. There were 205 invited talks in 12 of the technical conferences. On behalf of the organization committee of AOPC, I express thanks to all of the invited speakers and authors for their contributions to and support of the conference.

To celebrate the International Year of Light 2015, we set up 12 display boards highlighting IYL in the exhibition area on the first level. These display boards were to educate the public about light and the applications of light in society.

Finally, on behalf of Prof. Songlin Zhuang, the other co-chairs, and the organization committee of AOPC, I would like to heartily thank our sponsors and cooperating organizations for all they have done for the conference. I thank all of the participants and friends for their interest and efforts in helping us make the conference a success. I also thank the program committee for their effective work and valuable advice—especially the AOPC2015 secretariat and the SPIE staff for their tireless effort and outstanding services in preparing the conference and publishing the proceedings.

Again, we extend our warmest greetings to you and hope you had a pleasant and exciting stay in Beijing!

Guofan Jin