OGC 2018
Optoelectronics Global Conference

# CONFERENCE PROGRAM

## 2018 the Optoelectronics Global Conference (OGC 2018)

Shenzhen Convention & Exhibition Center, Shenzhen, China
4-7 September, 2018

# OGC 2018

The Optoelectronics Global Conference

Shenzhen Convention & Exhibition Center, Shenzhen, China

4-7 September, 2018

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# About OGC 2018

The big leaps in optoelectronic technology and academia have drawn increasing attention from the industry community which is always in searching of innovative solutions. The Optoelectronics Global Conference (OGC) was created to pave the way connecting optoelectronic academia and industry as well as connecting China and the rest of the world.

2018 the 3rd Optoelectronics Global Conference will be held concurrently with the 20th China International Optoelectronic Exposition (CIOE) in Shenzhen. The conference aims to promote interaction and exchange of various disciplines among professionals in academia and industry at home and abroad. In addition, it also serves to turn technologies into industrial applications. It's expected that 300-500 professionals will attend the conference.

OGC will be an ideal platform for scholars, researchers and professionals to exchange insights and discuss the development of optoelectronics industry. It will be a perfect gathering to learn about new perspectives, technologies and trends which might pushes the boundaries of the technology and eventually creates a broader future for optoelectronics applications.

8 symposia will be talked on the conference with the topics covering precision optics, optical communications, lasers, infrared applications, and fiber sensors. Welcome the professionals, experts, managements and students from the universities, research institutions, military enterprises, and optoelectronic companies to attend the conference.

## Publication

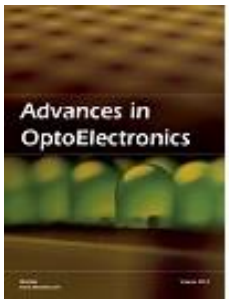
Accepted and registered papers will be published by IEEE Conference Publication.

After a careful reviewing process, all accepted papers after proper registration and presentation, will be published in the conference proceedings by Conference Publishing Services, and reviewed by the IEEE Conference Publication Program for IEEE Xplore.

Excellent papers selected by the guest editors will be recommended to be published on the one of the following journals:


**Journal of Innovative Optical Health Sciences** (Print ISSN: 1793-5458, Online ISSN: 1793-7205) published by World Scientific and indexed by **Science Citation Index Expanded (SCI)**, **Ei Compendex**, **Scopus** and other major Indexing databases.

Website: http://www.worldscientific.com/worldscinet/jiohs




**Advances in OptoElectronics** (ISSN: 1687-563X) published by Hindawi and indexed by **ESCI**, **Ei Compendex**, **Scopus** and other major Indexing databases.

Website: https://www.hindawi.com/journals/aoe/

# Presentation Instructions

## Instructions for Oral Presenters

**Devices Provided by the Conference Organizer:**
Laptop Computer (MS Windows Operating System with MS PowerPoint and Adobe Acrobat Reader)
Digital Projectors and Screen
Laser Stick

**Materials Provided by the Presenters:**
PowerPoint or PDF Files (Files should be copied to the Conference laptop at the beginning of each session.)

**Duration of each Presentation (Tentatively):**
Plenary Speech: **30** Minutes of Presentation
Invited Speech: about **20** Minutes of Presentation and **5** Minutes of Q&A.
Regular Oral Presentation: about **12** Minutes of Presentation and **3** Minutes of Q&A.

## Instructions for Poster Presenters

**Materials Provided by the Conference Organizer:**
The place to put poster

**Materials Provided by the Presenters:**
Home-made Posters
Maximum poster size is A1
Load Capacity: Holds up to 0.5 kg

## Best Presentation Award

One Best Oral Presentation will be selected from each presentation session, and the Certificate for Best Oral Presentation will be award at the end of each session.

## Dress Code

Please wear formal clothes or national representative of clothing.

# Conference Committee

## Honorary Chair

**Xiancheng Yang**
China International Optoelectronic Exposition Organizing Committee Office, China

## Conference Chairs

**Perry Shum**
Nanyang Technological University, Singapore
**Qihuang Gong**
Chinese Optical Society, China
**Junle Qu**
Shenzhen University, China

## Program Chairs

**Han Zhang**
Shenzhen University, China
**Chan Hau Ping**
City University of Hong Kong, China
**Lei Su**
Queen Mary University of London, UK
**Sze Y. Set**
University of Tokyo, Japan

## Session Chairs

**Session 1: Laser Technology**
**Tianye Huang**
China University of Geosciences, China
**Huanhuan Liu**
Shanghai University, China

**Session 2: Optical Communication and Networks**
**Jie Zhang**
Beijing University of Posts and Telecommunications, China
**Ming Tang**
Huazhong University of Science and Technology, China
**Anhui Liang**
Guangdong University of Technology, China

**Session 3: Infrared Technologies and Applications**
**Jianji Dong**
Wuhan National Laboratory for Optoelectronics, China
**YuPeng Zhang**
Shenzhen University, China
**Zhipei Sun**
Aalto University, Finland

**Session 4: Precision Optics**
**Baohua Jia**
Swinburne University, Australia
**Yuegang Fu**
Changchun University of Science and Technology, China
**Zhiying Liu**
Changchun University of Science and Technology, China

**Session 5: Lightings and Displays**
**Xiaowei Sun**
Southern University of Science and Technology, China
**Feng Teng**
Beijing Jiaotong University, China
**Qionghua Wang**

Sichuan University, China

**Session 6: Optoelectronic Devices and Applications**

**Baojun li**

Jinan University, China

**Qin Cheng**

Jinan University, China

**Session 7: Biophotonics and Biomedical Optics**

**Xunbin Wei**

Shanghai Jiao Tong University, China

**Buhong Li**

Fujian Normal University, China

**Tymish Y. Ohulchanskyy**

Shenzhen University

**Jun Qian**

Zhejiang University, China

**Session 8: Fiber-Based Technologies and Applications**

**Yiping Wang**

Shenzhen University, China

**Changrui Liao**

Shenzhen University, China

**Special Session 1: Optical Fiber Technology in Endoscope**

**Yunxu Sun**

Harbin Institute of Technology, Shenzhen, China

**Wenduo Zhang**

Beijing Hospital, China

## Workshop Chair

**workshop 1: China-Sweden Optical Fiber Technique for Spatial Division Multiplexing Transmission**

**Songnian Fu**

Huazhong University of Science and Technology, China

**Magnus Karlsson**

Chalmers University of Technology, Sweden

## International Advisory Committee

**Lijun Wang**

Changchun Institute of Optics and Fine Mechanics and Physics, Chinese Academy of Sciences, China

**Wenqing Liu**

Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

**Songhao Liu**

South China Normal University, China

**Yunjie Liu**

China Unicom Co. Ltd., China

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Xi'an Institute of Optics and Precision Mechanics,Chinese Academy of Sciences, China

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Institute of Modern Optical Instruments, Tianjin University, China

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Changchun University of Science and Technology, China

**Ziseng Zhao**

Wuhan Research Institute of Posts and Telecommunications, China

**Ying Gu**

The General Hospital of the People's Liberation Army , China

**Zhizhan Xu**

Shanghai Institute of Optics and Precision Mechanics,Chinese Academy of Sciences,

China

**Shuisheng Jian**

Institute of Light Wave Technology, Beijing Jiaotong University, China

**Dianyuan Fan**

Shenzhen University, China

## Local Organizing Committee

**Secretary General:**

Eric Yang

**Deputy Secretary General:**

Charles Xie, Wenda Peng

**Secretariat Office:**

Feng Wang, Xiaojia He, Yu, Yutao Zhang

# Plenary Speakers

Plenary Speakers I

**Lihong Wang**
California Institute of Technology

***Speech Title*** — World's Deepest-Penetration and Fastest Cameras: Photoacoustic Tomography and Compressed Ultrafast Photography

***Abstract*** — We developed photoacoustic tomography to peer deep into biological tissue. Photoacoustic tomography (PAT) provides in vivo omniscale functional, metabolic, molecular, and histologic imaging across the scales of organelles through organisms. We also developed compressed ultrafast photography (CUP) to record 10 trillion frames per second, 10 orders of magnitude faster than commercially available camera technologies. CUP can tape the fastest phenomenon in the universe, namely, light propagation, and can be slowed down for slower phenomena such as combustion.

***Biography*** — Lihong Wang is Bren Professor of Medical and Electrical Engineering at Caltech. Published 470 journal articles (h-index = 118, citations = 58,000). Delivered 460 keynote/plenary/invited talks. Published the first functional photoacoustic CT, 3D photoacoustic microscopy, and compressed ultrafast photography (world's fastest camera). Served as Editor-in-Chief of the Journal of Biomedical Optics. Received the Goodman Book Award, NIH Director's Pioneer Award, OSA Mees Medal, IEEE Technical Achievement and Biomedical Engineering Awards, SPIE Chance Biomedical Optics Award, IPPA Senior Prize, OSA Feld Biophotonics Award, and an honorary doctorate from Lund University, Sweden. Inducted into the National Academy of Engineering.

Plenary Speakers II

**Leping Wei**
Executive Deputy Director of Communication Technologies Commission of Ministry of Industry and Information

***Speech Title*** — Developing Opportunity and Challenge of Optical Communication Industry in 5G Era

***Abstract*** — Developing trend of backbone optical transmission link
Developing trend of backbone optical nodes
New relationship between 5G and fiber infrastructure
Prequel is the key to 5G bearer network
Major challenges for 5G
The opportunity that 5G brings to optical communication

***Biography*** — Leping Wei graduated from Tsinghua University and received his master degree in communications and electronic system at Wuhan Research Institute of Posts and Telecommunications. He was a visiting

scholar to Canada and Israel in programs funded by the state, and carried out many ground-breaking and forward-looking tasks for the strategic transformation of telecommunications network. He won the second prize of National Scientific and Technological Progress Award three times, was granted special government expert allowance, and was awarded with the title of National Outstanding Returned Overseas Talent as well as Young and Middle-aged Expert with Outstanding Contributions. He has published more than 100 papers and 9 books. He was the chief engineer of China Telecom, and is now the deputy director of Communications Science and Technology Committee of the Ministry of Industry and Information Technology. In addition, he is the director of Science and Technology Committee of China Telecom, dedicating to technical development strategy research and decision-making consultation for the industry and the company.

Plenary III

**Jianlin Cao**

Former Vice-Minister of Science and Technology of China

***Speech Title*** — Development Process Overview of China's First High-End Lithography Projection Lens

***Abstract*** — Advanced IC manufacturing lithography optics consists of two parts: lighting system and projection lens system. The projection lens system is the most precise and complicated optical system developed by human beings at present, the performance of which determines chip integration. This report reviews the development process of China's first advanced lithography projection lens system with independent intellectual property rights from the aspects of project establishment, development route, development logic, implementation & acceptance results, and industrial layout. The reports also summarizes the experience and understanding for nine years of hard work, and forecasts to establish international high-end optical industry brand and build China's ultra-precision optical industry ecosystem in the current international situation.

***Biography*** — 1982 Graduated from Department of Physics of Fudan University

1989 Acquisition of joint doctor degree from Changchun Light technology institute of Chinese Academy of Sciences and Tohoku university of Japan

1989—1992 Postdoctoral research in Changchun Light technology institute of Chinese Academy of Sciences. Served in Changchun Light technology institute, researcher, Phd supervisor, executive deputy director (legal representative), executive director, head of the institute, assistant to President of CAS and the head of preparatory group of Photoelectric group of CAS, President of Academy of Opto-Electronics of CAS

2001.1—2006.9 Vice president of CAS, Member of the CPC Leading Group, president of Academy of Opto-Electronics, director of State Key Laboratory of applied optics.

2006.9—2015.11 Vice Minister of Science & Technology, Member of the CPC Leading Group

2018.3 Deputy director of Committee of Education, Science, Culture, Health and Sports in the 13th CPPCC national committee.

Plenary IV

**Jianyu Wang**
Shanghai Insitute of Technical Physics,CAS

***Speech Title*** ─ Application of Photon Detection in Space Exploration

***Abstract*** ─ Photon detection is the limiting form of optical detection. With the rapid development of detector technology and the continuous improvement of performance, the detection ability of the system for few photons and single photon is constantly improving, and the application field is also expanding. For example, photon lidar is a main direction of the development of space lidar, which can improve the sensitivity of lidar in a large range and reduce the requirement of laser power. In space quantum communication, single photon detector is the core device of the system. This paper will introduce the development of photon detection technology and its applications in space exploration and communication, including laser radar, quantum communication and so on. A new application, space photon communication technology, will also be introduced. The technology has the characteristics of high communication speed, long communication distance and less demand for satellite resources. It is the first choice for data transmission in deep space exploration.

***Biography*** ─ Jianyu Wang is the academician of the Chinese Academy of Sciences and the researcher Professor of Shanghai Institute of Technical Physics. He is also the president of Shanghai branch of Chinese Academy of Sciences. He received his BS degree in Physics from Hangzhou University in 1982, and the MS degree and PhD from Shanghai Institute of Technical Physics, Chinese Academy of Sciences in 1987 and 1990. He is the associate editor of “Journal of Infrared and Millimeter Wave” and “Journal of Applied Science”. He serves as a member of the COSPAR Chinese Committee, and the chairman of SPIE Asia Pacific Conference on multispectral / hyperspectral remote sensing technology and application. His research interests include passive and active optoelectronic remote sensing system, Hyperspectral imaging technology, laser remote sensing imaging technology and free-space quantum communication technology. Now He is responsible for the implementation of the project of quantum science experimental satellite.

# Technical Program

| | | | |
|---|---|---|---|
| Reg Day｜Sep 4, 2018 | | | |
| Venue: Reg Desk, 5th F, SZCEC | | | |
| 10:00-17:00 | On-site Sign in | | |
| Day 1｜Sep 5, 2018<br>( Page 19 ) | | | |
| Venue: Reg Desk, 5th F, SZCEC | | | |
| 09:00-17:00 | On-site Sign in | | |
| Venue: Hall 5, SZCEC | | | |
| 08:00-09:00 | Invited Guest Registration | | |
| 09:00-10:00 | Opening Ceremony: Opening Speech, Leader's Speech | | |
| 10:00-12:00 | **2018 Optoelectronics Global Conference**<br>Guest Host：Junle Qu｜Shenzhen University, China | | |
| 10:00-10:30 | **Development Process Overview of China's First High-end Lithography Projection Lens**<br>Cao jianlin｜Former Vice-Minister of Science and Technology of China | | |
| 10:30-11:00 | **Developing Opportunity and Challenge of Optical Communication Industry in 5G Era**<br>Wei Leping｜Executive Deputy Director of Communication Technologies Commission of Ministry of Industry and Information | | |
| 11:00-11:30 | **Application of Photon Detection in Space Exploration**<br>Wang Jianyu｜Shanghai Insitute of Technical Physics, CAS | | |
| 11:30-12:00 | **World's Deepest-Penetration and Fastest Cameras: Photoacoustic Tomography and Compressed Ultrafast Photography**<br>Wang Lihong｜Bren Professor of Medical and Electrical Engineering at Caltech. | | |
| 12:00-13:30 | Lunch | | Venue:－1F, SZCEC |
| Venue: 5th F, SZCEC | | | |
| 13:30-15:05 | S4-A | < Precision Optics > | Lotus Hall 6 |
| | S3 | < Infrared Technologies and Applications > | Lotus Hall 2 |
| | S2-A | < Optical Communication and Networks > | Lotus Hall 4 |
| | S8-A | < Fiber-Based Technologies and Applications > | Lotus Hall 5 |
| 15:05-15:35 | Coffee Break | | Venue；Hall Way |

| | | | |
|---|---|---|---|
| 15:35-17:05 | S4-A | < Precision Optics > | Lotus Hall 6 |
| | S3 | < Infrared Technologies and Applications > | Lotus Hall 2 |
| | S2-A | < Optical Communication and Networks > | Lotus Hall 4 |
| | S8-A | < Fiber-Based Technologies and Applications > | Lotus Hall 5 |
| 18:30-20:00 | Dinner | | Venue: Hua Tang (see "Dinner Venue") |
| Day 2 \| Sep 6, 2018 ( Page 42 ) | | | |
| Venue: 5th F, SZCEC | | | |
| 09:00-17:00 | On-site Sign in | | Reg Desk |
| 09:00-10:15 | S4-B | < Precision Optics > | Lotus Hall 6 |
| | S7-A | < Biophotonics and Biomedical Optics > | Lotus Hall 2 |
| | S2-B | < Optical Communication and Networks > | Lotus Hall 4 |
| | S6-A | < Optoelectronic Devices and Applications > | Lotus Hall 5 |
| 10:15-10:45 | Coffee Break | | Venue；Hall Way |
| 10:45-12:25 | S4-B | < Precision Optics > | Lotus Hall 6 |
| | S7-A | < Biophotonics and Biomedical Optics > | Lotus Hall 2 |
| | S2-B | < Optical Communication and Networks > | Lotus Hall 4 |
| | S6-A | < Optoelectronic Devices and Applications > | Lotus Hall 5 |
| 12:30-13:30 | Lunch | | Venue: －1F, SZCEC |
| 13:30-14:50 | S6-B | < Optoelectronic Devices and Applications > | Lotus Hall 6 |
| | S1-A | < Laser Technology > | Lotus Hall 2 |
| | S5 | < Lightings and Displays > | Lotus Hall 4 |
| | S8-B | < Fiber-Based Technologies and Applications > | Lotus Hall 5 |
| 14:50-15:20 | Coffee Break | | Venue: Hall Way |
| 15:20-17:25 | S6-B | < Optoelectronic Devices and Applications > | Lotus Hall 6 |
| | S1-A | < Laser Technology > | Lotus Hall 2 |
| | S5 | < Lightings and Displays > | Lotus Hall 4 |
| | S8-B | < Fiber-Based Technologies and Applications > | Lotus Hall 5 |
| 18:30-20:00 | Dinner | | Venue: Hua Tang (see "Dinner Venue") |

| Day 3 | Sep 7, 2018<br>( Page 88 ) | | |
|---|---|---|---|
| 5th F, SZCEC | | | |
| 09:00-10:15 | S6-C | < Optoelectronic Devices and Applications > | Lotus Hall 6 |
| | S7-B | < Biophotonics and Biomedical Optics > | Lotus Hall 2 |
| | S2-C | < Optical Communication and Networks > | Lotus Hall 4 |
| | S1-B | < Laser Technology > | Lotus Hall 5 |
| 10:15-10:45 | Coffee Break | | Venue：Hall Way |
| 10:45-12:25 | S6-C | < Optoelectronic Devices and Applications > | Lotus Hall 6 |
| | S7-B | < Biophotonics and Biomedical Optics > | Lotus Hall 2 |
| | S2-C | < Optical Communication and Networks > | Lotus Hall 4 |
| | S1-B | < Laser Technology > | Lotus Hall 5 |

| Workshop: China-Sweden Optical Fiber Technique for Spatial Division Multiplexing Transmission<br>Day 1 | Sept. 5 PM, 2018<br>( Page 22) | |
|---|---|---|
| Venue: Rose Hall 1, 5th Floor, SZCEC | | |
| Chair：Songnian Fu | | |
| 13:30-14:00 | Nonlinear Mitigation Using Phase Sensitive Amplifiers and Digital Back Bropagation | |
| 14:00-14:30 | Mode Division Multiplexing Amplifiers Based on HOF | |
| 14:30-15:00 | Feasibility of MIMO Transmission over a Single Spatially Multiplexed OM3 Multimode Fiber | |
| 15:00-15:30 | Coffee Break | Venue: Hall Way |
| Chair：Magnus Karlsson | | |
| 15:30-16:00 | Space-Division Multiplexed Distributed Fiber Sensing Using Multicore Fiber and Few-Mode Fiber | |
| 16:00-16:30 | Multi-Core Fibre Enabled High-Speed Datacentre Interconnect | |
| 16:30-17:00 | Multi-Core and Few-Mode Fiber: Recent Progress and Application Prospective | |
| 17:00-17:30 | High Spectral Efficiency Transmission | |

| Poster Session<br>Day 2 | Sep 6, 2018<br>( Page 23 ) | |
|---|---|---|
| Venue: the Lounge, 5th Floor, SZCEC | | |
| 13:30-17:30 | Effect of Absorptivity on Quantum Efficiency of Transmission-mode GaAs Photocathode | |
| | Infrared Target Detection Based on Local Contrast Method and LK Optical Flow | |
| | A Label-Free Characterization Method of Neuronal Firing Activities by Means of Phase Imaging | |
| | High Speed Novel Hybrid Modulation Technique of Visible Light Communication Based on Artificial Neural Network Equalizer | |
| | Cell Imaging with Squaraine Dye Based on Two-Photon Excitation Fluorescence Imaging | |
| | Design of Photonic Crystal Fiber Polarization Filter Based on Surface Plasmon Resonance | |
| | Rapid Response of High Precision Fiber Bragg Grating Based Temperature Sensor | |
| | Design and Fabrication of Infrared Photonic Crystal of Thermoelectric Sensor | |
| | Design and Analysis of A New Laser Communication Terminal | |
| | Frequency-Quadrupled Microwave Signal Generation with Tunable Phase Shift Employing No Optical Filter | |
| | Resolution Improvement of Multi-Spot Structured Illumination Microscopy with Sparse Bayesian Learning Algorithm | |
| | Rapid 3D Image Scanning Microscopy with Multi-Spot Excitation and Doublehelix Point Spread Function Detection | |
| | High Sensitive Fiber Bragg Grating Vibration Sensor Based on Quartz Diaphragm | |
| | Nanowire-Assisted Photonic Crystal Cavity for Low-Power Continuous-Wave Pumped Frequency Upconversions | |

| Special Session: Optical Fiber Technology in Endoscope<br>Day 2 | Sep 6, 2018<br>( Page25 ) | |
|---|---|---|
| Venue: Rose Hall 1, 5th Floor, SZCEC | | |
| Chair：Yunxu Sun | Harbin Institute of Technology, Shenzhen. China | |
| 09:00-09:20 | Theranostics Catheter: concept, design and application in interventional therapy | |
| 09:20-09:40 | DCB in coronary artery disease | |
| 09:40-10:00 | Specialty fibers for biomedical applications | |
| 10:00-10:20 | Coffee Break | Venue: Hall Way |
| Chair：Wenduo Zhang | Beijing Hospital, China | |
| 10:20-10:40 | Optogenetics controlling cardiac neurosis for arrhythmia | |
| 10:40-11:00 | New material of special optical fiber. | |
| 11:00-11:20 | Detection bandwidth reduction in optical coherence tomography by dual optical frequency combs Fiber-optic ultrasound generation and detection | |
| 11:20-11:30 | Fiber-optic ultrasound generation and detection | |
| 11:30-12:00 | Panel Discussion | |

| DAY 1｜ Sep 5, 2018 | | |
|---|---|---|
| S4-A < Precision Optics ><br>( Venue: Lotus Hall 6, 5th F, SZCEC ) | | |
| Chair: Baohua Jia | | |
| 13:30-13:55 | Invited | **Optical Properties of Dielectric Nonspherical Nanoparticles**<br>Yongqian Li｜Northwestern Polytechnical University, China |
| 13:55-14:10 | G0011 | **A Hybrid FPGA/GPU Computing Platform for Super-resolution Localization Microscopy**<br>Dan Gui and Zhen-Li Huang｜Huazhong University of Science and Technology, China |
| 14:10-14:40 | Coffee Break | |
| 14:40-15:05 | Invited | **Theory and Ultra Precision Manufacturing Technology on Imaging Diffractive Optical Elements**<br>Changxi Xue｜Changchun University of Science and Technology, China |
| 15:05-15:20 | G0033 | **Cross Nanoantenna for Fluorescence Enhancement: Giant Intensity Enhancement and Polarization Preservation**<br>Li Ma, Song Sun, Ru Li, Huigao Duan and Mo Li｜Hunan University,China |
| 18:30-20:00 | Dinner | |
| S3 < Infrared Technologies and Applications ><br>( Venue: Lotus Hall 2, 5th F, SZCEC ) | | |
| Chair: Jianji Dong, YuPeng Zhang | | |
| 13:30-13:55 | Invited | **Monolithically Chip-Integrated Germanium Photonic Devices for Mid-Infrared Applications**<br>Zhenzhou Cheng｜The University of Tokyo, Japan |
| 13:55-14:20 | Invited | **Ultrafast All-fiber Mid-IR lasers**<br>Zhengqian Luo｜Xiamen University, China |
| 14:20-14:35 | G0016 | **Fast Classification Algorithm of High-dimensional Tobacco Leaf Near-infrared Spectral Data Based on Deep Learning Method**<br>Jianqiang Zhang and Weijuan Liu｜Yunan Reascend Tobacco Technology (Group) Co., Ltd,China |
| 14:35-14:50 | G0019 | **A Directional-progressive Search Method for Infrared Small Target Detection**<br>Xiangyue Zhang｜Shenyang Institute of Automation, Chinese Academy of Sciences, China |
| 14:50-15:05 | G0021 | **Infrared Quantum Dot and Quantum Cascade Broadband Superluminescent Light Emitters**<br>Hongmei Chen｜Chinese Academy of Sciences, China |

| | | |
|---|---|---|
| 15:05-15:35 | Coffee Break | |
| 15:35-16:00 | Invited | **Mid-Infrared Technologies and Opportunities Using Dysprosium-Doped Fluoride Fiber**<br>Robert Ian Woodward｜Macquarie University, Australia |
| 16:00-16:25 | Invited | **Tailoring the Responses of Thermal Detectors Using Optical Antennas**<br>Fei Yi｜Huazhong University of Science and Technology, China |
| 16:25-16:50 | Invited | **2 μm Ultrashort-Pulse Fiber Lasers**<br>Jinzhang Wang｜Shenzhen University, China |
| 16:50-17:05 | G0081 | **Large Field of View Binocular Stereo Vision Sensor Calibration Method Based on 3D Virtual Target**<br>Shoubo Yang｜Key Laboratory of Precision Opto-mechatronics Technology Minitry of Education，Beihang University, China |
| 18:30-20:00 | Dinner | |
| S2-A < Optical Communication and Networks ><br>( Venue: Lotus Hall 4, 5th F, SZCEC ) | | |
| Chair: Jie Zhang | | |
| 13:30-13:55 | Invited | **The Evolution of A New ISP and Recent Development in 5G Technology**<br>Gordon K. P. Lei｜MTel Telecommunication Company Limited, China |
| 13:55-14:20 | Invited | **Chip-Scale Mode Division Multiplexed System**<br>Yu Yu｜Huazhong University of Science and Technology, China |
| 14:20-14:35 | G0003 | **Design, Fabrication and Measurement of a Novel Ultra Low Loss 6-LP-Mode Fiber**<br>Lei Zhang｜Yangtze Optical Fiber and Cable Joint Stock Limited Company, China |
| 14:35-14:50 | G0015 | **X-ray Detector with High Temporal Resolution by Using Pulse-dilation Technology**<br>Houzhi Cai, Wenyong Fu, Dong Wang and Jinyuan Liu｜University of Shenzhen, China |
| 14:50-15:20 | Coffee Break | |
| 15:20-15:35 | G0028 | **Optical Spectroscopic Study on 1.3μm InAs/GaAs Quantum Dots and Laser Diodes - Towards High Speed Fiber-optic Communication Applications**<br>Qizhu Li, Xu Wang, Ziyang Zhang and Jiqiang Ning｜Chinese Academy of Sciences,China |
| 15:35-15:50 | G0035 | **Study on Optical Fiber Sensor for Measurement of Strain Based on Dual Demodulation of Wavelength and Intensity**<br>Ningbo Gao｜Xian Research Institute of High Technology,China |
| 15:50-16:05 | G0077 | **Dissimilar Single Mode Fiber Splice Appearance in Relation to Splice Quality**<br>Lin Zhao｜FUJIKURA (CHINA) CO., LTD.China |

| | | |
|---|---|---|
| 18:30-20:00 | Dinner | |
| S8-A < Fiber-Based Technologies and Applications ><br>( Venue: Lotus Hall 5, 5th F, SZCEC ) | | |
| Chair: Yiping Wang | | |
| 13:30-13:55 | Invited | **Nonlinearity of 2D Materials with Silica Microfibers**<br>Fei Xu｜Nanjing University, China |
| 13:55-14:20 | Invited | **Multicomponent Glass and Fiber for Photonic Applications**<br>Shifeng Zhou｜South China University of Technology, China |
| 14:20-14:35 | G0004 | **Design and Application of Erbium-doped Photonic Crystal Fiber for Superfluorescent Fiber Source**<br>Li Zhang｜Shenzhen University, China |
| 14:35-14:50 | G0007 | **Application Research of FBG Vibration Sensor used for Perimeter Security**<br>Meng Wang｜Laser Research Institute,Qilu University of Technology (Shandong Academy of Sciences),China |
| 14:50-15:20 | Coffee Break | |
| 15:20-15:45 | Invited | **Otofluidic Chip for Biological/Chemical Analytic Devices**<br>Yi Yang｜Wuhan University, China |
| 15:45-16:00 | G0023 | **Time Delay Measurement in Optical Fibers Based on Phase Detection**<br>Xinxin Huang｜Beijing University of Posts and Telecommunications |
| 16:00-16:15 | G0027 | **Application of FBG Sensor for Low Frequency Vibration Monitoring in Hydroelectric Generating**<br>Shujuan Li｜Laser Institute, Qilu University of Technology (Shandong Academy of Sciences), China |
| 16:15-16:30 | G0039 | **The Test System of DFB Fiber Laser Hydrophone Acoustic Pressure Sensitivity**<br>Yuanyuan Yang｜Lase Institute of Shandong Academy of Sciences,Qilu University of Technology (Shandong Academy of Sciences), China |
| 18:30-20:00 | Dinner | |

| Workshop: China-Sweden Optical Fiber Technique for Spatial Division Multiplexing Transmission （Venue: Rose Hall 1, 5th Floor, SZCEC） | |
|---|---|
| Chair：Songnian Fu｜School of Optical and Electronic Information, Huazhong University of Science and Technology, China | |
| 13:30-14:00 | **Nonlinear mitigation using Phase Sensitive Amplifiers and digital back propagation**<br>Magnus Karlsson｜Chalmers University of Technology, Sweden |
| 14:00-14:30 | **Mode division multiplexing amplifiers based on HOF**<br>Kyunghwan Oh｜Yonsei University, Korea |
| 14:30-15:00 | **Feasibility of MIMO Transmission over a Single Spatially Multiplexed OM3 Multimode Fiber**<br>Jianqiang Li｜Beijing University of Posts and Telecommunications, China |
| 15:00-15:30 | Coffee break |
| Chair：Magnus Karlsson｜Chalmers University of Technology, Sweden | |
| 15:30-16:00 | **Space-division multiplexed distributed fiber sensing using multicore fiber and few-mode fiber**<br>Zhiyong Zhao｜The Hong Kong Polytechnic University, Hong Kong, China. |
| 16:00-16:30 | **Multi-core fibre enabled high-speed datacentre interconnect**<br>Lin Rui｜KTH Royal Institute of Technology, Sweden |
| 16:30-17:00 | **Multi-core and Few-mode fiber: Recent progress and application prospective**<br>Yang Chen｜Yangtze Optical Fibre and cable joint stock limited Company(YOFC), China |
| 17:00-17:30 | **High spectral efficiency transmission**<br>Jochen Schröder｜Chalmers University of Technology, Sweden |
| 18:30-20:00 | Dinner |

| Poster Session<br>（Venue: the Lounge, 5th Floor, SZCEC） | | |
|---|---|---|
| 13:30-17:30 | G0012 | **Effect of Absorptivity on Quantum Efficiency of Transmission-mode GaAs Photocathode**<br>Jing Zhao｜Nanjing Institute of Technology, China |
| | G0013 | **Infrared Target Detection Based on Local Contrast Method and LK Optical Flow**<br>Jiajia Pan｜University of Chinese Academy of Science, China |
| | G0029 | **A Label-free Characterization Method of Neuronal Firing Activities by Means of Phase Imaging**<br>Ying Ji｜Jiangsu University, China |
| | G0036 | **High Speed Novel Hybrid Modulation Technique of Visible Light Communication Based on Artificial Neural Network Equalizer**<br>Weipeng Guan｜South China University of Technology, China |
| | G0054 | **Cell Imaging with Squaraine Dye Based on Two-photon Excitation Fluorescence Imaging**<br>Junxian Genga, Rongxing Yia, Junle Qu and Liwei Liu｜Shenzhen University, Shenzhen, China |
| | G0059 | **Design of Photonic Crystal Fiber Polarization Filter Based on Surface Plasmon Resonance**<br>Fanshu Ma｜University of Science and Technology Beijing, China |
| | G0046 | **Rapid Response of High Precision Fiber Bragg Grating Based Temperature Sensor**<br>Long Ma｜Qilu University of Technology, China |
| | G0062 | **Design and Fabrication of Infrared Photonic Crystal of Thermoelectric Sensor**<br>Chih-Hsiung Shen｜National Changhua University of Education, Taiwan (R.O.C.) |
| | G0067 | **Design and Analysis of a New Laser Communication Terminal**<br>Youjian Zhang｜Chang Chun University of Science and Technology, China |
| | G0073 | **Frequency-Quadrupled Microwave Signal Generation With Tunable Phase Shift Employing No Optical Filter**<br>Xinjing Qiu｜Institute of Electronic Information Engineering, Inner Mongolia University, China |
| | G0074 | **Resolution Improvement of Multi-spot Structured Illumination Microscopy with Sparse Bayesian learning Algorithm**<br>Jingjing Wu｜Shenzhen University, China |
| | G0075 | **Rapid 3D Image Scanning Microscopy with Multi-spot Excitation and Doublehelix Point Spread Function Detection**<br>Siwei Li｜Shenzhen University, China |

| | | |
|---|---|---|
| | G0086 | **High Sensitive Fiber Bragg Grating Vibration Sensor Based on Quartz Diaphragm**<br>Qingchao Zhao｜Lase Institute of Shandong Academy of Sciences, Qilu University of Technology (Shandong Academy of Sciences), China |
| | G0098 | **Nanowire-assisted Photonic Crystal Cavity for Low-power Continuous-wave Pumped Frequency Upconversions**<br>Hao Yang｜Northwestern Polytechnical University, China |

| Special Session: Optical Fiber Technology in Endoscope<br>( Venue: Rose Hall 1, 5th Floor, SZCEC ) | |
|---|---|
| Chair: Yunxu Sun｜Harbin Institute of Technology, Shenzhen, China | |
| 09:00-09:20 | **Theranostics Catheter: concept, design and application in interventional therapy**<br>Jianan Li｜ Xi'an Institute of Optics and Precision Mechanics of CAS, China |
| 09:20-09:40 | **DCB in coronary artery disease**<br>Wenduo Zhang｜Beijing Hospital, China |
| 09:40-10:00 | **Specialty fibers for biomedical applications**<br>Kaiwei Li｜Nanyang Technological University, Singapore |
| 10:00-10:20 | Coffee Break |
| Chair：Wenduo Zhang｜Beijing Hospital, China | |
| 10:20-10:40 | **Optogenetics controlling cardiac neurosis for arrhythmia**<br>Lilei Yu｜Wuhan University, China |
| 10:40-11:00 | **New material of special optical fiber.**<br>Shifeng Zhou｜The South China University of Technology, China |
| 11:00-11:20 | **Detection bandwidth reduction in optical coherence tomography by dual optical frequency combs Fiber-optic ultrasound generation and detection**<br>Qiang Ji｜University of Hong Kong, Hong Kong, China |
| 11:20-11:30 | **Fiber-optic ultrasound generation and detection**<br>Jiajun Tian｜Harbin institute of technology, Shenzhen, China |
| 11:30-12:00 | Panel Discussion |

# Sub-session 4-A

# < Precision Optics >

## ---------- Invited ----------

**Optical Properties of Dielectric Nonspherical Nanoparticles**

**Yongqian Li**
Northwestern Polytechnical University, China

***Abstract*** — Dielectric nonspherical nanoparticles are elemental blocks for building metasurfaces and optical devices with novel functionalities. The light intensity, phase, polarization, and other parameters would be controlled by these metasurface and devices. Our works focus in two steps. The scattering effects of high-dielectric silicon nanoparticles are investigated by discrete-dipole approximation (DDA). The multipole contribution into the resonant responses of nanoparticles are calculated. Resonant electric and magnetic multipole responses up to the electric octupole moment have been analyzed in theory and calculated by our self-written DDA program. The results help to understand the resonant scattering process made of dielectric nanoparticles. Secondly, the optical properties of nanoparticles array have been investigated by rigorous coping wave approaches (RCWA). The reflectivity, transmissivity, and the phase of dielectric nanoparticles array have been investigated accurately. The works provides some interesting phenomena of the dielectric nanoparticles.

**Biography**

Professor Yongqian Li is currently at Northwestern Polytechnical University (NWPU), Xi'an, China, working as a principal researcher at the MicroNano System Lab. He received his B.S. and Ph.D. in Mechanical Engineering from NWPU in 1998 and 2003, respectively, and then completed his postdoctoral research at the Micro System Lab of the Dalian University of Technology (DLUT) in 2005. He had been a visiting scholar at the University of California, Berkeley, USA for one year. His research interests focus on light–matter interactions, involving plasmonic optics, metamaterials, and metasurfaces.

**Theory and Ultra Precision Manufacturing Technology on Imaging Diffractive Optical Elements**

**Changxi Xue**
Changchun University of Science and Technology, China

***Abstract*** — Diffraction optics is one of the most active research fields in optical engineering, the hybrid optical systems that consisted of refraction, reflection and diffraction optical elements can effectively correct the aberration, like chromatic aberration and spherical aberration, and further expand the field of view and improve image quality, it is very promising for increasing the performance of imaging system, simplify the structure and reduce the cost of optical systems. Especially in recent years, multilayer diffractive optical element can overcome the key problem that the diffraction efficiency of traditional single-layer diffractive elements decreases quickly when the working wavelength deviates from the design wavelength, and finally achieve higher

diffraction efficiency within the wide band. Ultra-precision manufacturing technology of diffraction optical elements is important to the development and application of the diffraction optical element in the field of optical engineering. Meantime, the application of diffraction optical element in the optical system also promoted the development of manufacturing technology, and made it possible to make the objective with higher resolution, promote the development of lithography to smaller scale, which can fabricate the more sophisticated optoelectronic devices. This report presents the basis of diffraction optics theory, the design method of multilayer diffractive optical element and ultra-precision machining technology.

**Biography**

Xue Changxi has received his PhD from Changchun University of Science and Technology.He worked in Department of Optical Engineering, Changchun University of Science and Technology since 2002. He is a Professor now, and has published more than 40 papers in refereed journals. His research interest includes diffractive optics and fabrication technology for optical elements.

## ---------- Oral ----------

OGC 2018 - G0011

**A Hybrid FPGA/GPU Computing Platform for Super-resolution Localization Microscopy**

**Dan Gui, Zhen-Li Huang**

Huazhong University of Science and Technology, China

***Abstract*** — Super-resolution localization microscopy (SRLM) is a popular super-resolution microscopy technique with offers unprecedented spatial resolution (typically 30-50 nm) for biomedical researches. With the invention and maturation of a new type of low-light detector called sCMOS camera, it is now possible to significantly enlarge the field-of-view of SRLM without compromising the spatial resolution. However, the use of sCMOS camera brings big challenges (for example, heavy data flow and data volume) to SRLM. Such challenges are difficult to be tackled under conventional data processing platforms such as multi-core CPU or GPU, especially for long-term SRLM or high-density molecule localization.

In this talk, we will introduce a hybrid FPGA/GPU computing platform for SRLM. We will also evaluate the data processing capability of this hybrid platform in some typical application scenarios, for example, SRLM with sparse/high-density molecules. We believe this hybrid computing platform will have great potentials in various fields including but not limited to SRLM.

OGC 2018 – G0033

**Cross Nanoantenna for Fluorescence Enhancement: Giant Intensity Enhancement and Polarization Preservation**

**Li Ma[1,2], Song Sun[1,2], Ru Li[1,2], Huigao Duan[3], Mo Li[1,2]**

[1] Microsystem and Terahertz Research Center, China Academy of Engineering Physics, Chengdu, China; [2] Institute of Electronic Engineering, China Academy of Engineering Physics, Mianyang, China; [3] Hunan University, Hunan, China

***Abstract*** — Development of precision nanoantenna technology for fluorescence enhancement is attractive for a variety of applications like photodetection, nano-imaging and super bright single-photon source. These emergent applications challenge the capability of nanoantenna to manipulate the fluorescence emitter at multi-dimensional levels, including intensity, polarization, and directivity, etc. Previous literatures mainly focus on the intensity enhancement and directivity control because these figures of merits are more visible in the experiment. However, little attention has been paid to the polarization of the emitter, albeit it is particularly important for applications such as protein detection on cell membrane. Here, we use a highly symmetrical cross nanoantenna to enhance the fluorescence intensity while preserving the polarization of the emitter. The cross nanoantenna is made of Au, and fabricated on ITO substrate using electron beam lithography (EBL) technology. The fluorescence emitter is assumed to locate at the middle of gap. The geometry (e.g. arm length, width, gap etc.) of the cross nanoantenna is properly designed to achieve the best balance between the fluorescence excitation rate $\gamma_{\text{exc}}$ and quantum yield $q$, so as to maximize the fluorescence enhancement $FE = (\gamma_{\text{exc}} / \gamma_{\text{exc}}^{0}) \cdot (q / q^{0})$ . An ordinary line nanoantenna is used for comparison. Our preliminary results show that the cross configuration is able to generate consistent fluorescence enhancement 30-50 times for emitters with arbitrary polarizations illuminated by a circular polarized light, whereas the line nanoantenna can only provide a maximum 25 times enhancement at a particular polarization that the emitter aligns parallel to the axis of the line. This proves that the cross nanoantenna is practically more robust than the line counterpart since the emitter is generally randomly oriented in the real situation. On top of that, the defocus imaging calculation has shown that the cross-nanoantenna is able to preserve the polarization of the emitter. For a particular emitter orientation, the resultant defocus-imaging pattern with the cross-nanoantenna is very similar to that of a free emitter, whereas the polarization information is generally lost in the line configuration. Our results indicate that the cross nanoantenna can be widely used as a tool for generating giant fluorescence enhancement as well as preserving the polarization of emission light, which would be beneficial in the biological diagnosis and cell tracking.

## Sub-session 3

## < Infrared Technologies and Applications >

### ---------- Invited ----------

**Monolithically Chip-Integrated Germanium Photonic Devices for Mid-Infrared Applications**

**Zhenzhou Cheng**
The University of Tokyo, Japan

***Abstract*** ─ The mid-infrared (mid-IR) fingerprint spectral region, spanning approximately 8-15 μm, has numerous applications in biochemical sensing and spectroscopy. Traditional mid-IR sensors such as Fourier-transform IR spectroscopy spectrometers are based on bench-top free-space optical systems, suffering from their expensive and bulky instrumentation. To overcome such limitation, photonic integrated circuits (PICs) have been developed in recent years. However, previous PICs are applicable only at wavelengths below 8 μm, which is moderated by the transmittance of waveguide or substrate materials. In this present, I report our recent research progress on the development of monolithically chip-integrated germanium photonic devices for mid-IR applications. Specifically, I discuss chip-integrated focusing subwavelength grating couplers, suspended-membrane waveguides, and high-Q micro/nano cavities on a germanium photonic chip. Our study paves a new way for the development of on-chip mid-IR applications in biochemical sensing and spectroscopy.

**Biography**

Dr. Zhenzhou Cheng is an assistant professor of Physical Chemistry in the Department of Chemistry at the University of Tokyo. He received his B.S. degree in Physics and M.S. degree in Optics from Nankai University in 2006 and 2009. He received his Ph.D. degree in Electronic Engineering from the Chinese University of Hong Kong in 2013. In 2015, he joined Goda Lab in the Department of Chemistry at the University of Tokyo as an assistant professor. In 2018, he was selected in Thousand Talents Program, China. His research interests focus on novel photonic integrated circuits and nanophotonic devices based on Group IV materials for applications in sensing, spectroscopy and nonlinear optics. He has published 49 peer-reviewed journal papers in ***Nature Photonics***, ***Nature Communications***, ***Optics Letters*** *et al.* and received several academic awards such as Young Scientist Award, Hong Kong Institute of Science (2013), Young Scholars Thesis Award, the Chinese University of Hong Kong (2013), and Second-Class Award in Research Achievements, Ministry of Education, China (2014).

**Ultrafast All-fiber Mid-IR lasers**

**Zhengqian Luo**
Xiamen University, China

***Abstract*** ─ At present, most of ultrafast mid-IR lasers are based on optical parametric oscillators or amplifiers using nonlinear optical crystals, resulting in large footprint and complex systems. It is very important to

develop compact ultrafast fiber laser in mid-IR spectral region. However, current mid-IR fiber lasers still largely rely on bulk optical elements for assembling mid-infrared resonators, precluding compact all-fiber structure. Here, our research group propose a few of new methods to develop ultrafast all-fiber mid-IR lasers in the 2-2.5 μm and 2.7-2.9 μm tunable wavelengths. The mid-IR pulse duration can be as short as ~200 fs.

**Biography**

Prof. Luo received the B.S. degree in applied physics from Harbin Institute of Technology in 2004, and the joint Ph.D. degree in electronic and communication engineering from Xiamen University and Nanyang Technological University (Singapore) in 2009. He is currently a Full Professor in the School of Electronic Science and Technology, Xiamen University, China. From 2016 to 2017, he worked at Massachusetts Institute of Technology, as a one-year visiting Professor. His research interests include laser physics, nonlinear fiber optics and on-chip photonics. He is an author or co-author of more than 120 international journal and conference papers, especially 7 papers selected in 'ESI highly-cited papers'. Dr. Luo received the Science Funds for Distinguished Young Scientists of Fujian Province, Young Top Notch Talents of Fujian Province, and the Program for New Century Excellent Talents in Fujian Province, China. He is an IEEE Senior Member and an OSA Member.

**Mid-Infrared Technologies and Opportunities Using Dysprosium-Doped Fluoride Fiber**

**Robert Ian Woodward**
Macquarie University, Australia

***Abstract*** — The mid-infrared (mid-IR) spectral region holds many opportunities for new optical technologies and potentially transformative applications in medicine, manufacturing and defence. To date, however, such applications have been held back by a lack of high-brightness coherent light sources at mid-IR wavelengths with sufficient flexibility and robustness for practical deployment. Rare-earth-doped fluoride fibers are currently emerging as a promising and highly versatile platform for mid-IR laser technology and in the past few years, there has been particularly strong progress using the dysprosium ion, which offers broadband emission from ~2.7-3.5 μm and even has potential to enable a new class of 4 μm fiber lasers. In this presentation, we review the spectroscopy of dysprosium-doped fluoride fibers and present recent developments of compact, high-power, broadly tunable mid-IR sources, in addition to offering an outlook towards further developments and practical applications.

**Biography**

Robert received an MA and MEng in Electronic and Electrical Engineering from Trinity Hall, University of Cambridge (UK) in 2012, followed by a PhD in the area of nonlinear fiber optics and ultrafast laser engineering at Imperial College London (UK). After this he was awarded a one-year EPSRC Doctoral Prize Fellowship, before moving to

Macquarie University (Australia) to take up an MQ Research Fellowship to continue his research into high-power ultrafast fiber lasers, specifically targeting the promising mid-infrared spectral region.

**Tailoring the Responses of Thermal Detectors Using Optical Antennas**

**Fei Yi**
Huazhong University of Science and Technology, China

***Abstract*** — Optical antennas are the electromagnetic antennas in the optical frequencies that can convert the freely propagating optical waves into highly localized optical near fields via the localized surface plasmon resonances(LSPRs) in metallic nanostructures or magnetic resonances (MRs) in dielectric nanostructures. The localized optical energy is dissipated as heat and elevates the ambient temperature of the optical antennas. Besides, optical antennas can resolve the parameters such as the wave front(phase), wavelength and polarization state of the incoming electromagnetic waves at the nanoscale. Therefore, optical antennas provide a versatile and multifunctional platform for artificially manipulating and resolving optical waves. In this talk I will present our recent progress of tailoring the responses of thermal detectors using optical antennas towards spectroscopic analysis.

**Biography**

Dr. Fei Yi received his Bachelor's Degree (2003) and Master's Degree (2006) from Zhejiang University(ZJU), China, and Doctor's Degree (2011) in Electrical Engineering from Northwestern University(NWU), USA. He then worked as a Postdoctoral Researcher at University of Pennsylvania (UPenn) until 2015. He is now an Associate Professor in the School of Optical and Electronic Information (SOEI) at Huazhong University of Science and Technology (HUST), China.

He has authored and co-authored 30 journal papers in high impact journals such as Nature Photonics, Nano Letters, Applied Physics Letters and Optics Express, 1 book chapter and 23 conference papers in international conferences such as Optical Fiber Conference (OFC), Conference on Lasers and Electro-Optics (CLEO) and SPIE Photonics West.

## ---------- Oral ----------

OGC 2018 – G0016

**Fast Classification Algorithm of High-dimensional Tobacco Leaf Near-infrared Spectral Data Based on Deep Learning Method**

**Zhang Jianqiang, Liu Weijuan**
Yunan Reascend Tobacco Technology (Group) Co., Ltd, Kunming, Yunan, China

***Abstract*** — Three different classifiers based on deep learning method are proposed in the paper to classify tobacco leaf near-infrared (NIR) spectral data. All the NIR spectral data of training samples are used to make up a data dictionary of the sparse representation (SR) and the test samples are represented by the sparsest linear combinations of the dictionary by l1-least squares (*l1LS*), non-negative least squares (*NNLS*), l1-non-negative least squares (*l1-NNLS*) three different sparse coding algorithms. Then the regression residual of the

test sample to each class is computed and it is assigned to the class with the minimum residual. The results have also been compared and showed that *l1-NNLS* sparse coding method achieves the best prediction performance over the other methods and it can be very effective for classifying high-dimensional tobacco leaf NIR data.

OGC 2018 – G0019

**A Directional-progressive Search Method for Infrared Small Target Detection**

**Xiangyue Zhang[1,2,3,4], Qinghai Ding[5], Haibo Luo[1,3,4], Bin Hui[1,3,4] , Zheng Chang[1,3,4], Junchao Zhang[1,2,3,4]**

[1] Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang; [2] University of Chinese Academy of Sciences, Beijing; [3] Key laboratory of Opto-Electronic Information Processing, CAS, Shenyang; [4] The Key Lab of Image Understanding and Computer Vision, Liaoning Province, Shenyang; [5] Space star technology co,LTD,Beijing

***Abstract* —** Infrared small target detection plays a key role in infrared precision guidance and infrared early-warning system. It has been a difficult problem for researchers to study on how to detect targets accurately at a long distance as early as possible. Most of the existing algorithms can detect small targets in simple backgrounds, but they would fail on the detection when the background clutters are chaotic and the signal to clutter ratio(SCR) is low. Therefore, we propose a new infrared small target detection method which called a directional-progressive search(DPS) method. Our method derives from a fact that a small target is an isotropic Gaussian distribution at a long distance, while clutters show different characteristics in different directions. Based on this difference, we decompose the original image into first-order sub-images with different directions by using a first-order directional derivative(FODD) filter. Then zero-crossing points are detected in each direction step by step to distinguish small targets and background clutters. After screening progressively, the positions where existing zero-crossing points in every sub-image can be confirmed as targets. Experimental results show that our method acquires higher detection rates and lower false alarm rates compared with other methods. At the same time, our method can still keep better performance under various complex backgrounds. The robustness of our method is strong.

OGC 2018 – G0021

**Infrared Quantum Dot and Quantum Cascade Broadband Superluminescent Light Emitters**

**Hong Mei Chen[1], Chun Cai Hou[1], Jin Chuan Zhang[2], Ning Zhuo[2], Ji Qiang Ning[1], Zhan Guo Wang[2], Feng Qi Liu[2] and Zi Yang Zhang[1]**

[1] Key Lab of Nanodevices and Applications, Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, Suzhou, China; [2] Key Laboratory of Semiconductor Materials Science, Institute of Semiconductors, Chinese Academy of Sciences, P.O. Box 912, Beijing, China

***Abstract* —** Broadband superluminescent light emitters (SLEs) are an edge emitting light sources which utilize the internal amplification of spontaneous emission. SLEs are emerging as the ideal core optical sources for numerous industrial and medical applications, such as in fibre-optic gyroscopes and sensors, in wavelength-division

multiplexing (WDM) system testing, and especially in optical coherence tomography (OCT) systems. Recently, such broadband light sources operating in the near-infrared (NIR) have been successfully employed in OCT for clinical ophthalmology and skin disease diagnosis. However, there is always a trade-off between the high power output and wide spectral bandwidth of SLE devices, therefore it is very challenging to broaden the emission bandwidth (full width at half maximum, FWHM) beyond ~ 100 nm while keeping a high continuous wave (CW) power output of >10 mW. So currently the main challenge for the NIR-OCT imaging technique is to simultaneously widen the bandwidth and increase light power of the light sources, and hence enhance the axial resolution of the images and the penetration depth in tissues. Compounds such as collagen amide, phosphate, and carbonate absorb relatively little within the spectrum covered by existing NIR-OCT systems, so the spectral response to molecular species in the NIR region comprises very weak overtones and combination vibrational absorption bands. In contrast, the mid-infrared (MIR) spectral region is dominated by fundamental absorption bands specifically attributable to these compounds. The characteristic MIR absorption by these biochemical species therefore provides a potentially powerful, sensitive and specific method of imaging tissue like bone, tendon, and stratum corneum of skin. However，the lack of an appropriate MIR-SLE has lead to the absence of MIR-OCT systems. Semiconductor SLEs are compact, robust, and easy to operate lending themselves to low cost mass production, and therefore have great potential to realize such MIR-OCT imaging system.

As described above, although NIR-SLEs have found increasingly wide utilization in these imaging applications, the requirement to simultaneously achieve both a high spectral bandwidth and output power is still challenging for such devices. Due to the relatively weak amplified spontaneous emission, as a consequence of the very short non-radiative carrier lifetime of the inter-subband transitions in quantum cascade structures, it is even more challenging to obtain desirable MIR-SLEs. There have been great efforts in the past twenty years to pursue high-efficiency broadband optical gain and very low reflectivity in waveguide structures, which are two key factors determining the performance of SLEs. In this work, we describe the realization of a high CW light power of >20 mW and broadband width of >130 nm with NIR-SLEs and the first MIR-SLEs operating under CW mode at room temperature by employing a modulation p-doped InGaAs/GaAs quantum dot active region with a "J" shape ridge waveguide structure and a quantum cascade active region with a dual-end analogous monolithic integrated tapered waveguide structure, respectively. This work is of great importance to improve the performance of existing NIR-OCT systems and describes a major advance toward reliable and cost-effective MIR imaging and sensing systems, which do not presently exist due to the lack of appropriate low-coherence MIR-SLEs.

OGC 2018 – G0081

## Large Field of View Binocular Stereo Vision Sensor Calibration Method Based on 3D Virtual Target

**Shoubo Yang and Yang Gao**

Key Laboratory of Precision Opto-mechatronics Technology Minitry of Education, Beihang University, Beijing, China

***Abstract*** — In this paper, to address the problem of high calibration accuracy for the binocular stereo vision sensor of large field of view, a binocular stereo vision sensor calibration method using a three-dimensional virtual target constructed by a precision

two-axis turntable, laser tracker and a single calibration reference point is studied. The precision two-axis turntable drives the camera capturing a fixed single optical reference point to make two-dimensional rotation, which construct a precise reference control field and achieve calibration. The internal and external reference calibration of the binocular stereo vision sensor is automatically and efficiently completed by the program control, so the method does not need to adjust or know the positional relationship between the reference point and the camera or the turntable. The error simulation analysis and calibration experiments verify that the calibration method proposed in this paper has high reliability and calibration accuracy

## Sub-session 2 - A

## < Optical Communication and Networks >

### ---------- Invited ----------

**The Evolution of A New ISP and Recent Development in 5G Technology**

**Gordon K. P. Lei**
MTel Telecommunication Company Limited, China

***Abstract*** **—** In this talk we present the evolution of a new telecommunication company – MTel Telecommunication Company Limited (MTel) in Macau SAR, China. We will introduce the technologies behind, the challenges we have faced, and the future we are making. We will also demonstrate the experimental results of a fiber-based 5G transmission experiment, which is the collaboration results between MTel and Huazhong University of Science and Technology.

**Biography**

Dr. Gordon K. P. Lei received his Bachelor and Doctorate degrees in Department of Electronic Engineering, the Chinese University of Hong Kong in 2007 and 2011, respectively. After graduation, he joined the College of Engineering, Swansea University in Wales, United Kingdom as a research officer from 2013 to 2014. Since 2014, he joined MTel Telecommunication Company Limited as a

consultant in the CEO office, and later promoted to the General Manager of the Project Coordination department. His research focus is mainly on nonlinear optical signal processing and optical parametric amplifiers. Dr. Lei is serving as reviewers for IEEE and OSA journals, and he has authored/co-authored over 50 publications in top-tier journals and conference proceedings.

**Chip-Scale Mode Division Multiplexed System**

**Yu Yu**
Huazhong University of Science and Technology, China

***Abstract*** — To satisfy the exponentially increasing data demand, the mode-division multiplexing (MDM) is becoming more and more attractive, as multiple spatial modes share a single-wavelength link to further improve the communication capacity. We present our recent work on silicon chip-scale MDM system, which includes modulator, detector, multiplexer/demultiplexer and coupler/bending/crossing, as well as switches for mode multiplexed signals.

**Biography**

Yu Yu is currently with Wuhan National Laboratory for Optoelectronics (WNLO), Huazhong University of Science and Technology (HUST), as a Professor. He received the B.S. degree and Ph.D. degree in 2003 and 2009, respectively, both from HUST, Wuhan, China. From 2008 to 2010, he was with the Centre for Photonic Systems, University of Cambridge, U.K., as a Research Associate. Dr. Yu is the author or co-author of more than 100 peer-reviewed journal and conference papers, including 15 invited talks in international conferences. His research interests include Silicon Photonics, Fiber-optics communications and all-optical signal processing.

## ---------- Oral ----------

OGC 2018 – G0003

**Design, Fabrication and Measurement of a Novel Ultra Low Loss 6-LP-Mode Fiber**

**Lei Shen, Lei Zhang, Su Chen, Xueting Sun, Yaping Liu, Jie Luo**
State key Laboratory of Optical Fiber and Cable Manufacture technology, Yangtze Optical Fiber and Cable Joint Stock Limited Company, Wuhan, Hubei, China

***Abstract*** — We report the design, fabrication and measurement of a ultra low loss 6-LP-mode fiber, and the attenuations of all LP modes are less than 0.168dB/km. This FMF can be used in weakly-coupled mode-division-multiplexed systems that allows to multiply the capacity.

OGC 2018 – G0015

**X-ray Detector with High Temporal Resolution by Using Pulse-dilation Technology**

**Houzhi Cai, Wenyong Fu, Dong Wang, and Jinyuan Liu**
College of Optoelectronic Engineering
University of Shenzhen, Shenzhen, China

***Abstract*** — In the inertial confinement fusion (ICF) experiment, the x-ray image is detected by gated microchannel plate (MCP) based detector with temporal resolution of 35-100 ps. The ICF implosion typically lasts

around 100 ps. Therefore, the detailed time history of the burn phase of implosion cannot be captured by such traditional detector. A new detector with better temporal resolution is needed. In this paper, a new x-ray detector is reported by coupling pulse-dilation technique with a traditional detector. This detector uses pulse dilation of an electron signal from a pulsed transmission photo-cathode (PC) to achieve high temporal resolution. While the PC is not applied with pulse
voltage, the measured temporal resolution of the detector without pulse-dilation is about 80 ps. While the excitation pulse is applied on the PC, the measured temporal resolution is improved to 10 ps by using the pulse-dilation technology. The spatial resolution of the dilation x-ray detector is also measured, which is better than 100 μm.

OGC 2018 – G0028

**Optical Spectroscopic Study on 1.3μm InAs/GaAs Quantum Dots and Laser Diodes - Towards High Speed Fiber-optic Communication Applications**

**Qizhu Li, Xu Wang, Ziyang Zhang and Ningji Qiang**
Suzhou Institute of Nano-Tech and Nano Bionics
Chinese Academy of Sciences, Suzhou China

***Abstract*** ─ InAs/GaAs quantum dots (QD) and laser diodes demonstrate outstanding merits of high quantum efficiency, low threshold current and high temperature stability, and hence attract wide attention of both academic and industrial communities especially for their applications in high-speed fiber-optic communications. For high-speed laser applications, a very short cavity length is crucial due to the significantly reduced lifetime of photons. However, owing to the low ground state (GS) gain of QDs, it is very challenging to obtain 1.3μm GS lasing from QD laser diodes with a short cavity length, which severely impedes the high speed application of the device. In this work, with a typical p-i-n configured laser structure of InAs/GaAs self-assembled QDs, we have successfully fabricated a Fabry-Perot laser diode of a very short cavity length of 400μm and a distributed-feedback (DFB) laser diode of 450μm cavity length, which both realize continuous-wave GS lasing at the wavelength of 1.3μm without facet coating. In addition, the QD DFB laser exhibits a high side-mode suppression ratio of >51dB, a high thermal stability of $d\lambda/dT$ = 0.09 nm/K, and a very large wavelength tuning range of >140nm. Improved crystalline and structural quality and delicately modified electronic and optical properties are the key to the as-obtained device performance. Focusing on the p-type doping and rapid thermal annealing effects on the composition and structural properties of the multiple InAs/GaAs QD active layers as well as the surrounding wetting and barrier layers, we investigate the electronic band structure and carries dynamic behaviors in the combined quantum material system by the means of optical spectroscopies and explore the optoelectronic mechanisms governing the crucial material properties and the laser diode performances. This work demonstrates great potential of InAs/GaAs QD lasers for the applications in high-speed fiber-optic communications. spatial resolution of the dilation x-ray detector is also measured, which is better than 100 μm.

OGC 2018 – G0035

**Study on Optical Fiber Sensor for Measurement of Strain Based on Dual Demodulation of Wavelength and Intensity**

**Qin Zhongbao and Gao Ningbo**
Department of mechanical foundation Xian Research Institute of High Technology, Xi'an, China

***Abstract*** — A strain sensor based on wavelength and intensity double demodulation is proposed. The sensor is composed of two sections of fine core cone structure which are connected in cascade. The fine core cone structure is made of single mode optical fiber by dislocation fusion. Through repeated experiments, it is found that when the transverse offset of the two fibers is 40μm and the effective distance between two cone structures is 15mm, the interference spectrum with smooth, large contrast and low loss can be produced. The phase difference of the external environment changes the phase difference between the modes leading to the shift of the transmission spectrum of the interferometer. The wavelength and intensity double demodulation method is used to monitor the spectral drift to calculate the strain change and to realize the strain measurement. The experimental results show that when the strain of the environmental equipment is changed from 0με to 1000με, the characteristic peak wavelength moves in the direction of short wavelength, and the intensity decreases gradually, the sensitivity is -1.28pm/με and -0.007dBm/με, and the linearity is 0.98 and 0.99. The sensor has the characteristics of simple fabrication method, high sensitivity and low cost, and is suitable for strain sensing measurement.

OGC 2018 – G0077

**Dissimilar Single Mode Fiber Splice Appearance in Relation to Splice Quality**

**Zhao Lin[1] and Douglas M. Duke, David W. Mansperger[2]**

[1] Fujikura (China) Co., Ltd. Pudong New Area, Shanghai, China; [2] Fusion Splicing Systems, America Fujikura Limited, Duncan, South Carolina, USA

***Abstract*** — This paper explores issues related to the appearance and performance of fusion splices conducted with dissimilar types of single mode fiber. For long distance telecom networks, dissimilar single mode fiber splices have been used for some time as it is sometimes desirable to mix different types of G.655 non-zero dispersion shifted fibers, and the G.655 fibers will be spliced to standard G.652 fibers at patch panel locations. In recent years, dissimilar SMF splices have become increasingly common throughout telecom networks with the proliferation of bend-insensitive (G.657) fibers types as well as low-loss pure-silica core (G.654) single mode fibers. In splices of dissimilar single mode fibers, there is frequently a vertical shadow or line at the splice point which is visible in the spliced fiber image on the LCD screen of the fusion splicer. We present an explanation of the cause of the visible line, and explore the optical performance as well as the strength and integrity of such dissimilar SMF splices.

## Sub-session 8 - A

## < Fiber-Based Technologies and Applications >

### ---------- Invited ----------

**Nonlinearity of 2D Materials with Silica Microfibers**

**Fei Xu**
Nanjing University, China

***Abstract*** **—** All-fiber nonlinear devices have attracted great interest, however, most of those applications are severely limited because of the challenge of integrating optoelectronic materials onto standard silica fibers. On the other hand, two-dimensional materials (TDMs) exhibit many extraordinary optoelectronic and nonlinear properties, are well suited for integration in not only planar photonic circuits but also optical fibers，especially microfibers. Microfibers with strong evanescent field are attractive for TDM integration. Here we will show several kinds of TDM-microfiber-integrated devices and the optoelectronic and nonlinear applications (e.g., Second harmonic generation and detector) will also be discussed.

**Biography**

Dr. Fei Xu received his Ph.D. in Optoelectronics in 2008 from the Optoelectronics Research Centre, University of Southampton, UK. He is currently a professor at the College of Engineering and Applied Sciences, Nanjing University, China. Dr. Xu's current research interests include developing novel fiber devices for ultra-small sensor and laser systems, the optomechanical effect in nano-scale waveguide systems. He received an award through the Program for New Century Excellent Talents in university run by the Ministry of Education of China, as well as the Program for Excellent Young Scientists run by the National Science Fund of China. To date, he has authored or coauthored 8 book chapters, granted >30 patents (China and US), and >110 peer reviewed articles in academic journals in the previously mentioned areas. His papers have been cited more than 2100 times in Web of Science, and he was invited to give more than 30 talks in international conferences.

**Multicomponent Glass and Fiber for Photonic Applications**

**Shifeng Zhou**
South China University of Technology, China

***Abstract*** **—** Multi-component-glass fibers are considered the building blocks of the next-generation of fiber photonics. In this talk, the recent progress in the design and fabrication of new multi-component-glass and fiber materials will be introduced. Their potential applications for photon generation, manipulation and detection will be highlighted.

**Biography**

Shifeng Zhou is a professor of Materials Science and Engineering at South China University of Technology. He received his PhD degree (2008) in Materials Science and Engineering from

Zhejiang University. He spent one year at the Hong Kong Polytechnic University as a research assistant (2007). Subsequently, he joined Hokkaido University as a postdoctoral researcher (2008-2009), and then moved to Kyoto University as a JSPS postdoctoral fellow (2009-2011). He was an associate professor in Zhejiang University (2011-2013). He has authored or coauthored more than 100 scientific journal papers. He is the recipient of the Motoharu Kurata Award of the Ceramic Society of Japan. His primary research area is photonic glass and fiber.

**Otofluidic Chip for Biological/Chemical Analytic Devices**

**Yi Yang**
Wuhan University, China

***Abstract* —** Optofluidics is a burgeoning technology through the fusion of micro and optics. Optofluidics aims to manipulate light and fluid at microscale,and exploits their interaction to create highly versatile devices and integrated systems. This new research area promotes the advancements in optics, biophysics and biochemistry. To fulfill these emerging demands, in this research program, we propose to investigate and exploit light modulation in heterogeneous media by unique fluid dynamic properties such as diffusion, heat transfer, centrifugation and others, and the interaction between biochemical samples and light in flowing liquids. Solving the scientific problems of the interaction between light and liquid in the optofluidc devices. On this basis, the theoretical results are applied to the research and development of novel optofluidic sensors for the rapid detection and manipulation of living cells or particles. We attempt to understand the novel photonic phenomena due to the interaction of fluids and light and aims to exploit these novel phenomena to provide better solutions to next generation integrated systems in micro-/nano-photonic devices, biological/chemical analytic systems, environment monitoring etc.

**Biography**

Dr Yi Yang is a Professor in School of Physics, Wuhan University. He specializes in the research field of optofluidics. He innovates new designs of optofludic chip and applications integrated with different microfluidic functionalities such as particle sorting, optical trapping etc. He has published 21 journal papers including publications in prestigious journals like *Nat. Commun.*, *Lab Chip.*, *Laser Photonics Review*., *Optica, ACS Photonics*. Dr Yi Yang was awarded the Thousand Youth Talents award in 2013 and he also worked as a Guest Editor of the Lab on a Chip and was awarded Emerging Investigators.

## ---------- Oral ----------

OGC 2018 – G0004

**Design and Application of Erbium-doped Photonic Crystal Fiber for Superfluorescent Fiber Source**

**Li Zhang, Xu Wu, Chengxiang Liu**
Shenzhen University, Shenzhen, China

***Abstract* —** An erbium-doped photonic crystal fiber (EDFCF) designed for superfluorescent fiber source is reported. The proposed EDPCF is composed of an erbium-doped core and a cladding with seven rings of air holes arranged in a circular structure. The full-vector

finite-element model of the EDPCF has been established and the relevant characteristics have been demonstrated via simulations. Using anisotropic perfectly matched layer as an absorbing boundary condition, the confinement loss $5.27\times10^{-12}$dB/m has been calculated, which is far below the level of 0.01dB/km. Furthermore, the splice losses between EDFCF and two type step-index fibers have been estimated and it implies that the design fulfils low splice loss conditions theoretically. The designed EDFCF has been fabricated successfully. The experiment has been carried out to evaluate the splice losses between the EDFCF and the common single mode fibers. It is turned out that using manual aligning mode of the fiber fusion splicer can obtain lower splice loss than using automatic aligning mode for PCF splice. The EDFCF has been applied in the superfluorescent light source as the plus medium.

OGC 2018 – G0007

**Application Research of FBG Vibration Sensor used for Perimeter Security**

**Meng Wang, Zhihui Sun, Fangxiang Zhang,Li Min,Shujuan Li,Shaodong Jiang**
Laser Institute,Qili university of Technology (Shandong Province Academy of Sciences)
Jinan,Shandong,China

***Abstract*** — Perimeter security is the first line of defense to protect the important facilities and assets. The peripheral security technology and method of high performance can eliminate or reduce the threat from the outside world. In this paper, we design a high sensitivity vibration sensor applied to perimeter security based on the principle of FBG (fiber Bragg grating) vibration sensitivity. The sensor was tested by a demodulator OPD4000 for its sensitivity and frequency response. The frequency response range is from 5 to 80 Hz and acceleration of the FBG vibration sensor is over 1000pm/g. A phase generated carrier(PGC) demodulator based on an unbalanced Michelson interferometer was proposed. The vibration sensor and the demodulator are tested in the field and the experimental data are presented.

OGC 2018 – G0023

**Time Delay Measurement in Optical Fibers Based on Phase Detection**

**Xinxin Huang, Feifei Yin, Jianqiang Li, Yitang Dai, Yue Zhou, and Kun Xu**
State Key Laboratory of Information Photonics and Optical Communications Beijing University of Posts and Telecommunications, Beijing, China

***Abstract*** — We developed an efficient and accurate fiber transfer delay measurement system. The main principle is to convert the fiber transfer delay in time domain into the phase detection, and eliminating the ambiguity by frequency scanning, followed with data process to get the result. This system has a resolution of picosecond, with an accuracy of 4 picosecond and a dynamic range of 40km. We also presented an uncertainty analysis and the implementation required to achieve results of the highest accuracy.

OGC 2018 – G0027

**Application of FBG Sensor for Low Frequency Vibration Monitoring in Hydroelectric Generating**

**Li Shujuan, Min Li, Zhang Xiaolei, Zhang Faxiang, Sun Zhihui, Wang Meng,**
Laser Research Institute, Qilu University of Technology (Shandong Academy of Sciences)

Jinan, China

***Abstract*** — Based on fiber Bragg grating, we design a low-frequency vibration monitoring system for hydrogenating set Fiber grating sensors are installed in the hydrogenating unit. The vibration signal of the hydro-generator can be acquired. We can judge the running state of hydro-generator unit. The application showed that the fiber grating sensing and monitoring system can timely and accurately report the status of hydrogenating unit.

OGC 2018 – G0039

**The Test System of DFB Fiber Laser Hydrophone Acoustic Pressure Sensitivity**

**Jia Liu, Yuanyuan Yang, Zhihui Sun, Xiaolei Zhang**

Laser Institute Qilu University of technology (Shandong Academy of Sciences) Jinan, China

***Abstract*** — Acoustic pressure sensitivity is an important indicator of hydrophone. This paper introduced the composition of the test system of DFB fiber laser hydrophone acoustic pressure sensitivity, detailed explanation of every steps, highlighted matters needed attention in the testing process, illustrated the usage of main equipment involved, and finally gave method for generating frequency response curve of the hydrophone. In testing of hydrophone, the system has a certain degree of versatility and practicality.

# DAY 2｜ Sep 6, 2018

| S4-B < Precision Optics > ( Venue: Lotus Hall 6, 5th F, SZCEC ) | | |
|---|---|---|
| Chair: Yuegang Fu, Zhiying Liu | | |
| 09:00-09:25 | Invited | **Regulating Structural Freedom for Multifunctional Metasurfaces: Holograms and Color Prints**<br>Xiangping Li｜Jinan University |
| 09:25-09:40 | G0041 | **Liposomal Iodinated CT Imaging Contrast Agent and Photosensitizer for Dual Model Imaging and Enhanced Photodynamic Therapy**<br>Hao Xu,Tymish Y.Ohulchanskyy,Junle Qu and Zhen Yuan｜University of Macau,China |
| 09:40-09:55 | G0058 | **Ultrasmall Ag-Fe-Se Ternary Nanocrystals: A New All-in-one Theranostic Platform for Bimodal Imaging Guided Photothermal Therapy of Cancer**<br>Qiang Wu, Liwei Liu, and Junle Qu｜Shenzhen University, China |
| 09:55-10:25 | Coffee Break | |
| 10:25-10:50 | Invited | **Fast Laser 3D Printing at Nanoscale**<br>Han Lin｜Swinburne University of Technology, Australia |
| 10:50-11:05 | G0087 | **Tracking and Position of Drogue for Autonomous Aerial Refueling**<br>Jingyu Zhang｜Beihang University, China |
| 12:00-13:30 | Lunch | |
| S7-A < Biophotonics and Biomedical Optics > ( Venue: Lotus Hall 2, 5th F, SZCEC ) | | |
| Chair: Tymish Y. Ohulchanskyy | | |
| 09:00-09:25 | Invited | **A Large, Switchable Optical Clearing Skull Window for Cerebrovascular Imaging**<br>Dan Zhu｜Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China |
| 09:25-09:50 | Invited | **Noninvasive Monitoring of Nanoparticle Clearance and Aggregation in Blood Circulation by in Vivo Flow Cytometry**<br>Xunbin Wei｜Shanghai Jiao Tong University, China |
| 09:50-10:15 | Invited | **NIR-II Fluorescence in Vivo Functional Bio-imaging**<br>Jun Qian｜State Key Laboratory for Modern Optical Instrumentation, Zhejiang University, China |
| 10:15-10:45 | Coffee Break | |
| Chair: Xunbin Wei | | |

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| 10:45-11:10 | Invited | **Bessel Brain-wide light-sheet fluorescence microscopy for high-resolution, isotropic imaging of ultra-fine neural structures**<br>Peng Fei｜Huazhong University of Science and Technology, Wuhan, China |
| 11:10-11:25 | G0096 | **Label-free Imaging on Cellular Level with Stimulated Raman Scattering Microscopy**<br>Yuanzhen Suo｜Peking University, China |
| 11:25-11:40 | G0006 | **AIEgen assisted STED Nanoscopy and Its Application for Dynamic Mitochondrial Visualization**<br>Dongyu Li｜Zhejiang University,China |
| 11:40-11:55 | G0090 | **Near Infrared Spectroscopy in the Noninvasive Assessment of Brain Death**<br>Ting Li｜Chinese Academy of Medical Science and PUMC, China |
| 11:55-12：10 | G0032 | **Study on The Key Technology of Preparing Individual Soldier Camouflage Ointment**<br>Jie Li, Heng Liu, Pu Zou, Xiaodong Chen, Jianxing Zhu and Fu Zuo｜Army Engineering University of PLA, China |
| 12:10-12:25 | G0002 | **Temperature correction and composite dielectric layer for optimization of plasmon waveguide**<br>Dongzhi Li｜Shenyang University of Technology,China |
| 12:30-13:30 | Lunch | |
| S2-B < Optical Communication and Networks ><br>( Venue: Lotus Hall 4, 5th F, SZCEC ) | | |
| Chair: Ming Tang | | |
| 09:00-09:25 | Invited | **A Pair of Equations More Precise Than the Uncertainty Principle, and Study on Modulation formats and PIC in Optical Communication and Human Retina**<br>Anhui Liang｜Guangdong University of Technology |
| 09:25-09:40 | G0047 | **Cross-task Dynamic Load Balancing Strategy**<br>Ming Chen｜Zhejiang University, China |
| 09:40-09:55 | G0055 | **Second Harmonics Generating Based on A Silicon Microring Modulator**<br>Lin Gui, Yushuang Zhu, Yaoyu Cao, Jiancun Zuo｜Shanghai Polytechnic University, China |
| 09:55-10:25 | Coffee Break | |
| 10:25-10:50 | Invited | **Silicon Photonic Devices for Optical Communication**<br>Tao Chu｜Zhejiang University |
| 10:55-11:10 | G0069 | **Design of Pointing-structure Optical Terminal for Network Communication Test**<br>Xiaoming Li｜Changchun University of Science and Technology, China |
| 11:10-11:25 | G0076 | **FBG Strain Sensor Applied in Harsh Environment of Aerospace**<br>Yifei Pei｜Beijing Institute of Spacecraft Environment Engineering, China |

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| 11:25-11:40 | G0083 | **Research and Test of Vehicle-mounted Laser Communication**<br>Lixin Meng｜Changchun University of Science anf Technology, China |
| 12:00-13:30 | Lunch | |
| S6-A < Optoelectronic Devices and Applications ><br>( Venue: Lotus Hall 5, 5th F, SZCEC ) | | |
| Chair: Baojun li | | |
| 09:00-09:25 | Invited | **Mesoscopic and Microscopic Strategies for Engineering Plasmon Enhanced Raman Scattering**<br>Zhiyuan Li｜South China University of Technology, China |
| 09:25-09:40 | G0017 | **Actively Dual-mode Distributed Feedback Laser and Passively Q-switched Dual-mode Fiber Laser towards Terahertz Applications**<br>Xu Wang｜Suzhou Institute of Nano-Technology and Nano-Bionics, CAS, China |
| 09:40-10:10 | Coffee Break | |
| 10:10-10:35 | Invited | **Single Mode Operation and Optical Bistability for Coupled-Cavity Semiconductor Lasers**<br>Yongzhen Huang｜University of Chinese Academy of Sciences, China |
| 10:35-10:50 | G0031 | **Domestically Designed Integrated Silicon-based Module for Coherent Optical Transmission Network**<br>Zhiqiang Tong｜Fiberhome Telecommunication Technologies Co., LTD, China |
| 10:50-11:05 | G0042 | **Development of high gain and low noise microchannel plate**<br>Shanli Wang｜China Building Materials Academy, China |
| 11:05-11:20 | G0052 | **High-visibility Fiber in-line Cascaded F-P Resonators Fabricated by Femtosecond Laser Assisted Chemical Etching for RI Sensing**<br>Peng Zhou, Zhengyong Li, Changrui Liao and Yiping Wang｜Shenzhen University, Shenzhen, China |
| 11:20-11:35 | G0056 | **An Ultrafast Responsed Photodetector Based on CsPbI2Br Fabricated in Low-temperature**<br>ChaoJie Qin, Ting Zhang and Shibin Li｜University of Electronic Science and Technology of China(UESTC), China |
| 12:00-13:30 | Lunch | |
| S6-B < Optoelectronic Devices and Applications ><br>( Venue: Lotus Hall 6, 5th F, SZCEC ) | | |
| Chair: Qin Cheng | | |
| 13:30-13:55 | Invited | **High-speed Silicon Optical Modulators for Data Center Networks**<br>Lin Yang｜State Key Laboratory of Integrated Optoelectronics, CAS, China |

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| 13:55-14:20 | Invited | **Silicon Nanophotonics for On-Chip Light Manipulation**<br>Daoxin Dai｜Zhejiang University, China |
| 14:20-14:35 | G0057 | **In Vitro on-chip Oxygen Sensing Platform for Study the Hypoxia Effect on Tumor Cells**<br>Yihua Zhao, Liang Hong, Shaoqiang Li, Liwei Liu and Junle Qu｜Shenzhen University, China |
| 14:35-14:50 | G0060 | **Non-volatile Optical Switch Based on a GST-loaded Directional Coupler**<br>Hanyu Zhang｜Shanghai Jiao Tong University |
| 14:50-15:20 | Coffee Break | |
| 15:20-15:45 | Invited | **Development of GaN-based Blue and Green Laser Diodes**<br>Jianping Liu｜Suzhou Institute of Nano-Tech and Nano-Bionics, CAS, China |
| 15:45-16:00 | G0063 | **Direct Electrical Read-Out Plasmonic Sensor via Ultra-Narrow Lattice Mode Resonance and Broad-Band Photon Conversion Extending to SWIR**<br>Long Wen and Qin Chen｜Institute of Nanophotonics, Jinan University, China |
| 16:00-16:15 | G0064 | **Experimental Research on Silicon Optical Waveguide and Focus Coupling Grating**<br>Piaopiao Gao｜College of Mechanical and Electrical Engineering, Central South University, China |
| 16:15-16:30 | G0065 | **SNOM (Near-field scanning optical microscopy) on InGaAsN Quantum Wells: A new perspective of laser annealing**<br>M.S.Sharma,S.Younis, D.Balestri, D.M.Di Paola, N.Balakrishnan, F.Biccari, M.Felici, M.Capizzi, A.Patane and A.Polimeni｜University of Rome, Rome, Italy |
| 18:30-20:00 | Dinner | |
| S1-A < Laser Technology ><br>( Venue: Lotus Hall 2, 5th F, SZCEC ) | | |
| Chair: Tianye Huang | | |
| 13:30-13:55 | Invited | **Control and Diagnosis of Laser Plasma Dynamics in Laser Wakefield Accelerators and High Harmonic Sources**<br>Zhengyan Li｜Huazhong University of Science and Technology, China |
| 13:55-14:20 | Invited | **All-Optical Thermo-Optic Devices Based on 2D Materials**<br>Kan Wu｜Shanghai Jiao Tong University, China |
| 14:20-14:35 | G0008 | **Design and Implementation of Laser Beam Monitoring System for Day-Time KHz Satellite Laser Ranging**<br>Ning An, Yuan Liu, Cheng-Zhi Liu, Guan-Yu Wen, Lei Ma, Hai-Tao Zhang ｜Changchun Observatory, National Astronomical Observatories, China |

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| 14:35-15:05 | Coffee Break | |
| 15:05-15:20 | G0026 | **Research on the Characteristics of Optoacoustic signal induced by Optical breakdown**<br>Ju Zhou｜QianXuesen Laboratory of Space Technology, China |
| 15:20-15:35 | G0034 | **Numerical Investigation of Conversion Factors for The Laser Simulation of Dose Rate Effects**<br>Ge Tang｜Chongqing University, China |
| 15:35-15:50 | G0038 | **Study on Spherical Aberration in the Laser Optical System**<br>Heng Jiang and Junfei Zhuang｜Army Engineering University of PLA, China |
| 15:50-16:05 | G0040 | **An Adaptive Quantum Receiver for Binary Coding Signals Outperforming the Standard Quantum Limit**<br>Fei Dong｜University of Science and Technology of China, China |
| 18:30-20:00 | Dinner | |
| S5 < Lightings and Displays ><br>( Venue: Lotus Hall 4, 5th F, SZCEC ) | | |
| Chair: Xiaowei Sun | | |
| 13:30-13:55 | Invited | **Resolution Enhancements for Three Dimensional Holographic Display**<br>Liangcai Cao｜Tsinghua University, China |
| 13:55-14:20 | Invited | **Flexible Organic Light-Emitting Diodes by Minimizing the Waveguide and Plasmonic Losses**<br>Jianxin Tang｜Soochow University, China |
| 14:20-14:35 | G0024 | **Reconstruction of Color Mixing Model Using Tunable Light-Emitting Diode With Unequal Radiated Power**<br>Revantino｜Institut Teknologi Bandung (ITB) / Center for Material and Technical Product (B4T), Indonesia |
| 14:35-14:50 | G0049 | **Miniaturized LEDs for Displays and Instrumentations**<br>Zheng Gong, Jiucheng Liu, ZhangXu Pan, Yanfeng Gong, Xiaoyan Liu and Zhitao Chen｜Guangdong Academy of Sciences, China |
| 14:50-15:20 | Coffee Break | |
| 15:20-15:45 | Invited | **The Principle and Realization of No Visual Fatigue 3D Display with Glasses-Free based on Nanotechnologies**<br>Linsen Chen｜Soochow University, China |
| 15:45-16:10 | Invited | **Carbon Electronics for Information Storage and Displays**<br>Juqing Liu｜Nanjing Tech University, China |
| 16:10-16:25 | G0053 | **Novel Super Resolution Method Based on the Principle of Single-pixel Imaging**<br>Wei Zhang,Zhigang Yang and Junle Qu｜Shenzhen University, Shenzhen, China |

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| 16:25-16:40 | G0061 | **Nosie-Corrected Compressed Sensing Localization Nano-Microscopy for Ultra-High Dense Labeling in live cell**<br>Bingling Chen, Zhigang Yang, and Junle Qu｜Shenzhen University, China |
| 16:40-16:55 | G0078 | **On-line Detection of Pantograph Offset based on Deep Learning**<br>Luonan Chang｜Beihang University, China |
| 16:55-17:10 | G0079 | **A Pantograph Horn Detection Method Based on Deep Learning Network**<br>Yuan Shen｜Beihang University,Key Laboratory of Precision Opto-mechatronics Technology, Ministry of Education, China |
| 17:10-17:25 | G0080 | **Global Calibration of Two Cameras with Optical Filter with Non-overlapping Views Using 1D Square Serrated Target**<br>Dong Li｜ Beihang University, China |
| 18:30-20:00 | Dinner | |
| S8-B < Fiber-Based Technologies and Applications ><br>( Venue: Lotus Hall 5, 5th F, SZCEC ) | | |
| Chair: Changrui Liao | | |
| 13:30-13:55 | Invited | **SLM-based High-Efficiency 3D Femtosecond Laser Microfabrication for Microoptical and Microfluidic Devices**<br>Dong Wu｜University of Science and Technology of China, China |
| 13:55-14:20 | Invited | **Short Pulses Fiber Lasers based on Tilted Fiber Gratings**<br>Chengbo Mou｜Shanghai University, China |
| 14:20-14:35 | G0068 | **Microwave Photonic Antenna for Fiber Radio Application**<br>Wang Lan｜Beijing University of Posts and Telecommunications, China |
| 14:35-14:50 | G0072 | **A Fiber-tip Fabry-Perot Sensor with Oil-sealed Thin-film Silica Microbubble Configuration for Temperature Sensitivity Enhancement**<br>Guanjun Wang, Mengxing Huang, Jianning Han,Shubin Zhang, YuhangLi, Jinyu Gu, Jinrong Liu and Kaiwei Jiang｜Hainan University, China |
| 14:50-15:20 | Coffee Break | |
| 15:20-15:45 | Invited | **Photoacoustic Imaging with Fiber-laser-based Ultrasound Sensors**<br>Long Jin｜Jinan University, China |
| 15:45-16:10 | Invited | **Three-dimensional Manipulation based on Hybrid Photothermal Waveguides**<br>Xiaobo Xing｜South China Normal University, China |
| 16:10-16:25 | G0085 | **High Sensitivity Sensing of Low Concentration Solution of -S Tapered Fiber Based on Maher Zed Interferometer**<br>Dujusn Yang,Hun Zhu,Yunxu Sun, Zhiwei Lu and Huazhen Xu｜The School of Electronic and Information Engineering, Harbin Institute of Technology,China |

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| 16:25-16:40 | G0089 | **The Research of Vibration Monitoring System for Transformer Based on Optical Fiber Sensing**<br>Min Li ｜Laser Institute, Qilu University of Technology (Shandong Academy of Sciences), China |
| 18:30-20:00 | Dinner | |

## Sub-session 4 – B

## < Precision Optics >

## ---------- Invited ----------

### Regulating Structural Freedom for Multifunctional Metasurfaces: Holograms and Color Prints

**Xiangping Li**
Jinan University

***Abstract*** **—** Metasurfaces, composed of arrays of nanostructures with exquisitely tailored geometries, have offered unprecedented prospects for light management and wavefront shaping. The captivation is built upon the know-hows by establishing the "library" of subwavelength meta-atoms with various complex two-dimensional (2D) geometries with a uniform flat-profile. With the miniaturized footprint and engineered structural sensitivity to wavelength and polarization, the emerging metasurfaces have revolutionized the design of lenses, holograms, illusionary optics and color prints. In the conventional wisdom, diverse arrays of such 2D nanostructures could be optimized to yield various functionalities of interest, and consequently great efforts have been concentrated on 2D geometries with meticulous designs. However, the 2D geometry offers limited structural freedom to achieve advanced funtionalities. In this paper, we reveal that formulating the structural freedom of meta-atoms in three dimensions could empower superior functionalities such as complex wavefront control, dispersion free and angular anisotropy. By controlling the displacements between adjacent meta-atoms with identical geometries and their orientations, we showcase that the amplitude, phase and polarization of the diffracted beam can be completely and continuously shaped. By reproducibly producing nanostructures with delicate 3D profiles, angularly-anisotropic coloration and crypto-image can be demonstrated.

**Biography**

Dr. Xiangping Li is focused on nanophotonic techniques for high capacity optical information technologies including optical multiplexing, plasmonics and superresolution microscopy. Dr. Li has published over 60 internationally referred journal publications including Science, Nature Photonics, and Nature Communications. Dr. Li is a recipient of a number of prestigious awards including the Australian Postdoctoral Fellow funded by Australian Research Council in 2011, Swinburne's Vice Chancellor Award for early career researcher in 2012, Victoria Fellowship in 2013, Discovery Early Career Researcher Award by Australian Research Council in 2014, China's Young 1000 talents Award in 2015 and Distinguished Young Scholars from National Natural Science Foundation of China in 2015. He joined the Institute of Photonics Technology in Jinan University as a full professor and found the nanophotonic devices group in 2015.

### Fast Laser 3D Printing at Nanoscale

**Han Lin**
Swinburne University of Technology, Australia

***Abstract*** **—** The ever increasing demand for fabrication of structures with micro/nanometer

scale and feature size compels the 3D laser printing at nanoscale. In the 3D laser nanoprinting system, the optical sensitive material is manufactured by introducing a localized physical or chemical change in the ultra-small focal volume with a tightly focused laser beam, which has become a powerful tool in flexible 3D micro/nanostructure manufacturing; however, the manufacturing speed is low as a result of the limitation of the light steering devices. In order to speed up the printing process and enhance the power efficiency of the 3D laser nanoprinting technique, we developed a principle to enhance the optical resolution and accelerate the processing speed of the laser 3D nanoprinting, which leads an enhancement in printing speed for hundreds of times. That opens the new horizon for 3D laser nanoprinting for the fabrication of micro/nanoscale devices in broad range of applications.

**Biography**

Dr Han Lin got his master degree in Xiamen University and PhD in Swinburne University of Technology in Australia. He has dedicated interest and substantial experience in the research on laser physics, optics, photonic nanomaterial and nanophotonic devices design and fabrication. He has expertise in optical system design and dynamic control of light-matter interaction in an ultrafast process for 3D laser nanoprinting. He has developed a principle to enhance the optical resolution and accelerate the processing speed of the 3D laser nanoprinting, which leads to broad applications in all related research fields.

## ---------- Oral ----------

OGC 2018 – G0041

**Liposomal Iodinated CT Imaging Contrast Agent and Photosensitizer for Dual Model Imaging and Enhanced Photodynamic Therapy**

**Hao Xu, Tymish Y. Ohulchanskyy, Junle Qu and ZhenYuan**

Shenzhen University, College of Optoelectronic Engineering, Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, Shenzhen , Guangdong, CN; Bioimaging Core, Faculty of Health Sciences, University of Macau, Taipa, Macau SAR, CN

***Abstract* —** Guiding photodynamic therapy (PDT) by fluorescence imagine (FI) and X-ray computed tomography (CT) image can realize a precise theranostics in tumor therapy. In our research, clinical iodinated CT imaging contrast agent (CTIA) and commercial photosensitizer (PS) were co-encapsulated in biocompatible PEGylated nanoliposome (CPNL) for FI and X-ray CT dual-model imaging and PDT. It was found that iodinated CTIA can enhance the PDT efficiency by means of the intraparticle heavy-atom effect on PS. Meanwhile, in-vivo FI and CT imaging study demonstrated significant accumulation of CPNL both within and among individual tumor during long term monitoring. CPNL have shown great potentials as a diagnosis and treatment agent for theranostic pharmaceutical drug.

OGC 2018 – G0058

**Ultrasmall Ag-Fe-Se Ternary Nanocrystals: A New All-in-one Theranostic Platform for Bimodal Imaging Guided Photothermal Therapy of Cancer**

**Qiang Wu, Liwei Liu, and Junle Qu**
Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, College of Optoelectronic Engineering, Shenzhen University, Shenzhen, China

***Abstract* —** Silver-based binary chalcogenides have very promising potential as multifunctional theranostic reagent for photothermal treatment of tumors. However, the design and synthesis of silver-based ternary chalcogenides for cancer theranostics remains challenging. In this work, multifunctional ultrasmall Ag-Fe-Se (AFSe) ternary nanocrystals (NCs) with the size of ~ 6.5 nm are synthesized by an environmentally friendly aqueous method under ambient conditions. Take advantage of the nearinfrared (NIR) absorbance and the high *r*2 relaxivity of the as-prepared ultrasmall AFSe NCs, *in vivo* bimodal imaging of photoacoustic/magnetic was carried out, showing efficient tumor accumulations of AFSe NCs after intravenous injections. *In vitro* and *in vivo* photothermal therapy were then conducted for cancer therapy under the irradiation of an 808-nm laser at a safe power density of 1 W cm-2 and the growth of tumors were highly inhibited. Histological analysis revealed no pathological change and inflammatory response in heart, liver, spleen, lung or kidney of the treated animals. The low-toxicity, excellent capability for bioimaging and highly efficient phothermal therapy property of AFSe NCs illustrated in this work enable them to be an ideal all-in-one nanotheranostic platform for cancer theranostics.

OGC 2018 – G0087

**Tracking and Position of Drogue for Autonomous Aerial Refueling**

**Jingyu Zhang and Zhen Liu**
Key Laboratory of Precision Opto-mechatronics Technology Minitry of Education Beihang University Beijing, China

***Abstract* —** In order to achieve autonomous aerial refueling, in this paper, we propose a method to solve the position and orientation of drogue based on stereo vision. The method can be mainly decomposed into three stages: initialization stage, tracking stage, and calculation stage. The pre-training model and the binocular constraint are used to initialize the position of drogue. Through the information fusion method, the position of drogue in each pair of images acquired by the binocular camera is located. After positioning the drogue, the center point of the ring region of the drogue is calculated by matching key points in binocular vision. The characteristics of this system is that it can operate simply and be easy to transplant which makes it apply widely. This system doesn't need to add cooperation logo on the drogue, which is convenient and feasible in actual projects. The method was carried out on a pair of ABB robots, and the experimental results demonstrate the effectiveness of proposed method

# Sub-session 7 – A

# < Biophotonics and Biomedical Optics >

## ---------- Invited ----------

### A Large, Switchable Optical Clearing Skull Window for Cerebrovascular Imaging

**Dan Zhu**
Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China

***Abstract*** — Intravital optical imaging provides a significant tool for investigating cerebrovascular structure and function. However, its imaging contrast and depth are limited by the turbid skull. Tissue optical clearing has great potential for solving this problem. In this presentation, we will report an easy-to-handle, large, switchable, and safe optical clearing skull window without performing a craniotomy, which was just topically applied of skull optical clearing agents. The skull window could be used on 2-8-month-old mice and could be expanded from regional to bi-hemispheric, which enhanced both the contrast and the depth. In addition, the window could be repeatedly established without inducing observable inflammation and metabolic toxicity. Thus, it has the potential for use in basic research on the physiological and pathologic processes of cortical vessels.

**Biography**

Dr. Dan Zhu is an active researcher in the field of biomedical photonics. She has led the efforts towards the in vivo tissue optical clearing. After having investigated mechanisms of tissue optical clearing, she developed switchable skin/skull optical clearing window by topical treatment of optical clearing agents, which can access to neuron, cells, vascular structure and function with high resolution. She has hold more than 150 research articles and 5 Chinese patents. During the past years, she made more than 30 invited presentations in the international conference. In addition, Dr. Dan Zhu has served the professional community. As the Vice-President & Secretary General of Biomedical Photonics Committee of Chinese Optical Society: To enhance academic communication, she organized more than 50 international and domestic conference as the Chair, Organizer Committee Chair, Program Committee Member, or Secretary. She is also the Member of Editorial Board of *Scientific Reports, Journal of Innovative Optical Health Sciences(JIOHS), Frontier of Optoelectronics (FOE), Journal of Biomedical Photonics & Engineering*, and Guest Editor of *Journal of Biomedical Optics; Photonics & Lasers in Medicine; JIOHS and FOE.*.

### Noninvasive Monitoring of Nanoparticle Clearance and Aggregation in Blood Circulation by in Vivo Flow Cytometry

**Xunbin Wei**
Shanghai Jiao Tong University, China

***Abstract*** — Nanoparticles have been widely used in biomedical research as drug carriers or imaging agents for living animals. Blood circulation is crucial for the delivery of nanoparticles, which enter the bloodstream through injection, inhalation, or dermal

exposure. However, the clearance kinetics of nanoparticles in blood circulation has been poorly studied, mainly because of the limitations of conventional detection methods, such as insufficient blood sample volumes or low spatial-temporal resolution. In addition, formation of nanoparticle aggregates is a key determinant for biocompatibility and drug delivery efficiency. Aggregation behavior of nanoparticles in blood is studied using dynamic light scattering in serum or serum protein solutions, which is still very different from in vivo condition. In this work, we monitored the dynamics of nanoparticle concentration and formation of nanoparticle aggregates in the bloodstream in live animals using in vivo flow cytometry. The results indicated that nanoparticles in smaller size could stay longer in the bloodstream. PEG-modification could prolong circulating time and reduce the formation of aggregates in the blood circulation. Our work shows that IVFC can be a powerful tool for pharmacokinetic studies of nanoparticles and other drug carriers, assessing cell-targeting efficiency, as well as potentially measuring cardiac output and hepatic function in vivo.

**Biography**

Prof Wei obtained his BS in Physics from University of Science and Technology of China in 1993. He received his Ph.D. in Biophysics from University of California at Irvine in 1999. He had been a Postdoc fellow at Harvard Medical School, and a faculty member at Wellman Center for Photomedicine, MGH. Dr. Wei was a professor at Department of Chemistry in Fudan University from 2006 to 2010. He joined Shanghai Jiao Tong University (SJTU) in 2011 and currently is the head of the Optical Molecular Imaging Laboratory and distinguished professor in School of Biomedical Engineering. Prof. Wei has authored and co-authored more than 80 papers in peer reviewed scientific journals, including *Nature*, *PNAS*, and *Nature Communications*. Dr. Wei received the National Outstanding Young Scientific Investigator Award in 2014. Currently he is an SPIE Fellow and Associate Editor of *Cytometry Part A* (IF=3.71). His research interests include early detection of cancer and treatment of Alzheimer's disease by optical methods.

## NIR-II Fluorescence in Vivo Functional Bio-imaging

**Jun Qian**
State Key Laboratory for Modern Optical Instrumentation, Zhejiang University, China

***Abstract*** — Fluorescence bioimaging in the second near-infrared spectral region (NIR-II, 1000-1700 nm) can provide advantages of high spatial resolution and large penetration depth, due to low light scattering. In addition, since long-wavelength light with low photon energy is utilized as the excitation and less absorbed by the biological tissues, NIR-II fluorescence bioimaging also has low autofluorescence, as well as negligible photodamage towards biosamples. During the past five years, NIR-II fluorescence bioimaging has experienced rapid development. In this talk, I will introduce some recent research works about NIR-II fluorescence bioimaging in our group, such as video-rate brain angiography, gastroenterography/cystography, as well as diagnosis and imaging guided treatment.

**Biography**

Dr. Jun Qian received his bachelor and Ph.D.

Degrees from the Department of Optical Engineering of Zhejiang University in 2004 and 2009, respectively. He worked at Prof. Paras Prasad's Group in the University at Buffalo as a visiting scholar during the years 2006~2007. He is now a professor in the College of Optical Science and Engineering, Zhejiang University. Dr. Qian's research focuses on Nano-Bio-Photonics, especially nanoparticle-assisted optical functional bioimaging. He has published over 60 peer-reviewed journal papers. Dr. Qian is the principle investigator of several research projects, including the Zhejiang Natural Science Funds for Distinguished Young Scholar, National Natural Science Foundation of China, sub-projects of the National Basic Research Program of China (973 Program) and the National High Technology Research and Development Program (863 Program).

**Bessel Brain-wide light-sheet fluorescence microscopy for high-resolution, isotropic imaging of ultra-fine neural structures**

**Peng Fei**
Huazhong University of Science and Technology, Wuhan, China

***Abstract*** **—** Study of the brain is the hottest topic in neuron science. The complex functionalities of brain is highly from its complicated neuron structures (circuits). For better understanding how the brain works, it is crucial to map the neuron network at whole brain level, with high resolution. Among a variety of optical brain imaging techniques, such as serial two photon tomography (STP), micro-optical sectioning tomography (MOST), light-sheet fluorescent microscopy (LSFM) has recently emerged for its advantages of high-throughput and low photo-bleaching. However, compared to STP or MOST, its relatively low axial resolution at whole-brain scale limits its application for visualizing the neural connections in the brain, at subcellular level.

We hereby develop a Bessel brain-wide light-sheet fluorescence microscopy (2B-LSFM) for high-resolution, isotropic imaging of ultra-fine neural structures. Merely using continuous wave laser combined with large apex axicon, large aperture lenses, and tightly-synchronized confocal slit of camera, we final realize superior scanning Bessel light-sheet illumination on whole mouse brain, with 2 cm-long working distance, 2 mm-wide coverage and only 1 μm-sharp excitation at the vicinity of the focal plane. Using 2B-LSFM, we obtain the 3-D connections of the giant pyramidal neurons in a whole mouse brain, including their tip dendrites and long axon projections, with an isotropic voxel resolution of 0.5 by 0.5 by 0.5 μm. Compared to the hyperbolic Gaussian laser-sheet which is the mainstream of LSFM, our 2B method improves the axial resolution of current LSFM-based whole brain imaging for 5 to 10 folds. By a relatively cost-effective means, with keeping the high-throughput, low photon burden advantages, 2B-LSFM method further achieves subcellular, isotropic resolution at whole-brain scale. Thus it shows great potentials for various applications of neuron/brain research.

**Biography**

Director (PI) of "Biological photonics and micro-flow control Technology laboratory" of Opto-Electronic Information Institute; Department young people Plan winners; Head of Science and Technology 863 program project; The bird's Nest plan scholar of

Huazhong University; Title: Professor (Opto-Electronic Information Institute/Innovation Institute); Researcher (hust Shenzchen Research Institute); Research direction: Bio-imaging technology, microfluidic biochip technology, integrated optoelectronic device technology

## ---------- Oral ----------

OGC 2018 – G0096

**Label-free Imaging on Cellular Level with Stimulated Raman Scattering Microscopy**

**Yuanzhen Suo , Wenlong Yang, and Xiaoliang Sunney Xie**
Peking University, China

***Abstract*** — Optical microscopy plays a significant role in biomedical research and clinical examinations. Fluorescence microscopy is one of the most powerful optical microscopy techniques. With the development of fluorescent probes, fluorescence microscopy is able to image samples from single molecules to mammalian organs with high sensitivity and specificity. Unfortunately, fluorescent probes may perturb the studies systems inevitably, especially when labeling small molecules such as drugs and neurotransmitters. Spontaneous Raman scattering microscopy is an alternative technique of label-free imaging. It is able to image cells and tissues by measuring their Raman scattering spectra. However, the spontaneous Raman scattering signal is very weak, making it time-consuming for live samples. Thus, its application in biomedical research is limited.

Coherent Raman scattering microscopy is an emerging label-free imaging technique based on the chemical vibration of molecules. It uses two laser beams to coincide on the sample, which is different from the spontaneous Raman with only one laser beam. When the difference of frequencies between the two beams, the pump beam and the Stocks beam, matches the vibrational frequency of a particular molecule in the sample, an anti-Stocks beam is enhanced by several orders of magnitude. Meanwhile, the intensity of the pump laser decreases while the intensity of the Stocks laser increase due to the virtue of stimulated excitation of molecular transition. Stimulated Raman Scattering (SRS) microscopy is developed by detecting the pump laser loss or the Stocks laser gain. It enables high-speed biological imaging.

To monitor single cells in fresh tissues, we set up SRS systems for a broad range of applications. The SRS system with a picosecond laser as the light source is used to provide high spectral resolution, while the SRS system with a femtosecond laser is used for hyperspectral imaging. Confocal fluorescence microscopy is also combined in our systems. Previously, SRS microscopy was applied in brain tumor detection, lipid metabolism, pharmaceutical research, etc. Here, we applied SRS to detect tumor cells, immunocytes in fresh lymph nodes. B/T cells, dendritic cells, blood cells, vessels can be distinguished in the fresh lymph node. Tumor cell zones are found in lymph nodes of tumor-bearing mice. Lipid metabolism is unnormal in these lymph nodes. Interestingly, we found that the morphology and chemical constitutes of cells are very different between young lymph nodes and old lymph nodes. Additionally, we are developing ultra-highly sensitive SRS

microscopy to monitoring neurotransmitters.

OGC 2018 - G0006

**AIEgen assisted STED Nanoscopy and Its Application for Dynamic Mitochondrial Visualization**

**Dongyu Li,[1] Liwei Liu,[2] Ben Zhong Tang,[3] Junle Qu,[2] and Jun Qian[1]**

[1] Zhejiang University, Hangzhou, China. ; [2] Shenzhen University, Shenzhen, China.; [3] The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, China.

***Abstract* —** Stimulated emission depletion (STED) nanoscopy is a typical super-resolution imaging technique that has become a powerful tool for visualizing intracellular structures on the nanometer scale. Aggregation-induced emission luminogens (AIEgens) are ideal fluorescent agents for bioimaging and have been widely used for organelle targeting, cellular mapping and tracing. Since AIEgens generally have a large Stokes' shift, which is beneficial for restraining the fluorescence background induced by the STED light, as well as high photobleaching resistance in their nanoaggregate states, which provides the potential for long-term imaging under a STED beam with high power density, they are ideal fluorescent agents for STED nanoscopy.[1] Herein, TPE-TPA-FN (TTF), a "star" AIE luminogen, was doped into colloidal mesoporous silica to form fluorescent nanoparticles (NPs) and to perform STED nanoscopy in cancer cells. The STED efficiency of the TTF@SiO2 NPs could reach more than 60% and exhibited a high lateral spatial resolution of 30 nm in the stained cells. It is worth mentioning that, long-term (more than half an hour) super-resolution cell imaging was achieved with low fluorescence loss.[2] In addition, AIEgen based STED nanoscopy was then used for a specific organelle, mitochondria, in live cancer cells. TPA-T-CyP, a red&NIR emitted luminogen with AIE feature was synthesized, which could spontaneously and specifically aggregate on mitochondria without any encapsulating or surface-modification. The STED efficiency of aggregated TPA-T-CyP could reach more than 80%, and the dynamic mitochondrial visualization was achieved on the nanometer scale. Their moving, fission and fussion of mitochondria was clearly observed with a lateral spatial resolution of 74 nm. Thus, AIEgen based STED nanoscopy holds great potential for many basic biomedical studies of vital activities those require super resolution.

OGC 2018 – G0090

**Near Infrared Spectroscopy in the Noninvasive Assessment of Brain Death**

**Ting Li**

The Biomedical Engineering Institute, Chinese Academy of Medical Science and Peking Union Medical College, Tianjin, China

***Abstract* —** Brain death is the irreversible loss of all the functions of the brain and brainstem. The traditional diagnostic methods mainly relies on complex, harmful or unstable test, including apnea test, evoked potential test, etc. Near infrared spectroscopy (NIRS) utilize the good scattering properties of blood corpuscle to NIR, has the ability to monitor cerebral hemodynamics noninvasively.

We use our portable NIRS oximeter to measure the physiological data of fifteen brain death patients and twenty-two patients under natural state. The varied fractional

concentration of inspired oxygen (FIO2) were provided in different phase.

We found that the ratio of the concentration changes in oxy-hemoglobin to deoxy-hemoglobin (Δ[HbO2]/Δ[Hb]) in normal patients is significantly lower than brain death patients, and its restore oxygen change process in low-high-low paradigm is more remarkable. This resulting promotion indicates potential of NIRS-measured hemodynamic index in diagnosing brain death.

OGC 2018 – G0032

**Study on The Key Technology of Preparing Individual Soldier Camouflage Ointment**

**Jie LI, Heng LIU, Pu ZOU, XiaoDong CHEN, JianXing ZHU, Fu ZUO**

Army Engineering University of PLA, Nan Jing, China

***Abstract* —** Aiming at the poor camouflage performance and the poor skin affinity of the existing camouflage ointment, we chose food grade pigments, adopted single variable control method and the high shear emulsifying and dispersing technology to prepare individual soldier camouflage ointment. The reflection and radiation properties of ointments were tested by UV-visible-IR spectrophotometer and thermal imager respectively. The effects of dispersing process, pigment type, ratio and color rendering on the fineness and spectral reflectance of the ointment were studied. The results show that after mixing the sodium copper chlorophyllin with alcohol and lanolin according to 1:0.5:10, the color rendering of chlorophyll can be enhanced to meet the requirement of spectral fitting. Mix the blue, yellow, red and 800 titanium dioxide pigments at 64.3%, 23.6%, 0.2%, 11.9% mass ratio, then dispersing it for 5 minutes,5 minutes and 15 minutes at A、B、C gears respectively, the individual soldier camouflage ointment which has fine skin affinity and optical and near infrared camouflage performance will be obtained. This research provides solutions to problems such as lack of ointment, poor camouflage performance and usability of the existing camouflage ointment.

OGC 2018 – G0002

**Temperature correction and composite dielectric layer for optimization of plasmon waveguide**

**Dongzhi Li1, Pengfei Zhang[2, 3]**

[1] Department of Physics, School of Science, Shenyang University of Technology, Shenyang 100870, China; [2] Department of Microscopy, KYKY Technology co. LTD., Chinese Academy of Science, Beijing 100190, China; [3] Shenzhen Key Laboratory for Minimal Invasive Medical Technologies, Institute of optical imaging and sensing,Graduate School at Shenzhen, Tsinghua University, Shenzhen, China, Guangzhou, China

***Abstract* —** Plasmon waveguide resonance (PWR) sensor is an extension of surface plasmon resonance (SPR) sensor, where temperature control has significant effect on the measurement reliability. In this article, a PWR sensing structure based on the composite dielectric layer was proposed, and the temperature correction mode was presented for the PWR sensors. The presented PWR sensor could be prepared with conventional film coating techniques, and its feasibility was demonstrated both theoretically and experimentally.

## Sub-session 2 – B

## < Optical Communication and Networks >

---------- **Invited** ----------

**A Pair of Equations More Precise Than the Uncertainty Principle, and Study on Modulation formats and PIC in Optical Communication and Human Retina**

**Anhui Liang**
Guangdong University of Technology

***Abstract*** — We discovered two equations which are more precise than the Heisenberg's Uncertainty Principle. We find our equations can be 10^7-10^9 times more precise than Heisenberg's Uncertainty Principle in quantum communications. Our equation can resolve the important question what is the relation between the quantum indeterminacy and the non-locality.

There are more than 120 millions of photodetectors, and electrical components on human retina, and they are very advanced PIC in nature, and we first discovered there are optical couplers, and biological transistors on retina. We shall discuss what we can learn from the advanced PIC on human retina and how to mimic them design PIC in Optical fiber Communication。We first proposed the modulation formats for small signals on human eye: PAM4 and PAM8 in foveal in single eye, and QAM 16 and QAM 64 in foveal in double eyes. These modulation formats on human retina are similar to those used in 100, 400 Gb/s high speed optical fiber communications. We first found more than ten color golden ratios in human vision. We first proposed amacrine cells and interplexiform cells are in charge of the clock recovery on human retina, and we compare the clock recovery in optical fiber communication systems and on human retina.

**Biography**

Prof. Anhui Liang is a National Distinguished Expert, and he is the Head of Optical Engineering Discipline, Guangdong University of Technology. He held several important R&D positions in several universities and companies in USA and China, e.g. he was the Deputy Director of Academic Committee, Nanjing University of Posts and Telecommunications, a Chief Scientist, FiberHome Technologies etc. He made significant contributions on Optical fiber communications，quantum electronics, vision，Chinese medicine and new golden ratios. E.g,, He found two important equations which are more precise than Heisenberg's Uncertainty Principle; he first proposed central foveal cones are single mode fiber detectors, and he found there are couplers on human retina and he unified the tricolor theory and opponent color theory, and he discovered there are biological transistors on human retina; He first proposed the Chinese Meridian are optical fibers, which are consisted of collagenous fibers, nerves, blood capillaries and lymphatic; he discovered several tens of new Golden Ratio Points, including color, temperature, ancient buildings, human bodies and cultures etc. and he proposed a new theory for the reason why dinosaurs got extinguished. He received several awards including The Yearly Person of Scientific Chinese.

**Silicon Photonic Devices for Optical Communication**

**Tao Chu**
Zhejiang University

***Abstract*** **—** Accompanying the rapid developments of the big-data society, novel technologies for constructing high-speed and low-power-consumption communication systems are highly demanded. Silicon photonic integration is widely regarded as one of the most promising ways in various applications, due to the low-cost and high-density-integration of silicon photonic devices. In this presentation, our researches on silicon photonic devices will be introduced, including silicon based laser, modulators, wavelength MUX/DeMUX, Mode MUX/DeMUX, polarization controller, EO/TO switches, photodetectors, with their designs, fabrications, measurements and future applications.

**Biography**

Prof. Tao CHU received the B.S. degree from Sichuan University, Chengdu, China, in 1991. He received the M. Eng. & D. Eng. degree and from Kyoto Institute of Technology, Kyoto, Japan, in 1999 and 2002. From 2003 to 2011, he worked in NEC Central Research Laboratories and National Institute of Advanced Industry Science and Technology (AIST), Japan, as a Principal Researcher and a Senior Manager, respectively, Tsukuba, Japan. In 2010, He was selected as a National Distinguished Professor of China. From 2011 to 2016, he worked in the Institute of Semiconductors, CAS, Beijing, China, as a CAS Distinguished Professor. In 2017, he joined the college of Information Science and Electronic Engineering, Zhejiang University, Hangzhou, China, as a full professor and EPIC-Group Leader.

## ---------- Oral ----------

OGC 2018 – G0047

**Cross-task Dynamic Load Balancing Strategy**

**Ming Chen[1] and Haifeng Huang[2]**
[1]Zhejiang University, Hangzhou, China; [2] Nanjing Electric Science Research Institute, Nanjing, China

***Abstract*** **—** In a multi-computer request application scenario, a certain number of computer resources need to be used to process multiple computer tasks[6] at the same time. However, currently there is no load balancing strategy that can be effectively applied in such scenarios. This paper proposes the cross task load balancing strategy CTLB (Cross Task Load Balancing), the strategy at the beginning of each task, re-estimate the resource overhead of each task, and then according to the amount of tasks to re-allocate the available computer re-sources. This strategy is based on the "time continuity" feature in the computer technology, so it is a dynamic load balancing strategy of the past-frame type. The strategy can handle a plurality of computer requests in a balanced manner with a certain amount of computer resources, and improve the performance of the parallel computer system in a multi-projection or multi-request scenario. This paper first briefly describes the CTLB dynamic load balancing strategy, and then gives the specific algorithm of the dynamic load balancing strategy. Then describes the dynamic load balancing strategy on the GGPRF integration, and finally the per-formance of the dynamic

load balancing strategy.

OGC 2018 – G0055

**Second Harmonics Generating Based on A Silicon Microring Modulator**

**Lin Gui, Yushuang Zhu, Yaoyu Cao, Jiancun Zuo**

College of Computer and Information Engineering, Shanghai Polytechnic University, Shanghai, China

***Abstract* —** Recently, silicon photonics is regarded as the key technology because it has the potential capability of integrating plenty of optical components on a single chip with standard CMOS process, so its application covers from the telecommunication to the MWP. Microring modulator, as one of the significant silicon integrated component, is preferred by more researcher due to its great advantages like compact footprint, low drive-voltages. Some researchers utilize this carrier-depletion-based microring modulator to generate a second harmonic microwave signal, and the proof-of-concept experiment is demonstrated. A RF signal from 10 to 20 GHz has been acquired with this silicon modulator. However, other harmonics deteriorate the performance of generated second harmonic microwave signal due to the nonlinearity in the silicon microring modulator.

In this paper, the optimized condition for generating the second harmonic microwave signal in silicon microring modulator is demonstrated by utilizing a full model with both the electrical nonlinearity in PN junction and the optical nonlinearity originated from the Lorentzian-shaped transfer function of microring, and the optimized phase shift with respect to the resonant wavelength is also analyzed. The typical structure of silicon microring modulator is composed of a 2×2 coupler(F) and a feedback waveguide(G). The coupler F has cross coupling ratio *r*, and the feedback waveguide G is doped with the waveguide round-trip loss *a*. The modulating process occurs in the feedback waveguide with a proper electrode on G. The free carrier plasma dispersion effect and the free carrier induced depletion effect are both obtained through electricfield-induced carrier depletion of a p-n diode embedded inside a rib waveguide. So if an input voltage applied on the electrode, following responses will mainly affect the output photon current:1) electrical response of the silicon waveguide, which converts the voltage to the current in the p-n junction in diode, 2) electro-optical response of silicon material, which converts the current to the changing of refractive index in the silicon waveguide, and finally affects the phase shift of the optical wave in the waveguide G, 3) the optical response of the ring structure, which modifies the output optical field by the phase shift containing the modulating information.

In section III, we consider the full model including the response 1)-3), and give a simulation and performance analysis for the second harmonic generating in a silicon microring modulator. the parameters in the silicon microring modulator are as follows: the loss in the doped silicon waveguide is 3dB/mm, 50lm , 0.9829a ,0.98r ,200k FSR=2THz.The RF frequency *rff*is 10GHz, and the input laser power is 1dBm.The detector responsivity set at 1 A/W. The load impedance of electrode is 50 Ω. SH=P second-harmonic /Prf

The results are shown in Fig.1. When the value of SH is over 30dB, the range of *op* is from -56.810 to -58.510 , corresponding to the frequency stability of 17MHz. When the value of SH is over 20dB, the range of is from to , corresponding to the frequency stability of 54MHz.

OGC 2018 – G0069

**Design of Pointing-structure Optical Terminal for Network Communication Test**

**LI Xiao-ming，LIU Ming, GAO Jin-wei**
National and Local Joint Engineering Research Center of Space and Optoelectronics Technology, Changchun University of Science and Technology, CUST, Changchun, China

***Abstract* —** The network laser communication antenna has multiple independent working mirrors to communicate with different objectives at the same time, overcome the deficiency that traditional laser communication only be one-to-one communication. This paper introduced a kind of pointing-structure optical terminal that used moving-target structure to simulation the target for tracking accuracy and communication test of the network communication antenna indoor. The optical system of the terminal has the features of beacon and duplex communication, so it can cooperate the network antenna to test the communication performance with multiple objective in dynamic tracking by using multiple pointing-structure optical terminals. Firstly, it analyzed the effect of the sway in the shaft of terminal to moving target's motion characteristic, then established a mathematic model of the moving target and finally designed the mechanical structure and optical system. The test which about the pointing-structure optical terminal and network laser communication antenna performance testing shows that the terminal achieved design objective and meet the test requirement

OGC 2018 – G0076

**FBG Strain Sensor Applied in Harsh Environment of Aerospace**

**Yifei[1] PEI, Tao LIAO[2], Jian XU, Heng LIN, Tigang NING[3]**
[1] Beijing Institute of Spacecraft Environment Engineering, Beijing, China; [2] School of Precision Instrument and Opto-Electronics Engineering Tianjin University, Tianjin, China; [3] Key Lab of All Optical Network & Advanced Telecommunication Network of EMC, Beijing Jiaotong University, Beijing, China

***Abstract* —** We have designed a novel FBG strain sensor in this paper, which is optimized for aerospace application and available in harsh environment. The proposed FBG strain sensor is improved in mechanical structure and filler for aerospace, whose characteristic is investigated by FEM simulation and experimental tests. In our design we fix the grating with special mechanical structure and metal coating to ensure the stability. We have demonstrated that developed sensor could detect the minimum strain of 0.602με by experiment. Our sensor has high sensitivity and good stability and can be used for many aspects in aerospace.

OGC 2018 – G0083

**Research and Test of Vehicle-mounted Laser Communication**

**MENG Lixin[1,2], ZHAO Honggang[1,3], ZHANG Lizhong[1,2], LI Xiaoming[1,2], BAI Yangyang[1,2], LIU Ming[1,3]**
[1] Changchun university of science and technology, National and Local Joint Engineering Research Center of space Optoelectronics Technology , Changchun; [2] Changchun university of science and technology, Fundamental Science on Space-Ground Laser Communication Technology Laboratory, Changchun; [3] Changchun university of science and

technology, Electro mechanic Engineering College, Changchun

***Abstract*** — In order to verify the feasibility of in-vehicle laser communication technology, the application scenarios and basic principles of vehicle-mounted laser communication system are researched. According to the index requirements, the overall design of the system is completed and field experiments are carried out. Under different atmospheric visibility and different communication distance Communication error rate, to evaluate the communication quality, and to detect and analyze the mast sloshing. Finally, the vehicle laser communication prototype was completed to achieve near-surface laser communication within 15km and 100mbps. The feasibility and design of vehicle-mounted laser communication were verified The correctness of the scheme and provide the basis for the improvement of the prototype of the principle in the future.

## Sub-session 6 – A

## < Optoelectronic Devices and Applications >

## ---------- Invited ----------

**Single Mode Operation and Optical Bistability for Coupled-Cavity Semiconductor Lasers**

**Yongzhen Huang**
University of Chinese Academy of Sciences, China

***Abstract*** — In this talk, we will report a coupled-cavity laser composed of a Fabry-Pérot (FP) cavity and a square microcavity for mode selection. Stable single-mode operation with high coupling efficiency to a single mode fiber is realized by injecting currents to the square microcavity and the FP cavity sections at the same time. Furthermore, optical bistability is realized as the microcavity is unbiased, due to saturable absorption and mode competition. All-optical flip-flop is demonstrated using 100 ps-wide trigger optical pulses.

**Biography**

Professor Huang received the B.S., M.S., and Ph.D. degrees in physics from Peking University, Beijing, China, in 1983, 1986, and 1989, respectively. In 1989, he joined Institute of Semiconductors, Chinese Academy of Sciences (CAS), Beijing, where he worked on the tunneling time for quantum barriers, asymmetric Fabry–Perot cavity light

modulators, and VCSELs. In 1994, he was a visitor with BT Laboratories, Ipswich, U.K., where he was involved in the fabrication of the 1550-nm InGaAsP VCSEL. Since1997, he has been a Professor with the Institute of Semiconductors, CAS, where he is now the Director of the State Key Laboratory on Integrated Optoelectronics and Director academic committee of the Institute of Semiconductors. His current research interests are mainly focused on semiconductor microcavity lasers, nonlinear dynamics for microcavity lasers, hybrid III-V/Si semiconductor lasers, and the applcaton of microcaty lasers for photonic integrated circuit.

**Mesoscopic and Microscopic Strategies for Engineering Plasmon Enhanced Raman Scattering**

**Zhiyuan Li**
South China University of Technology, China

***Abstract*** **—** Surface plasmon resonance (SPR) in noble metal nanoparticles and nanostructures offer an efficient means to transport and localize the energy of light into some nanoscale space regions called hot spots, where the electromagnetic field is enhanced by many orders of magnitude upon the incident light. This local field enhancement can induce very huge enhancement of Raman signal for a molecule embedded within the hot spot, which has tremendous applications in surface-enhanced Raman spectroscopy (SERS) and tip-enhanced Raman spectroscopy (TERS) [1]. In this talk, we discuss how to engineer this SPR enhanced Raman scattering from both the mesoscopic and microscopic level [2-4]. The mesoscopic level focuses on engineering and optimizing the geometric (shape, size, topology, monomer, dimer, aggregate, etc.) and physical (composite, alloy, loss, gain, etc.) configuration of plasmonic nanoparticles in order to have as large as possible electromagnetic field enhancement factor in the hot spot. The microscopic level focuses on investigating the light-molecule interaction (both chemical and physical) in the microscopic level, either classical or quantum, in order to have deep and complete understanding the key microscopic issues influencing the Raman scattering and then exploring microscopic means to further enhance the Raman scattering as large as possible.

**Biography**

Prof. Zhi-Yuan Li is a professor in College of Physics and Optoelectronics, South China University of Technology. Before this he worked in Institute of Physics, CAS as a principal investigator. Prof. Li's research interests include theory, experiment, and application of photonic crystals, nonlinear and ultrafast optics, lasers, plasmonics, optical tweezers, quantum optics, and quantum physics. He is the author or coauthor of more than 380 peer-reviewed papers in physics, optics, chemistry, and materials science journals. These papers have been cited by about 19,000 times. He serves as a Co-Editor of EPL and the editorial board member of Acta Optica Sinica, and Advanced Optical Materials. He has presented over 100 invited talks in international and domestic conferences

---------- **Oral** ----------

OGC 2018 – G0017

**Actively Dual-mode Distributed Feedback Laser and Passively Q-switched Dual-mode Fiber Laser towards Terahertz Applications**

**Xu Wang, Qizhu Li, Yuanjun Zhu, and Ziyang Zhang**

Suzhou Institute of Nano-Technology and Nano-Bionics, CAS, Suzhou, China

***Abstract* —** Terahertz (THz) spectroscopy and spectral imaging techniques have attracted considerable attention due to their potential applications in various fields, particularly in homeland security, medicine, and non-destructive testing across a wide range of industries. However, there is few commercialized product because system-level components are complex, large, and prohibitively expensive. THz sources based on intracavity difference frequency generation (DFG) are capable of high power continuous wave (CW) operation at room temperature. Among the intracavity DFG-based THz sources, both electrically pumped semiconductor lasers and passively semiconductor saturable absorber mirror (SESAM)-based Q-switched pulse fiber lasers have recently attracted great attention due to their potential for mass production, operating simplicity and compact sizes.

Distributed feedback (DFB) laser based on quantum dot (QD) materials have been demonstrated great potential to address THz applications owing to their high quantum efficiency, low threshold current, broadband wavelength tuning rage. Two independent DFB lasers with beams of slightly different frequencies have emerged as an excellent technique to generate THz radiation. To further simplify the device operation, and improve the temperature stability and the spectral quality, the THz signals generated by using simultaneous emission of two laser lines from a single DFB laser become very appealing. The passively Q-switched dual-wavelength fiber lasers, fundamentally mode-locked using SESAMs, is one of the most promising approaches for monochromatic THz waves due to their balanceable and stable proportion of dual-wavelength output, Watt-level output peak power, and high repetition rate. However, for commercial quantum well (QW)-based SESAMs, it is very difficult to achieve low saturable fluence (Fsat.) and moderate modulation depth (dR) in one single device because of the product Fsat. dR is constant, which severely limits the design and hence the applications. In comparison with QW, QD-based devices also offer many potential advantages such as the promise of broader mode-locked laser bandwidth and more flexibility in the laser central operating wavelength.

In this work, a modulation p-doped multiple InAs/GaAs QD LC-DFB laser has been fabricated, which exhibits a high thermal stability of $d\lambda/dT$ = 0.09 nm/K and a side mode suppression ratio of >47 dB under CW operation. Two lasing lines can be simultaneously obtained by delicately defining different periods for the grating structures at each side of the narrow ridge waveguide, or combining the reduced laser cavity length. The spacing between these two lasing wavelengths can be widely tuned from 0.1 to 73.4 nm corresponding to the frequency difference from 0.13 to 14 THz. In addition, in this work, to the best of our knowledge, it is the first time to demonstrate a stable dual-wavelength Q-switched Er-doped fiber laser by employing InAs/GaAs QD SESAM, in which the robust dual-wavelength emissions at 1532.0 and 1548.4 nm corresponding to the frequency difference of 1.77 THz was generated in an all fiber laser

system with the maximum output peak power of 20.44 W and the appropriate repetition rate of 45 kHz. These results have paved a new pathway towards the realization of compact THz radiation sources.

OGC 2018 – G0031

**Domestically Designed Integrated Silicon-based Module for Coherent Optical Transmission Network**

**LeXian Chen[1], Quan Cao, Zhiqiang Tong[2]**

[1] China Telecom Corporation Limited Shanghai Branch Shang Hai, China,; [2] FiberHome Telecommunication Technologies Co.,LTD, Wuhan, China

***Abstract* —** A line card with low power silicon-based module is demoed on current commercial network by Shanghai Telcom. This is China's first domestically designed silicon-based module in coherent transmission systems. This module has an excellent performance. All key parameters passed the test requirements of or Nx100Gbit/s optical wavelength division multiplexing systems and shows a more than 6-watt power consumption reduction.

OGC 2018 – G0042

**Development of high gain and low noise microchannel plate**

**Shanli Wang**

CHINA BUILDING MATERLALS ACADEMY

***Abstract* —** The low light level image intensifier can transform the LLL image signal through photon electron photon and enhance the night vision core device for human visual image signal. In this system, the microchannel plate is multiplying and amplifying electrons. The microchannel plate is made from lead silicate glass into capillary at high temperature. It has undergone physical and chemical treatment, forming a multiplier function for the two-dimensional space distribution of electrons, ions and rays. High gain and low noise are the main development directions of microchannel panels. On the basis of the study of the standard two generation microchannel plate, the new material system and fractal technology are studied, and the super two generation micro channel plate with 500 degree resistance, $10^{-6}$pa high vacuum baking and 45 microan hour large current is developed. The aperture is 8 micron micro channel plate, which is used for XX1450 low light level image intensifier. The electronic gain is more than 500, the dark current density is less than $10^{-13}$A/cm$^2$, and the image uniformity is good.

OGC 2018 – G0052

**High-visibility Fiber in-line Cascaded F-P Resonators Fabricated by Femtosecond Laser Assisted Chemical Etching for RI Sensing**

**Peng Zhou, Zhengyong Li, Changrui Liao and Yiping Wang**

Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, College of Optoelectronic Engineering, Shenzhen University, Shenzhen, China

***Abstract* —** A high-visibility fiber in-line cascaded Fabry-Perot (F-P) resonators was proposed and experimentally demonstrated for refractive index sensing. The proposed structure was fabricated by femtosecond (fs) laser micromachining and chemical etching. A number of lines were firstly inscribed in the

fiber core with a certain length unmodified in-between, then these lines were etched with hydrofluoric (HF) solution, and finally formed the cascaded resonators structure with micro-channels allowing liquid flow into/out of the resonators. The reflection spectra show a high-visibility contrast, ~24dB. The RI wavelength sensitivity is ~888nm/RIU with a sensor resolution of 1.0×10-5 RIU, much higher than in a single resonator (10-3 RIU). Moreover, the RI intensity sensitivity is -882.01dB/nm/RIU in the RI range from 1.325 to 1.330. The results show that the structure is suitable for chemical and biomedical sensing applications.

OGC 2018 – G0056

**An Ultrafast Responsed Photodetector Based on CsPbI2Br Fabricated in Low-temperature**

**ChaoJie Qin, Ting Zhang, Shibin Li**
Department of Laboratory of Electronic Thin Films and Integrated Devices, and School of Optoelectronic Science and Engineering, University of Electronic Science and Technology of China(UESTC), Chengdu, Sichuan,China

***Abstract* —** In the past few years, organic–inorganic metal halide (OMH) perovskites have become one of the most promising materials due to their unprecedented optoelectronic properties,such as large absorption coefficient, high charge carrier mobility, long electron-hole diffusion, and tunable bandgap However, OMH perovskites display very low thermal decomposition temperatures, because they contain unstable organic monovalent cations. Therefore, solution-processed all-inorganic metal halide (IMH) perovskites ($CsBX_3$, B =Pb, Sn,Ge; X = Cl, Br, I) are rapidly emerging as promising alternatives for opto-electronic applications because of their superior stabilities and comparable properties, such as strong emission, high fluorescence quantum yield and tunable bandgap covering entire visible spectrum. Here, we investigate the $CsPbI_2Br$ perovskite materials the annealing temperature dropped from 350 to 65 degrees.$CsPbI_2Br$ is prepared using CsBr, CsI, $PbBr_2$, $PbI_2$ precursors and mixed in an appropriate molar ratios in dimethyl sulfoxide (DMSO).The $CsPbI_2Br$ film were spun from 0.4 M $CsPbI_2Br$ solutions fabricated by one-step solution method. Our perovskite photodetectors based on a vertical photoconductors architectures (glass/ITO/$CsPbI_2Br$/Au) show a fast response with rise and decay time of 130μs and 107μs, respectively. Furthermore, at a low bias voltage of 0.1 V, the fabricated photodetectors exhibit a good on/off ratio of $10^4$, and a broadband photoresponse from the ultraviolet to entire visible light. We calculated the photoresponsivities of 650 and 520 nm are 0.002 $AW^{-1}$and 0.017 $AW^{-1}$, respectively. The results demonstrate a great potential of $CsPbI_2Br$ perovskites in photodetection fabricated by one-step solution method and provide a way to fabricate a broadband photodetector.

## Sub-session 6 – B

## < Optoelectronic Devices and Applications >

## ---------- Invited ----------

**High-speed Silicon Optical Modulators for Data Center Networks**

**Lin Yang**
State Key Laboratory of Integrated Optoelectronics, CAS, China

***Abstract*** **—** Silicon photonics is considered as a promising technology to overcome the challenges of the existing data center networks, such as explosively increased data stream and power consumption. Silicon optical modulator, as a component to transfer data from electronic domain to optical one, has attracted extensive attentions in the past decade. In this paper, I will review our efforts in developing high-speed silicon Mach-Zehnder optical modulators with large optical bandwidths

Firstly, I will introduce how to optimize the modulation efficiency, optical loss, electro-optical bandwidth of the silicon optical modulator. The fabricated silicon Mach-Zehnder optical modulator has an electro-optical bandwidth of up to 39.8 GHz. The device has the dynamic extinction ratios of 3.3 dB, 3.0 dB, 2.8 dB and 2.5 dB at the speeds of 70 Gbps, 80 Gbps, 90 Gbps and 100 Gbps for OOK modulation.

Secondly, I will introduce three types of silicon PAM-4 optical modulators. The first one is driven by a PAM-4 electrical signal. The second one is driven by two binary electrical signals with different peak-to-peak voltages. The third one is driven by a differential PAM-4 electrical signal. All the three devices can generate PAM-4 optical signals at the speed of over 35 Gbaud in the wavelength of 1525-1565 nm. The corresponding bit error rates can reach as low as ~$10^{-6}$, which is below the hard-decision forward error correction threshold of $3.8\times10^{-3}$. Finally, I will introduce a silicon 16-QAM optical modulator, which is based on four Mach-Zehnder modulators driven by four binary electrical signals. With the simple electrical driving configuration, the device generates a 16-QAM optical signal at 20 Gbaud with an error vector magnitude of 13.7%.

**Biography**

Lin Yang received his Ph. D. degree in microelectronics and solid state electronics from Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China, in 2003. From 2003 to 2007, he was a postdoctoral fellow of Research Center for Integrated Quantum Electronics, Hokkaido University, Sapporo, Japan. In Sept. 2007, he received support from the “Hundred Talents” program of Chinese Academy of Sciences and joined the Institute of Semiconductors. He is currently a professor in State Key Laboratory of Integrated Optoelectronics, Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China. His research interests include silicon photonic devices and subsystems for optical interconnect, optical computing and optical communication. He is the author or co-author of more than 80 refereed scientific journal papers and over 30 patents. He has delivered more than 40 invited talks in the international conferences.

## Silicon Nanophotonics for On-Chip Light Manipulation

**Daoxin Dai**
Zhejiang University, China

***Abstract*** **—** Silicon nanophotonics has been very attractive in the past decade because of the unique advantages including the CMOS-compatibility and ultra-high integration intensity. In particular, silicon nanophotonic integrated devices for on-chip light manipulation have been developed successfully and have been playing very import roles for various applications. In this paper, we give a review on recent progresses of silicon nanophotonic devices for on-chip light manipulation, including the static type and the dynamic type. The static manipulation of light includes polarization/mode manipulation and light nanofocusing, while the dynamic manipulation of light includes optical modulation/switching. This review also discusses the challenges and the prospects of high-performance silicon nanophotonic integrated devices for on-chip light manipulation.

**Biography**

Daoxin Dai (Member, IEEE) received the B.Eng. degree from the Department of Optical Engineering, Zhejiang University (ZJU), Hangzhou, China, in 2000 and the Ph.D. degree from the Royal Institute of Technology, Stockholm, Sweden, in 2005. He joined ZJU as an Assistant Professor in 2005 and became an Associate Professor in 2007 and a Full Professor in 2011. He visited the Chinese University of Hong Kong in 2005 and Inha University in South Korea in 2007. He was with the University of California, Santa Barbara, CA, USA, as a Visiting Scholar in 2008-2011. He is currently leading the Silicon Integrated Nanophotonics Group at ZJU and has published over 160 papers in refereed international journals. Dr. Dai was one of Most Cited Chinese Researchers in 2015-2018 (Elsevier). He has given over 60 invited talks and also served as the Technical Program Committee (TPC) Chair/Member for prestigious international conferences (e.g., OFC). He is also serving as the Associate Editor of IEEE Photonics Technology Letters, Optical and Quantum Electronics, and Photonics Research. He is the Guest Editor of the Special Issue on Photonics Research in Integrated Photonics and the Special Issue on Metamaterials Photonics and Integration in the IEEE Journal of Selected Topics in Quantum Electronics.

## Development of GaN-based Blue and Green Laser Diodes

**Jianping Liu**
Suzhou Institute of Nano-Tech and Nano-Bionics, CAS, China

***Abstract*** **—** Research on GaN-based blue and green laser diodes (LDs) has attracted great attention in the past years to meet the demand for laser display application. In this work, we improve luminescence homogeneity and reduce internal loss of GaN-based blue and green LD structures grown on c-plane free-standing GaN substrates. As a result, we have achieved 2.2 W of light output power for GaN-based blue laser diodes with 15 μm wide ridge under continuous-wave operation at room-temperature. By observing the morphology evolution of green InGaN/GaN QW and studying the optical property, we investigate Indium segregation related defects formed at green InGaN/GaN QW interface,

and the approach and the mechanism to remove them for green InGaN/GaN QW grown both on GaN templates and free-standing GaN substrates. By engineering the interface of green InGaN/GaN QWs, we have achieved green LD structure with low threshold current density of 1.85 kA $cm^{-2}$. The output power of the green LD is 100 mW under continuous-wave operation at room temperature.

**Biography**

Jianping Liu earned his doctoral degree from Institute of Semiconductors, Chinese Academy of Science in 2004. He worked at Lab of Optoelectronics Technology at Beijing University of Technology from 2004 to 2006. He did postdoctoral research in Department of Electrical Engineering at Georgia Institute of Technology from 2006 to 2010. He then joined Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, as a professor. His research interests include MOCVD growth, GaN-based materials and devices. He has been working on GaN-based laser diodes, LEDs and HEMTs. He has recently achieved the first green LD under continuous-wave operation at room temperature and the first high power blue LDs in China. He has published more than 100 peer-reviewed journal papers, including those published in top journal such as Light: Sci & Appl.、Nature Photonics、Appl. Phys. Lett.、Optical Express.

---------- **Oral** ----------

OGC 2018 – G0060

**Non-volatile Optical Switch Based on a GST-loaded Directional Coupler**

**Hanyu Zhang, Linjie Zhou, Liangjun Lu, and Jianping Chen[1], B. M. A. Rahman[2]**

[1] Shanghai Institute for Advanced Communication and Data Science, Shanghai Key Lab of Navigation and Location Services, State Key Laboratory of Advanced Optical Communication Systems and Networks Department of Electronic Engineering, SJTU Shanghai, China; [2] Department of Electrical and Electronic Engineering City, University of London, London, U.K.

***Abstract* —** We present a non-volatile optical switch based on a directional coupler comprising a silicon-Ge2Sb2Te5(GST) hybrid waveguide. The non-volatility of GST makes it attractive for reducing static power consumption in optical switching. Experimental results show that the optical switch has an extinction ratio of >20 dB in the bar state and >25 dB in the cross state around 1578 nm wavelength. The insertion loss is 2 dB and 7 dB for the bar and cross states, respectively.

OGC 2018 – G0063

**Direct Electrical Read-Out Plasmonic Sensor via Ultra-Narrow Lattice Mode Resonance and Broad-Band Photon Conversion Extending to SWIR**

**Long Wen, Qin Chen**

Institute of Nano photonics, Jinan University, Chengdu, Sichuan, China

***Abstract* —** Optical sensing based on fiber-optics and prism-coupled surface plasmon resonance (SPR) has been developed as an effective mean for chemical/biochemical

detection, medical research and clinical diagnostics, etc. However, most of these optical sensors require external high-resolution spectrophotometer and complex optical alignments to record the optical signal shift or change, resulting in a bulky and expensive system. In this context, we have developed a direct electrical-readout plasmonic sensor on Si platform using a near-flat metal-semiconductor (M-S) structure with shallow periodic trenches that can support ultra-narrow surface lattice resonances (SLRs) and capable of broad-band photoelectric conversion. Arising from the coupling of SPs with diffraction order, such a hybrid photonic-plasmonic resonance intrinsically has much higher quality factors and more extended field compared to pure SPs. The fabricated structures have high refractive index (RI) sensitivity up to 1000 nm/RIU, band-width down to 10 nm and perfect light absorption. With the M-S framework, electrical transduction of the SLRs was facilitated by the combined conversion mechanisms of inter-band photovoltaic effect of Si and intra-band plasmonic hot electron ejection of the ultra-thin metals. Our experimental results show that the spectral photocurrent responses of the devices perfectly maintain the features of SLRs and meanwhile exhibit photodetecting characteristics with peak responsivity up to 140 mA/W, and wide-band operating window ranging from 700-1700 nm. Combining all these features, the proposed electrical-readout plasmonic sensors as demonstrated in aqueous medium can provide a RI sensitivity of 3017 mA/W•RIU at wavelength of 1020 nm, and have a detect limit on the order of 10-5 to 10-4 RIU when operating under monochromatic illumination with photon energies both above and below Si band gap. With direct electrical-readout capability, high sensitivity and Si process compatibility, our proposed sensing strategy hold great potentials for development of future on-chip sensing devices or miniaturized sensing equipments without using external optical signal-processing instruments.

OGC 2018 – G0064

**Experimental Research on Silicon Optical Waveguide and Focus Coupling Grating**

**Yu Zheng, Piaopiao Gao, Bingxin Xia, Xionghui Wu, Yixiong Yan, Ji'an Duan**
State key Laboratory of High Performance Complex Manufacturing, College of Mechanical and Electrical Engineering, Central South University, Changsha, China

***Abstract* —** Fabrication of silicon optical waveguides and focus coupling gratings is described and measured through Ultra-depth Microscope and SEM. The focus grating with lower tolerances are optimized. The bottom surface roughness of waveguide etching region and its absorption spectrum is obtained though CLSM and IR-Microscope respectively.

OGC 2018 – G0065

**SNOM (Near-field scanning optical microscopy) on InGaAsN Quantum Wells: A new perspective of laser annealing**

**M.S.Sharma[1], S.Younis [1], D.Balestri[2], D.M.Di Paola[3], N.Balakrishnan[3], F.Biccari[2], M.Felici[1], M.Capizzi[1], A.Patane[3], A.Polimeni[1]**
[1] Department of Physics, "La Sapienza" University of Rome, Rome, Italy; [2] Dept. of Physics and Astronomy, and LENS, University of Florence, Florence, Italy; [3] Department of Physics & Astronomy, University of Nottingham, Nottingham, UK.

***Abstract*** — Controlling the band gap energy is a focus to design the high resolution semiconductor devices, which is creating the impact on this world, which only few other discoveries have ever done in the past in the support of humanity. In the 21st century, the research has taken a leap forward and nitrile semiconductors came to the centre of the studies because of its wide applications in the field of information and telecommunication technologies, security, energy conservation and environment. In particular, a large band-gap shrinkage even by 1-2% nitrogen shows how impactful and practical devices it can bring to the world of physics and engineering by changing the basic structural and electronic properties of the sample.

In our technique, we used a focused laser beam to laser anneal a hydrogenated 5nm nm (In0.21Ga0.79)(As0.975N0.025) QW/GaAs SQW and then characterizing it using micro-photoluminescence (μPL) which helps us to study the electronic activity of N- and H-atoms in (InGa)(AsN)/GaAs SQW, and thus the band-gap energy of (InGa)(AsN).

But, as shown in figure.1, this technique has a limitation that it burns out the sample for a high power of 35mW, which is in agreement with the theoretical simulation (figure.2) which shows that temperature reaches about 600℃ for 35mW at which arsenic (As) desorption takes place. This process leads to laser damage the sample. But, the visible effects start to occur at much lower power i.e., around 15mW.

Because of this drawback, we started using a technique called SNOM (Near-field scanning optical microscopy) in which a dielectric tip is used to focus the laser passing through optical fiber on the sample. This technique has many advantages over laser annealing: (1). Quantum dots formed are more confined (diameter of QDs are about 150-200nm with respect to 500nm formed using objective lens). (2). Laser damage is less. (3). Position accuracy of the QDs is about 50nm, which is much more than the laser annealing using objective lens. (4). Inhomogeneous broadening is as low as 20meV for SNOM. (5). No use of lithographic and etching processes are needed. Apart from the advantages, the confinement of the dots can be observed in fig.3. This technique works on the principle of exploiting near field, which has already been used for GaAsN, and reported.

# Sub-session 1 – A

# < Laser Technology >

## ---------- Invited ----------

### Control and Diagnosis of Laser Plasma Dynamics in Laser Wakefield Accelerators and High Harmonic Sources

**Zhengyan Li**
Huazhong University of Science and Technology, China

***Abstract* —** A femtosecond laser pulse ionizes materials and interacts with generated plasma, leading to applications of laser electron acceleration and laser micromachining. Experimental diagnosis of plasma distribution and its dynamics help underestand the underlying physics of laser plasma interactions. Here we developed single-shot visualization techniques to measure the spatio-temporal profiles of plasma. Based on such diagnosis techniques, plasma structures and dynamics can be precisely controlled, leading to novel ultrafast radiation sources such as GeV electron beams and attosecond laser pulses.

**Biography**

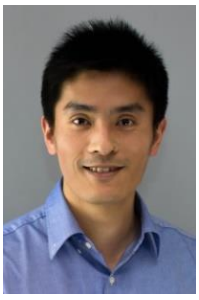
2008 BS in Physics, Peking University
2014 PhD in Physics, University of Texas at Austin,
Research Area: laser wakefield acceleration and diagnosis of plasma structure evolution
2014-2017 postdoc, University of Ottawa & National Research Council Canada
Research area: high harmonic generation and attosecond physics.

### All-Optical Thermo-Optic Devices Based on 2D Materials

**Kan Wu**
Shanghai Jiao Tong University, China

***Abstract* —** We summarize our recent works on thermo-optic devices based on two-dimensional (2D) materials. Thermo-optic properties of 2D materials are characterized and high-speed switches are demonstrated both on optical fiber system and integrated silicon nitride platform.

**Biography**



Dr. Wu Kan is currently an associate professor in the State Key Laboratory of Advanced Optical Communication Systems and Networks, Department of Electronic Engineering, School of Electronic Information and Electrical Engineering, Shanghai Jiao Tong University. He received the B.S degree and the M.S degree from Shanghai Jiao Tong University at Shanghai in 2006 and 2009, and the Ph.D. degree from Nanyang Technological University at Singapore in 2013. His research interests include femtosecond pulse generation, 2D material based optical devices and integrated optoelectronics. Dr. Wu has published more than 40 papers including Light Science and Applications, Physical Review X, Optica and Optical Letters, et al.

**2 μm Ultrashort-Pulse Fiber Lasers**

**Jinzhang Wang**
Shenzhen University, China

***Abstract*** **—** Ultrafast fiber lasers with broad bandwidth and short pulse duration at 2 micron regime have a variety of applications, such as gas sensing, ultrafast time-resolved spectroscopy and mid-IR supercontinuum generation. Tm- and Ho-doped fibers are the most common gain media at 2 μm spectral region in fiber lasers. Here, we will report sub-200 fs pulses generation from Tm-doped and Ho-doped fiber lasers. Moreover, we will also present a compact, all-fiber-integrated laser system that delivers Raman solitons with a duration of ~100 fs and pulse energy of up to 13.3 nJ, continuously wavelength tunable from 1.98 to 2.29 μm via Raman-induced soliton self-frequency shift in a Tm-doped fiber amplifier. All of lasers presented here are truly single-mode output and therefore inherently have a high beam quality.

**Biography**

Jinzhang Wang was born in Fujian, China, 1986. He received the B.S. degree in Electronic Information Engineering in 2008, M.S. degree in Optical Engineering in 2010 and Ph.D. degree in Circuits and Systems in 2014 from Xiamen University, China. From 2012 to 2013, he received the Chinese Government Overseas Study Scholarship and joined the Cambridge Graphene Centre, University of Cambridge, UK. His research interests include nonlinear fiber optics, ultrafast lasers, ultrafast time-resolved spectroscopy and nanomaterials photonics. He has been published more than 30 peer-reviewed journal papers.

He is currently an Assistant professor in the Shenzhen Key Laboratory of Laser Engineering, College of Optoelectronic Engineering, Shenzhen University, China.

## ---------- Oral ----------

OGC 2018 – G0008

**Design and Implementation of Laser Beam Monitoring System for Day-Time KHz Satellite Laser Ranging**

**AN Ning, LIU Cheng-zhi , WEN Guan-yu, MA Lei, ZHANG Hai-tao[1], LIU Yuan[2]**
[1] Changchun Observatory, National Astronomical Observatories Changchun Jilin, China; [2] Changchun Observatory, National Astronomical Observatories University of Chinese academy of science Changchun Jilin, Chin

***Abstract*** **—** In order to improve the detection probability of day-time KHz satellite laser ranging, the laser beam monitoring system was proposed based on the technology of spectral filtering and image processing. By adjusting the exposure time and exposure number of CCD carried out at synchronous triggering mode, a high-quality image of laser backward scattering was obtained under the condition of strong day-time background noise and massive aerosols. When the time delay of CCD in laser beam monitoring system was set to 0ms, the exposure time was set to 60μs and exposure number was1000times, the laser beam tip image could be identified easily with the highest brightness and legible outlines. This proposed system could monitor and control the laser beam in daytime and help to adjust the optical path in real time, which will provide technical support for daytime KHz laser satellite ranging.

OGC 2018 – G0026

**Research on the Characteristics of Optoacoustic signal induced by Optical breakdown**

**Zhou Ju, Lei Lihua[1], Zhang Jiandong[2], Cao Guixing, Li Cong[3]**

[1] QianXuesen Laboratory of Space Technology China Academy of Space Technology; [2] Ministry of Natural Resources of PRC, BeiJing, China; [3] Institute of Telecommunication Satellite China Academy of Space Technology, BeiJing, China

***Abstract*** **—** Optical breakdown is a mechanism of Laser-generated sound effect, based on the theory of optical breakdown mechanism in this paper, Characteristics of the photo-acoustic signal of the optical breakdown are studied through experimental, including the excitation threshold and the photoacoustic signal, Domain and frequency domain characteristics and characteristics of acoustic signals as a function of laser pulse energy. Study on the relationship between photoacoustic signal and laser source may serve for further study on laser-generated sound and underwater applications.

OGC 2018 – G0034

**Numerical Investigation of Conversion Factors for The Laser Simulation of Dose Rate Effects**

**Ge Tang[1,2,3], Mo Li[2,3], Peng Sun[2,3], Biao Wei[1]**

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***Abstract*** **—** Pulsed laser simulation is a powerful method in studying dose rate effects of the semiconductor devices. One of the key problems of the pulsed laser simulation is to obtain conversion factor (CF) precisely. The conventional methods are mostly using the carrier generation rate as the equivalent basis. However, the generation of carriers cannot be directly observed in the experiment process, and the photocurrent peak is routinely selected as the evaluation basis for convenience, which may led to the deviation between experimental and theoretical. Here, we propose a new numerical simulation method to quantitatively calculate the CF with peak of transient response as the equivalent basis. The simulation is done by finite element method (FEM), and the software platform is COMSOL Multiphysics 5.2. Compared with the conventional method, the numerical simulation method can take into account the effects of more devices and circuits parameters, such as bias voltages, series resistance, metallization coverage of device. Due to the consistency of the equicalent basis used by simulation and expriment, a more accurate CF is obtained through the new numerical method. The experimental verification in the classical PN junction indicates that the relative error obtained by the new numerical method is 13.11% which is less than the 30% described in the literature. Via combining CF with the result of pulsed laser radiation, the response of pulsed γ-ray can be simulated, and the correlation coefficient can be up to 0.9707 as shown in the inset. This can be used as an assistant method to research the changes of pulse width, response time and wave form under different dose rate. In addition to the classical PN junction, the CF of P-channel Metal Oxide Semiconductor (PMOS) transistors in different gate size are

also simulated through the numerical method. The results of PMOS transistors are shown in Fig. 1 (b). The simulation results agree quite well with experimental results, which proves the accuracy of calculating the CF of MOS transistors by the numerical simulation. Moreover, the laser simulation range can be up to $1\times10^{12}$ rad(Si)/s which is more than one order of magnitude compared with the actual dose rate range ("Qiang Guang-I" accelerator). This provides an effective forecasting tool for high dose rates.

OGC 2018 – G0038

**Study on Spherical Aberration in the Laser Optical System**

**JIANG Heng and ZHUANG Jun-fei**

Ordnance N.C.O Academy, Army Engineering University of PLA, Wuhan, China

***Abstract* —** The effect of spherical aberration on the radius of image beam waist in the design of laser optical system is discussed in detail, and the relationship between the spherical aberration and the image beam waist radius in the laser optical system is deduced. Radius variation of image beam waist due to spherical aberration which varies with the position of object beam waist and the optical system focus is analysed by the form of curve. The analysis results indicate that the effect of spherical aberration on the radius of image beam waist should be considered according to the position of object beam waist in the design of a laser optical system. Finally, a design example of the optical system used for atmospheric laser communication system is given to illustrate the effect of spherical aberration on the image beam waist.

OGC 2018 – G0040

**An Adaptive Quantum Receiver for Binary Coding Signals Outperforming the Standard Quantum Limit**

**Fei Dong and Bing Zhu**

Electronic Engineering and Information Science, University of Science and Technology of China; Key Laboratory of Electromagnetic Space Information, Chinese Academy of Sciences; Hefei, China

***Abstract* —** We present a joint-detection quantum receiver scheme. Performance of the receiver is improved by adaptive control strategy based on Bayes criterion and optimized displacement followed by single photon detection in each temporal slot. The adaptive quantum receiver is applied to on-off keying (OOK) and binary phase shift keying (BPSK) modulated binary coding signals. Numerical simulation shows that the adaptive quantum receiver can outperform the standard quantum limit (SQL).

## Sub-session 5

## < Lightings and Displays >

### ---------- Invited ----------

**Resolution Enhancements for Three Dimensional Holographic Display**

**Liangcai Cao**
Tsinghua University, China

***Abstract*** **—** Three dimensional holographic display could support full parallax with a truthful window. Recent achievements on the computer generated holograms from three dimensional models are reviewed. In Hololab, we have developed a fast algorithm to reduce the computational time and keep the resolution of the display. The resolution of the display has been further evaluated by the point spread function for different parameters of the modulators. The effect of the illumination is investigated and an adaptive correction method could enhance the display quality.

**Biography**

Liangcai Cao received his BS/MS and PhD degree from Harbin Institute of Technology and Tsinghua University, in 1999/2001 and 2005, respectively. Then he became an assistant professor at Department of Precision Instruments, Tsinghua University. He is now a tenured associate professor and serving as the director of Institute of Opto-Electronic Engineering at Tsinghua University. He was a visiting scholar at UC Santa Cruz and MIT in 2009 and 2014, respectively. His current research interests are information storage, processing and display based on holography. He is a senior member of OSA and SPIE.

**Flexible Organic Light-Emitting Diodes by Minimizing the Waveguide and Plasmonic Losses**

**Jianxin Tang**
Soochow University, China

***Abstract*** **—** Flexible organic light-emitting diodes (FOLEDs) have shown the amazing applications in full-color flat panel displays and solid-state lighting due to their prominent advantages, including low power consumption, light weight, wide color gamut, fast response time and high contrast. To realize high-performance FOLEDs, a major research direction is to develop the alternative transparent electrodes with superior optical and electrical properties for replacing the ITO electrodes that are commonly used in conventional OLEDs. Various materials and structures have been proposed to function as transparent conductive electrodes. Metal-dielectric composite electrode (MDCE) has been regarded as an effective TCE for flexible devices in terms of mechanical flexibility, electrical conductivity, optical transparency, and large-area film uniformity. Whilst MDCE may be an ideal candidate to replace ITO, several technical challenges should be overcome when using MDCEs as transparent electrodes in transparent OLEDs. First, the presence of thin metal films in MDCEs will cause surface plasmonic (SP) loss at the metal-dielectric interface due to the oscillation coupling between free electrons at the metal surface and the emitting dipoles. Second, an optical microcavity effect is inevitable with the use of a planar MDCE structure, leading to the spectral and angular

dependence of the emission characteristics. Herein, an effective nanostructured metal/dielectric composite electrode (NMDCE) on plastic substrate is applied to transparent OLEDs with an ultrathin metal alloy film for optimum optical transparency, electrical conduction and mechanical flexibility. By combining an light-extraction structure for broadband and angle-independent outcoupling of white emission, the waveguided light and surface plasmonic loss can be remarkably reduced in white flexible OLEDs, resulting in a substantial increase in the external quantum efficiency and power efficiency to ~70% and 160 lm/W.

**Biography**

Jianxin Tang received his B.Sc. degree in physics from Zhejiang University in 2002, and Ph.D. degree in Physics and Materials Science from City University of Hong Kong in 2006. In 2008, he was appointed professor at the Institute of Nano Functional & Soft Materials (FUNSOM), Soochow University. He has published over 140 papers in internationally refereed journals (>3000 citations) in the field of device physics and optical engineering of organic optoelectronics. His current research areas/interests span device physics and surface science on organic and inorganic light-emitting diodes technology for flat panel display and solid-state lighting, and organic/perovskite photovoltaic cells for renewable energy, including localized electronic state and charge barrier formation at organic interfaces, and novel device architectures to improve device performance with interface modification for carrier transport and light manipulation.

**The Principle and Realization of No Visual Fatigue 3D Display with Glasses-Free based on Nanotechnologies**

**Linsen Chen**
Soochow University, China

***Abstract* —** The developments of new devices and advanced materials with nano structures perform significant roles in accelerating the progress of ultra-thin 3D display with glasses-free. Composite sub-wavelength optics and nano-structure devices with functional designs have become the trends in the novel display industries.

One of the critical questions is how to breakthrough the limitation of visual fatigue with barrier or lenticular approaches for 3D display in the past century? Recently, 3D display with glasses-free has been promoted by advanced nanotechnologies. To realize NO visual fatigue 3D display with glasses-free, a new principle based on the combination of phase light modulation plate with nano-structures and the LCD has been presented and analyzed. Another of important questions for commercialization of 3D display is how to fabricate the phase light plate with nano-structures and replicate the them to on the ultra-thin substrates in cost-effective?

The 5.5 inch and 32inch 3D display have been fabricated with light modulation plate and LCD, and show the wonderful real 3D effects from the different view of angles. The no visual fatigue 3D display has been achieved. The strategies to push the 3D display ahead have been introduced for either the research work, or the industrial applications. The glasses-free 3D display has shown powerful vital force in industry field. There are lots of opportunities to be collaborated together for 3D display.

**Biography**

Chen Linsen, born in 1961, graduated from Soochow University in 1982, and a visiting scholar of Carnegie-Mellon University in 1996. As a professor of Soochow University from 1998, he has been engaged in holography, 3D display, nano-imprinting and the micro-nano lithography systems for more than 25 years. He is the director of Holography & Optical Information Processing Committee of Optical Society of China.

He has established the top-level platform of advanced micro- nanotechnologies and devices for industrial applications. He and his team have made great of contributions to the innovation on the holographic technologies, the nano-patterning, the roll-to-roll nano-imprinting systems and the related flexible opto-electro devices in china. His achievements have been widely applied in the display, touch sensor, public-security, holography and printing industries. He founded the SVG Optronics in 2001, who become successfully one of stock companies in Shenzhen Stock Exchanges in 2012.

He earned the National Science and Technology Progress Award(2$^{nd}$grad) by Chinese central government twice in 2001 and 2011, the 12$^{th}$ and 14$^{th}$ Innovation Award for Excellent Chinese Patent in 2010 and 2012 by SIPO & WIPO, and won the Distinguished Award of Suzhou and Jiangsu in 2008 and 2011, respectively. He has also the 100 published papers and 80 patents. His interesting is to merge optics with nanotechnologies to promote the energy-saving for 3D display large size touch panel and nano-printing industries.

## Carbon Electronics for Information Storage and Displays

**Juqing Liu**
Nanjing Tech University, China

***Abstract*** **—** Carbon electronics have attracted significant attention from the scientific community due to their unique structures and novel properties, making them potential applications in next generation information technologies, largely because traditional silicon electronics are approaching their fundamental limits in terms of miniaturization and capacity. In this talk, opportunities and challenges facing information storage and display technologies will be introduced briefly. Then our work towards emerging resistive memory and light emitting devices based on carbon electronics will be demonstrated. Specially, several new concept devices, such as flexible electronics, transient electronics, and recyclable electronics, have been constructed via solution process strategy for data storage and light emission, which enable a mass-production with low-cost potential. Our study not only paves a way to create emerging carbon electronics in information technology, but also boosts the evolution of greener electronics for sustainable development.

**Biography**

Dr. LIU Juqing is currently Professor at Institute of Advanced Materials (IAM) at Nanjing Tech University. His group aims to the design and fabrication of carbon electronics, organic/plastic electronics, flexible and stretchable electronics, these devices include electrical memories for information storage,

light-emitting devices for information displays, and transistors for logical circuits. He has been honored as Excellent Young Scholar of China by NSFC and the Jiangsu Specially-Appointed Professor.

## ---------- Oral ----------

OGC 2018 – G0024

**Reconstruction of Color Mixing Model Using Tunable Light-Emitting Diode With Unequal Radiated Power**

**Revantino, R. A. Mangkuto, A. R. Sanjaya, J. K. Putra, F. X. N. Soelami, R. M. Soegijanto[1], Revantino[2]**

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***Abstract* —** Experiment used single chip of high power Light-emitting Diode (LED) was conducted to construct a model of color mixing. The used LED consisted of red-green-blue (RGB) components and formed into simple bulb prototype. The light intensity of each color could be adjusted by *Arduino* type microcontroller, with variation input levels from 0 to 250. It was obtained from initial characterization, by set same input levels, each color component had unequal peak of radiated power. Data processing and analysis were performed by multi-linear regression, to determine a linking matrix between *Arduino*'s input levels and mixed output in tri-stimulus values. By determining tuning coefficients from equalization of radiated power; it yielded evenly distribution of chromaticity coordinates in CIE-1931 diagram compared to initial model.

OGC 2018 – G0049

**Miniaturized LEDs for Displays and Instrumentations**

**Zheng Gong, Jiucheng Liu, ZhangXu Pan, Yanfeng Gong, Xiaoyan Liu, and Zhitao Chen**

Guangdong Institute of Semiconductor Industrial Technology, Guangdong Academy of Sciences

***Abstract* —** We discuss the use of various techniques, including advanced micro-fabrication, transfer printing, and flip-chip bonding, for the development of high-density addressable Micro-LED arrays, where each pixel has a pixel size of a few tens of microns. We show that multi-color display can be enabled by integrating QD/nanophosphors onto a monochromic blue-emitting Micro-LED array. Combined with suitable driver circuitry, we demonstrated high-resolution display prototype systems. We further demonstrated a number of different scientific instrumentation applications by using these micro-LED arrays as light sources, including mask-free lithography, optoelectronic tweezers, and fluorescent detection.

OGC 2018 – G0053

**Novel Super Resolution Method Based on the Principle of Single-pixel Imaging**

**Wei Zhang, Zhigang Yang and Junle Qu**

Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, College of

Optoelectronic Engineering, Shenzhen University, Shenzhen, China

***Abstract* —** The spatial resolution of optical microscopes is limited by light diffraction, and it is a obstacle to observe the fine structures of objects that below the diffraction limit with conventional optical microscopes. Besides, time resolution is also important to record molecule movements for biomedical study. In recent years, many superresolution methods have been proposed to break the diffraction limitation. By using photoswitchable molecules and capturing images of sparse located molecules, photoactivated localization microscopy (PALM), and stochastic optical reconstruction microscopy (STORM) can precisely determine the locations of molecules from the centroids of point spread function (PSF). Stimulated emission depletion (STED) microscopy obtain the diffraction-unlimited spatial resolution by applying the saturated stimulated emission and spatially restrict the system PSF. Structured illumination microscopy (SIM) use nonuniform illumination to shift the high frequency components into the pass-band of the microscope, and obtain two-fold spatial resolution improvement.

Although the mentioned methods can break the spatial resolution limit, they still limited by time resolution. Even if SIM is applied to obtain superresolution image which has fastest reconstruction speed, at least 9 original low-resolution images need to be captured. In this paper, we propose a novel superresolution method which aims to reach high temporal-spatial resolution. Firstly, we deduced the equivalent relationship between two calculation processes of superresolution image, PSF and patterns. Then, based on the deduced equivalent relationship and the principle of the single-pixel imaging, we can eventually get the superresolution image from known system PSF and only a original low resolution image. As a result, the time resolution of our proposed method is 9 times higher than that of SIM. It is suitable for tracing the dynamic procedures in biomedical study. Results of simulation experiments have verified the feasibility of the proposed method.

OGC 2018 – G0061

**Nosie-Corrected Compressed Sensing Localization Nano-Microscopy for Ultra-High Dense Labeling in live cell**

**Bingling Chen, Zhigang Yang, and Junle Qu**

Key Laboratory Of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, College of Optoelectronic Engineering, Shenzhen University, Shenzhen, China

***Abstract* —** The rapid development of super-resolution imaging, also termed as nano-microscopy, in recent ten years enabled hyperfine structures of organelles within cells to be visualized using optical microscopy. This extremely high resolution imaging circumvented the problem of the ‘diffraction limit’ allowed molecular biologists to track the significant signaling events within individual cells. Among this various super-resolution imaging technologies, localization microscopy achieve the highest resolution, even for individual molecules. But live cell imaging remains a challenge for localization-based super-resolution imaging because of sparse molecules snapshot is required to resolve distinguish between structures smaller than an Airy disk. A typical fine super-resolution imaging to meet Nyquist criterion of about 30- to 60-nm spatial resolution in STORM usually requires several

thousand frames and the timescale of imaging is generally on the order of minutes to an hour. Faster imaging modalities are inviting prospect. An alternative approach to improve the temporal resolution is to increase the density of staining probes so that more emitters can be captured per single camera frame. But, high-density probes cause fluorescent spots overlap and invalidate the commonly used single-molecule localization algorithm. A robust and high performance algorithm for high-density super-resolution image reconstruction based on global optimization using compressed sensing (CSSTORM) can dramatically improve the temporal resolution through squeezing the amount of camera frames from several thousands to hundreds for building a fine super-resolution imaging.

Furthermore high density labeling will also cause another serious problem is highly noise pollution that corrupted the measurements and optimization recovery. To address this problem, we have developed a noise-corrected algorithm based on principal component analysis (NC-PCA) couple with K-factor image factorization algorithm for raw data prior to CSSTORM localization. In short, NC-PCA was designed to project time series fluorescence image containing many pixels onto a subspace of reduced dimensionality to preserve the maximal variability contained in the data yet optimally reducing the noise. This noise follows the Poisson-distributed characteristic of single photon detection from EMCCD. The first and key step of the algorithm is a procedure that each single frame of the images is divided by the square-root of its average intensity for Poisson noise correction. This noise correction is necessary for accurate recovery of the underlying signal variance. Principal component analysis relies on the singular value decomposition (SVD) of the covariance matrix of this noise-corrected frames dataset and returns a new basis of orthogonal eigenvectors. The projections onto the new subspace were obtained by writing each decay as a linear combination of the eigenvectors. This is done for each pixel and each principal component.

OGC 2018 – G0078

**On-line Detection of Pantograph Offset based on Deep Learning**

**Luonan Chang, Zhen Liu and Yuan Shen**
Key Laboratory of Precision Opto-mechatronics Technology, Ministry of Education, Beihang University, Beijing, China

***Abstract* —** A safe train operation relies on the well-contact of pantograph and the power grid above, therefore identifying the state of pantograph plays an vital role. Among all of the malfunctions, pantograph offset is a strong reflection of the state. We have proposed a new approach to reconstructing the three-dimensional (3D) information of the bow by substituting the offset with connection of left and right horns. To locate the region of pantograph horn, we refer to an efficient deep learning method, named Single Shot MultiBox Detector (SSD). In the located area, region growing or wiener filtering is applied to extract connected components and enhance the prospects. For processed images, grayscale morphological gradients is adopted to obtain image edges, on which Harris corner detection can provide dozens of potential corner-points. These points containing one correct horn point needs selection by assuming the lowest one is the best, only when the background noise is as low as possible. After attaining the two-dimensional (2D) image coordinates of the horns, binocular stereo vision method makes contribution to reconstructing 3D

coordinates. Using the 3D coordinate line of the left and right horns to represent the pantograph offset can easily reflect the degree of deviation by comparing it with the initial location of pantograph. Our approach is of great significance to prevent malfunction, which are about to arise later, such as horn loss or deflection, spark of pantograph and catenary system contact-point. The detection of the pantograph offset provides a strong guarantee for maintaining railway traffic safety.

OGC 2018 – G0079

**A Pantograph Horn Detection Method Based on Deep Learning Network**

**Yuan Shen, Zhen Liu and Luonan Chang**
Key Laboratory of Precision Opto-mechatronics Technology Ministry of Education, Beihang University, Beijing, China

***Abstract* —** A good contact between the pantograph and catenary ensures the safety of high-speed train operation. Pantograph horn, which is the curved structure at both ends of the pantograph, plays important roles in monitoring the operation state of the train. Nowadays, deep learning method has a significant effect in the detection of horns and fault. In this paper, a pantograph horn detection method has been proposed. The method is based on single-shot mutibox detector(SSD) method, which is a real-time method and also with high detection accuracy. A on-orbit image data set with multiple viewing angles and multiple pantograph types is collected to be used in the training stage. The target region is converged through the combination of the feature map in early convolution layers and the prior knowledge. Then, detection results with the partial image and global image as input are obtained, and high accuracy detecting result is generated after confidential decision. Results on actual datasets show that our method can stably obtain accurate horn location, and help to monitor the pantograph status. Moreover, pantograph defects of several common pantograph types can be detected robustly.

OGC 2018 – G0080

**Global Calibration of Two Cameras with Optical Filter with Non-overlapping Views Using 1D Square Serrated Target**

**Dong Li and Xiao Pan**
Key Laboratory of Precision Opto-mechatronics Technology Minitry of Education, Beihang University, Beijing, China

***Abstract* —** Many multi-vision measurement systems like outdoor industrial engineering utilize optical filter to filter unexpected light which makes it impossible to use traditional planar pattern for calibration. In this paper，we propose a stereo vision global calibration method for non-overlapping views that comprises two cameras，an optical line laser whose wave band within the optical filter's and 1D square serrated target. Vertex-points coordinates in the camera coordinate frame (CCF) are obtained based on the cross ratio invariance theory and vanishing points. Initial rotation vector and translation vector are confirmed by flexibly moving the target to at least three different positions. After a nonlinear refinement，external parameters are precisely determined. Experimental results show that the measurement accuracy reaches to 0.06 mm within the cameras' FOV of 450mm*370mm.

## Sub-session 8 – B

## < Fiber-Based Technologies and Applications >

## ---------- Invited ----------

### SLM-based High-Efficiency 3D Femtosecond Laser Microfabrication for Microoptical and Microfluidic Devices

**Dong Wu**
University of Science and Technology of China, China

***Abstract*** — Femtosecond laser induced two-photon polymerization (TPP) has been proved to be a powerful microfabrication technique with high efficiency and quality. However, the main drawback of TPP technique is its low fabrication efficiency caused by the point-to-point raster scanning strategy, which seriously restricts its applications. In order to overcome the disadvantages, SLM-based (spatial light modulator) 2D-3D laser intensity patterns (e.g., mutlifoci or arbitrary patterns) were proposed to significantly speed up the fabrication process by serveral orders of magnitude, and has a wide range of applications in optics, micromachines, and biology, owing to its capability to dynamically update the intensity distributions in the focal plane by modifying the phase of incident light. A series of 2D-3D functional microdevices such as Damman grating, microfilter and flower-like microtube arrays were rapidly fabricated and show various functions, such as beam splitting, particles filtering and cell manipulation.

**Biography**

Dong Wu is a professor at University of Science and Technology of China. He obtained the fifth Chinese Thousand Youth Talents Plan and National Excellent Doctorial Dissertation. His current research interests are femtosecond laser 3D microfabrication for microoptical devices, microfluidic chips, micromachines, and biomimetic microstructures. Prof. Wu has published 65 papers in the international journals of Light: Sci & Appl.(Nature publishing group), PNAS, Laser Photon. Rev., Adv. Mater., Adv. Funct. Mater., Small, Lab Chip, Appl. Phys. Lett., Opt. Lett. and so on.

### Short Pulses Fiber Lasers based on Tilted Fiber Gratings

**Chengbo Mou**
Shanghai University, China

***Abstract*** — Short pulses fiber lasers based on either mode-locking or Q-switching have found various types of applications in the fields of telecommunication, micromachining, biological study etc. Using nonlinear polarization based pulsation technique, short pulses ranging from nanosecond to femtosecond can be routinely generated in fiber laser cavities. The polarizing element in achieving short pulses within a fiber laser cavity is therefore critically important, especially a fiber based polarizing element is highly desirable. In this talk, I will summarize the recent development of short pulses fiber lasers based on tilted fiber grating devices. Such fiber grating device features nominally high polarization dependent loss. It is this strong polarization effect help on obtaining laser self-pulsation when incorporated into a

fiber laser cavity. While mainly focusing on the Erbium doped fiber lasers system, side works with collaborator on Yb and Tm doped fiber lasers based on such grating devices will also be reviewed.

**Biography**

Chengbo Mou obtained his B.Eng degree in electronic science and technologies from Tianjin University in 2004. In 2005, he received M.Sc in photonics and optoelectronic devices from the University of StAndrews in Scotland. He received his Ph.D degree in photonics from the Aston Institute of Photonic Technologies at Aston University in 2012. He then worked as an industrial research fellow at Aston University. From 2016, he joined in the Key Laboratory of Specialty Fiber Optics and Optical Access Networks as a full professor. He is the recipient of National "Young 1000 Talent" programme of China, he is also the recipient of Young Eastern Scholar Fellowship from the Shanghai Institute of Higher Learning. His research interests are nanophotonics, nanomaterial based nonlinear photonic devices, ultrafast fiber lasers, novel type of mode locked lasers, nonlinear applications of advanced fiber grating devices.

**Photoacoustic Imaging with Fiber-laser-based Ultrasound Sensors**

**Long Jin**
Jinan University, China

***Abstract* —** Photoacoustic imaging (PAI) has made great progress in the past decade. Further development of PAI requires ultrasound probes with miniature size and high sensitivity, especially for intravascular and endoscopic applications. Fiber optic sensors are compact in size, highly sensitive to applied perturbations, flexible in geometry and have found applications in biomedical imaging. We have developed a new photoacoustic sensor based on a small-sized fiber laser. It presents a noise-equivalent pressure (NEP) of 40 Pa over a 50-MHz bandwidth, which is sufficient for PAI applications. By using this sensor, we have demonstrated fast, wide-field optical-resolution photoacoustic microscope. Microvascular imaging with a frame rate of 2 Hz over a 2×2 $mm^2$ area was demonstrated in vivo. The new technique may be used in the visualization of biological and physiologic dynamics.

**Biography**

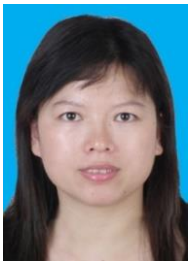
L. Jin received the B.S. degree in applied physics and the Ph.D. degree in optics from Nankai University, China, in 2003 and 2008, respectively. He joined the Department of Electrical Engineering, Hong Kong Polytechnic University in 2008, as a research assistant and then a Postdoctoral Research Fellow. Since 2010, he has been with Institute of Photonics Technology, Guangzhou, China as an associate professor and then a full professor. His research interests include fiber optics, photonic sensors and their imaging applications.

**Three-dimensional Manipulation based on Hybrid Photothermal Waveguides**

**Xiaobo Xing**
South China Normal University, China

***Abstract* —** A method for manipulating tiny particles both vertically and horizontally using lasers has been developed by scientists in China. Intense beams of light create vortices in a fluid that can trap nanoscale objects. This concept is harnessed using so-called 'optical tweezers' for accurately positioning or sorting cells. The ideal optical manipulation set-up can transfer the target particle in any direction. We have realized just such a system using micrometer-scale channels in graphene oxide. Vertical manipulation was achieved by using laser light to heat the fluid-carrying channel and generate buoyancy. Similarly, heat-induced capillary action drove horizontal motion. This approach could be used in lab-on-a-chip applications: portable compact devices that can sensitively and accurately analyze chemical or biological samples.

**Biography**



Xiaobo Xing received the B. S. degree from Qufu Normal University, Qufu, China in 2002 and Ph.D. degree from Sun Yat-Sen University, Guangzhou, China in 2008. From 2009 to 2011, she was Postdoctor Fellow at Jinan University, Guangzhou, China. In 2011, he joined College of Biophotonics, South China Normal University, where she is presently a Professor. From 2015 to date, she was appointed Member of editorial committee from Scientific Reports. Prof. Xing was awarded a Second Class National Natural Science Award of China in 2015 and First Science and Technology Award of Guangdong in 2014. Her Doctoral Dissertation has been nominated as National Excellent Doctorial Dissertation in 2011 and awarded as Excellent Doctorial Dissertation of Guangdong in 2010. She has published 60 academic papers such Nano Letters, NPG Asia Materials, Applied Physics Letters, etc.

Current Research Interests: Photonics, Optical Sensors and Instrumentation, Optofluidics, Lab-on-a-disc, Nano-materials.

## ---------- Oral ----------

OGC 2018 – G0068

**Microwave Photonic Antenna for Fiber Radio Application**

**Wang Lan and Yu Jianguo**

Beijing University of Posts and Telecommunications, Electronic Engineering Institute, Beijing ,China

***Abstract* —** In this paper, a 4×1 photonic array antenna which operates at a center frequency of 20GHz is proposed. Photonic frequency up conversion technology is applied to generate 20GHz microwave signal. Based on silicon material, the photonic devices and antenna are integrated on the substrate to achieve high-speed massive information processing. 3D electromagnetic simulation software HFSS is used to build and optimize the simulation model of antenna. The performance of antenna is measured in the electromagnetic darkroom, verifying the design is feasible. For fiber radio application, the measured antenna maximum gain in the bandwidth is 12.49dBi. Photonic antenna maintains a relatively good performance which can be widely used in the future mobile communication network.

OGC 2018 – G0072

**A Fiber-tip Fabry-Perot Sensor with Oil-sealed Thin-film Silica Microbubble Configuration for Temperature Sensitivity Enhancement**

**Guanjun Wang, Mengxing Huang, Shubin Zhang1[1], Jianning Han, YuhangLi1, Jinyu Gu, Jinrong Liu[2], Kaiwei Jiang[3]**

[1] Collage of Information Science & Technology, Hainan University, Haikou,China; [2] Collage of Information and Telecommunication Engineering, North University of China, Taiyuan, China; [3] College of Mechatronic Engineering, North University of China, Taiyuan, China

***Abstract* —** An improved pressure-assisted arc discharge technology was utilized to fabricate a thin-film silica microbubble based fiber-tip temperature sensor. Then, it was coated with metal film before immersed with oil for ten times of sensitivity enhancement.

OGC 2018 – G0085

**High Sensitivity Sensing of Low Concentration Solution of -S Tapered Fiber Based on Maher Zed Interferometer**

**Dujuan Yang, Han Zhu, Member, Yunxu Sun, Zhiwei Lu, Huazhen Xu**

the School of Electronic and Information Engineering Harbin Institute of Technology, Shenzhen ShenZhen, China

***Abstract* —** The light propagation in the S tapered optical fiber sensor is simulated by R-soft. It is proved that theory of interference in S tapered fiber. Instead of using the fiber fusion splicer, we utilize the common fused biconical taper machine used in industry to fabricate the S tapered fiber by arc heating. We study to measure the sensing characteristics of the S tapered fiber sensor in low concentration of solution. The results show that the maximum sensitivity of the concentration of solution in the range from 2g/L (1.3336677) to 10g/L (1.3340331) is about 814.921 nm/RIU, and the resolution is 8.7247714×10-6RIU.

OGC 2018 – G0086

**High Sensitive Fiber Bragg Grating Vibration Sensor Based on Quartz Diaphragm**

**Qingchao Zhao, Xiaohui Liu, Yingying Wang, Long Ma, Wenan Zhao, Hui Li, Faxiang Zhang**

Lase Institute of Shandong Academy of Sciences, Qilu University of Technology (Shandong Academy of Sciences), Jinan, China

***Abstract* —** In view of the plastic deformation of the metal diaphragm, a cantilevered beam fiber Bragg grating(FBG) vibration sensor based on quartz diaphragm is designed. The relationship between the structural parameters of the sensor, the sensitivity and the harmonic vibration frequency is theoretically analyzed and optimized. Samples of sensors were produced and the sensor's acceleration sensitivity and frequency response were tested. The results show that the harmonic vibration frequency of the sensor is 52HZ, and the acceleration sensitivity below 40HZ can reach 785pm/g.

OGC 2018 – G0089

**The Research of Vibration Monitoring System for Transformer Based on Optical Fiber Sensing**

**Min Li, Li Shujuan, Zhang Xiaolei, Zhang Faxiang ,Sun Zhihui, Wang Meng, Zhao QingChao, Yang Yuanyuan, Ma Long**

Laser Institute,, Qilu University of Technology (Shandong Academy of Sciences), Jinan, China

***Abstract* —** Transformer is the key equipment in power system and its stability directly affects the stability of power grid. Under normal, the magnetostriction of silicon steel sheet will cause the vibration of the transformer's core and the winding will vibrate by the electromagnetic force of loading current. We can know the operation condition of transformer by Monitoring vibration .In this paper, a high-sensitivity fiber Bragg grating vibration sensor is used to monitor the vibration signal of the transformer during real-time on-line monitoring. Compared with
the existing transformer winding deformation test technology, the vibration analysis method has no electrical connection with the entire power system. The normal operation has no effect, and can achieve the purpose of online monitoring safely and reliably. It can not only detect the winding deformation fault caused by the short circuit, but also detect the looseness of the structural parts such as the iron core and the tap changer.

# DAY 3｜ Sep 7, 2018

| S6-C < Optoelectronic Devices and Applications > ( Venue: Lotus Hall 6, 5th F, SZCEC ) | | |
|---|---|---|
| Chair: Baojun li, Qin Cheng | | |
| 09:00-09:25 | Invited | **Reconfigurable Silicon Photonic Processors**<br>Linjie Zhou｜Shanghai Jiao Tong University, China |
| 09:25-09:40 | G0066 | **The Application of Inorganic Hole-Transport Material in Perovskite Solar Cells**<br>She Zhen ｜University of Electronic Science and Technology of China, China |
| 09:40-09:55 | G0071 | **A Broadband Microwave Photonic Mixer with the Capability of Phase Shifting**<br>Ruiying He｜Inner Mongolia University, China |
| 09:55-10:25 | Coffee Break | |
| 10:25-10:50 | Invited | **Visible Light Lasers and Integrated Photonics for Smart Lighting and High Bitrate Visible Light Communications**<br>Chao Shen｜KAUST, Saudi Arabia |
| 10:50-11:05 | G0082 | **Towards Autonomous Driving Technology: A Method to Enhance Visibility in Fog based on Low-Position Road Lighting**<br>Bolin Xu｜Shenzhen University,China |
| S7-B < Biophotonics and Biomedical Optics >\ ( Venue: Lotus Hall 2, 5th F, SZCEC ) | | |
| Chair: Jun Qian | | |
| 09:00-09:25 | Invited | **Recent advances on optical monitoring technologies for photodynamic therapy**<br>Buhong Li｜Fujian Normal University |
| 09:25-09:50 | Invited | **Gap-enhanced Raman Tags (GERTs) for Intraoperative Cancer Imaging and Therapy**<br>Jian Ye｜Shanghai Jiao Tong University, China |
| 09:50-10:15 | Invited | **Phototheranostic nanoagents active in near and short-wave infrared spectral ranges**<br>Tymisg Ohulchanskyy｜Shenzhen University |
| 10:15-10:45 | Coffee Break | |
| Chair: Buhong Li | | |
| 10:45-11:10 | Invited | **Cancer Cell Membrane-Modified Multifunctional Nanoparticles for Tumor Imaging and Photodynamic Therapy**<br>Xiaolong Liu｜Mengchao Hepatobiliary Hospital of Fujian Medical University,China |

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|---|---|---|
| 11:10-11:25 | G0094 | **Two-photon Excited Fluorescence of Small Squaraine Dye and Its Application in Long- term Near-infrared II Bioimaging**<br>Rongxing Yi, Liwei Liu, and Junle Qu｜Shenzhen University, China |
| 11:25-11:40 | G0057 | **In Vitro on-chip Oxygen Sensing Platform for Study the Hypoxia Effect on Tumor Cells**<br>Yihua Zhao｜Shenzhen University, China |
| 11:40-11:55 | G0014 | **A Novel Type of Visual Gas Sensing Technology**<br>Wenli Zhang and An Song｜Chongqing University, China |
| 11:55-12:10 | G0025 | **Multi-channel Optical Coherence Tomography (MC-OCT): A Daisy-Chained Sensing Approach**<br>Taye Mekonnen｜Macquarie University,Australia |
| 12:10-12:25 | G0091 | **Hyperspectral Stimulated Raman Scattering Microscopy Facilitates Accurate Diagnosis of Clear Cell Renal Cell Carcinoma**<br>Shuhua Yue｜Beihang University, China |
| S2-C < Optical Communication and Networks ><br>( Venue: Lotus Hall 4, 5th F, SZCEC ) | | |
| Chair: Anhui Liang | | |
| 09:00-09:25 | Invited | **Output Power Enhancement in Photonic-Based RF Generation by Optical Pulse Compression with a Dispersion Managed Fiber**<br>Hiroyuki Toda｜Doshisha University, Japan |
| 09:25-09:40 | G0084 | **Electromechanical Co-simulation of Car-mounted Optical Termina in Laser Communication**<br>Yangyang Bai｜Changchun University of Science and Technology, China |
| 09:40-09:55 | G0092 | **A Laser Communication Antenna with Integrated Optical Hood**<br>Xiang Li｜Changchun University of Science and Technology, China |
| 09:55-10:25 | Coffee Break | |
| 10:25-10:40 | G0093 | **Research on Effect of Multiple Factors on BER in Quantum Key Distribution System Based on Movable Platform**<br>Yu Zhu｜Air Force Engineering University, China |
| 10:40-10:55 | G0097 | **An Asymmetric Key Distribution Scheme Based on Physical Characteristics of Optical Fiber Channel**<br>Yingwen Fu, Yajie Li, Yongli Zhao and Jie Zhang｜Beijing University of Posts and Telecommunications,China |
| S1-B < Laser Technology ><br>( Venue: Lotus Hall 5, 5th F, SZCEC ) | | |
| Chair: Tianye Huang | | |
| 09:00-09:25 | Invited | **Ultra-Short-Pulsed Mid-Infrared Optical Parametric Oscillators**<br>Zhaowei Zhang｜Huazhong University of Science & Technology, China |

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|---|---|---|
| 09:25-09:40 | G0050 | **Characteristics research on cross-media interaction and transmission of ultrashort pulse laser**<br>Lihua Lei｜CAST,China |
| 09:40-09:55 | G0051 | **Tunable Nanosecond Pulse Fiber Laser with High Beam Quality and All Fiber Structure**<br>Yao Wen｜Southern University of Science and Technology & Harbin Insititute of Technology, China |
| 09:55-10:25 | Coffee Break | |
| 10:25-10:50 | Invited | **Ultrafast Fiber Lasers and Their Applications**<br>Xiaohui Li｜Shaanxi Normal University, China |
| 10:50-11:05 | G0088 | **High Precision Echo laser simualtor for Perfomance Detection of Individual Soldier Fire-control Device**<br>Ming Liu｜Changchun Obsercatory, National Astronomical Observatory, Chinese Academy of Sciences, China |
| 11:05-11:20 | G0095 | **Saturable Absorber Based on Black Phosphorus-Polymer Composites for High-Power Operation of Pulsed Er-doped Fiber Laser**<br>Wei Song｜ Shanghai University, China |

# Sub-session 6 – C

# < Optoelectronic Devices and Applications >

## ---------- Invited ----------

### Reconfigurable Silicon Photonic Processors

**Linjie Zhou**
Shanghai Jiao Tong University, China

***Abstract*** **—** We present our recent work on versatile optical signal processing using reconfigurable integrated silicon photonic devices and chips. The functionality of a chip can be altered by redefining the optical routes in the photonic circuits, greatly expanding its applications as a universal optical processor. Various factors that affect the processing capability such as elementary components, optical connection topology, active tuning implementation method will be discussed. Typical functions like filtering, switching, delay and optical beam steering have been experimentally demonstrated.

**Biography**

Dr. Linjie Zhou is a full professor of School of Electronic Information and Electrical Engineering, Shanghai Jiao Tong University. He received his B.S. degree in microelectronics from Peking University in 2003. He received his Ph.D. degree in electronic and computer engineering from the Hong Kong University of Science and Technology in 2007. From 2007 to 2009, he worked as a postdoctoral researcher at University of California, Davis. In 2010, he joined the State Key Lab of Advanced Optical Communication Systems and Networks of Shanghai Jiao Tong University. His research interests include silicon photonics, plasmonic devices and optical integration. He has published near 200 peer-reviewed international journal and conference papers and has given more than 40 invited talks in international conferences. He has organized many sessions in multiple international and domestic conferences. He was elected as the "Yangtse River Young Scholar" by the Minister of Education of China in 2016. He was granted the "Newton Advanced Fellowship" in 2016 and "National Science Fund for Excellent Young Scholars" in 2014, and entered the "Shanghai Rising-Star Program" in 2014. He also got the SMC Excellent Young Faculty Award of Shanghai Jiao Tong University in 2014 and 2010.

### Visible Light Lasers and Integrated Photonics for Smart Lighting and High Bitrate Visible Light Communications

**Chao Shen**
KAUST, Saudi Arabia

***Abstract*** **—** As a key component in visible light communication (VLC) systems, the spotlight on device innovations for enabling high data rate and modulation bandwidth VLC is pivotal. To date, smart lighting and VLC functionalities have been demonstrated based on discrete devices. In this presentation, we propose, design, fabricate and characterize the integration of III-nitride photonic components towards the realization of III-nitride integrated photonics. Such on-chip integration offers the advantages of small-footprint, high-speed, and low power consumption for enabling high bitrate VLC links. The recent advances in

laser based free-space VLC, underwater VLC and non-line-of-sight (NLOS) VLC will also be discussed.

**Biography**

Chao Shen received the PhD degree in Electrical Engineering from KAUST and the BSc degree in Materials Physics from Fudan University. He is currently a research consultant at KAUST. Dr. Shen has published over 50 peer-reviewed journal and conference papers, including *Optics Express, Optics Letters, ACS Photonics, Nano Letters, Nanoscale, Applied Physics Letters, APEX, CLEO, IEDM, OFC,* etc., and has 6 US patents pending. His work has been highlighted in over 40 media reports. His research interests include III-nitride photonic integrated circuit, GaN-based laser diodes, superluminescent diodes, micro-LEDs, and VCSELs.

## ---------- Oral ----------

OGC 2018 – G0066

### The Application of Inorganic Hole-Transport Material in Perovskite Solar Cells

**She Zhen**

State Key Laboratory of Electronic Thin Films and Integrated Devices, Optical Engineering, UESTC, ChenDu, SiChuan, China

***Abstract* —** Perovskite material is one of the most popular semiconductor materials which is widely used in semiconductor photovoltaic devices especially in solar cells. Perovskite materials not only has high response and high absorb to the visible spectrum, also possesses large carrier mobility and large carrier diffusion length which makes it the most suitable materials for applications in photovoltaic devices. But as a battery semiconductor, it not only needs high cost material to be the hole-transport layer, but also cause stability problems. That's the main research direction in perovskite solar cells at present.

Now, we use a kind of inorganic hole-transport material CuSCN to fabricate devices. And the main purpose of this research is to analyze the principle of perovskite materials, and the use of CuSCN. And how to fabricate a solar cell which arrive a high photon-to-current efficiency(PCE). And we have achieved PCE as high as 15%. CuSCN has a wide band width, and so is transparent in visible spectrum which makes it using in inverted structure device. This gives the electron-transport layer more options. CuSCN has a high rate of hole transfer ability and don't need to anneal with a high temperature. This gives it great potential for use in flexible devices.

Solar cells will play a more and more important role in our future life since the energy shortage problem is becoming more and more serious. And according to the characters and functions mentioned above, the device we made could be applied in military, communication equipment and life application. Because of the low defect density, high carrier mobility, narrow band gap and low cost, CuSCN can be an ideal material for high-efficiency photodevice.

OGC 2018 – G0071

### A Broadband Microwave Photonic Mixer with the Capability of Phase Shifting

**Ruiying He, Xiaoyu Zhang, Yikun Zhao,**

**Caili Gong, Kai Sun, Yongfeng Wei**
Department of Electronic Information Engineering, Inner Mongolia University, Hohhot, China

***Abstract* —** A broadband microwave photonic mixer with 360-degree phase tunable range and without optical filter is proposed. In the proposed system, two integrated dual-parallel Mach-Zehnder modulators (DPMZM) and a phase modulator (PM) are used. The two DPMZMs driven by the local oscillator (LO) and the radio frequency (RF) signals respectively are properly biased at the minimum transmission point to serve as a carrier-suppressed single-sideband (CS-SSB) modulators. Beating between the two sidebands at a photodetector generates a/an RF/IF signal with a phase equal to the optical phase difference controlled by the bias voltage of PM. The proposed system is theoretically verified and demonstrated, the results that a RF signal from 15 to 39 GHz and an IF signal from 5 to 29 GHz, and a full 360 ° continuous phase shift of the output IF/RF signal are achieved

OGC 2018 – G0082

**Towards Autonomous Driving Technology: A Method to Enhance Visibility in Fog based on Low-Position Road Lighting**

**Bolin XU, Songbai YANG, Guanhua Lai, Shenfei CHEN , Weisheng LI, Bing ZHANG, Haitian ZHAO**
School of Architecture & Urban planning SHENZHEN UNIVERSITY, Shenzhen, China

***Abstract* —** To see through the thick fog is an important challenge in the field of autonomous driving technology. This experiment developed a new lighting method to improve visibility under thick fog based on the principle of visual acuity in biology of vision. The experiment was conducted in a fog equipment that is 1.5 meters * 1.2 meters * 4.0 meters in volume, with an accurate ratio of 1:15 compared with realistic road. The experiment increased the visual distance under thick fog from 1.5 meters to 3.0 meters, increased by one times. The research results are of great significance to the development of autonomous driving technology.

# Sub-session 7 - B

# < Biophotonics and Biomedical Optics >

## ---------- Invited ----------

### Recent advances on optical monitoring technologies for photodynamic therapy

**Buhong Li**
Fujian Normal University

***Abstract*** — Photodynamic therapy (PDT) is a promising photonic therapeutic modality for both oncological and non-oncological diseases. In order to further elucidate the biological mechanisms and to optimal the treatment dosimetric parameters for clinical PDT, the recent developed optical monitoring technologies for dosimetric monitoring will be presented. In addition, the challenges for developing real-time and noninvasive optical technologies for PDT application will be discussed.

**Biography**

Buhong Li is a professor of Biomedical Photonics at Fujian Normal University. He received his PhD degree in Optical Engineering from Zhejiang University in 2003. He was the New Century Excellent Talents in Ministry of Education of China since 2009. He was a visiting scientist in the Ontario Cancer Institute and University of Toronto from September 2005 to September 2007. He then worked as a senior visiting fellow in Institute of Physics of Humboldt University of Berlin from April 2014 to August 2014. His research focuses on optical modalities and apparatus for monitoring photodynamic therapy dosimetry, in particular for the spatiotemporal detection of singlet oxygen luminescence. He has authored more than 100 publications.

### Gap-enhanced Raman Tags (GERTs) for Intraoperative Cancer Imaging and Therapy

**Jian Ye**
Shanghai Jiao Tong University, China

***Abstract*** — Recently a new type of surface-enhanced Raman scattering (SERS) tag, termed gap-enhanced Raman tag (GERT), has been reported by us and other groups. GERTs are composed of a uniform and subnanometer-sized interior gap between the metallic core and shell. We have demonstrated a number of greatly important optical properties of GERTs, including charge transfer effect, large Raman enhancement and highly tunable multiplexed enocoding capability, refractive index quantification of sub-nanometer thick molecular layers on nanoparticles, ultrahigh photostability during laser continuous irradiation with an off-resonance strategy, and high-speed cell imaging. Recently GERTs exhibit great potential for accurate and intraoperative location of the sentinel lymph nodes in clinical application.

The inability to intraoperatively diagnose and eliminate microscopic and residual tumors represents a significant challenge in cancer surgery. These residual microtumors cause lethal recurrence and metastasis. In this talk, we will show a crucial example of Raman imaging with GERTs to serve as a robust platform for intraoperative detection and

eradication of residual microscopic foci, which exist in surgical margins, tumor invasion, and multifocal tumor spread. This unique nanostructure elicits highly sensitive and photostable Raman signals for microtumor detection by applying a 785-nm, low-energy laser, and produces hyperthermia effects for microtumor ablation upon switching a 808-nm, high-power laser. In the orthotopic prostate metastasis tumor model, systematic delivery of GERTs enabled precise imaging and real-time ablation of macroscopic malignant lesions around surgical bed, without damaging normal tissues. Consequently, the GERTs-based surgery prevented local recurrence and delivered 100% tumor-free survival.

Abdominal miliary spread and metastasis is one of the most aggressive features in advanced ovarian cancer patients. The current standard treatment is cytoreductive surgery (CRS) combined with hyperthermic intraperitoneal chemotherapy (HIPEC). However, most patients cannot receive optimal CRS outcomes due to the extreme difficulty of completely excising all microtumours during operation. Though HIPEC can improve prognosis, treatment is untargeted and may damage healthy organs and cause complications. In the second example, cisplatin-loaded GERTs are designed specifically for the intraoperative detection and elimination of unresectable disseminated advanced ovarian tumours. With unique and strong Raman signals, good biocompatibility, decent plasmonic photothermal conversion, and good drug loading capacity, GERTs enable detection and specific elimination of microtumours with a minimum diameter of 1 mm via chemo-photothermal synergistic therapy, causing minimal side effects and significantly prolonging survival in mice. Our results demonstrate that GERTs based chemo-photothermal synergistic therapy can effectively control the spread of disseminated tumours in mice and has potential as a safe and powerful method for treatment of advanced ovarian cancers, to improve survival and life quality of patients.

**Biography**

Jian Ye received his B.E. degree (2000) and M.S. degree (2003) in Polymer Science and Engineering from Zhejiang University, China, and his Ph.D. degree (2010) in Chemistry from KU Leuven, Belgium. From 2003 to 2005, he worked at Intel Products (Shanghai) Ltd. as a material engineer. From 2005 to 2010, he performed his Ph.D. research project in Interuniversity Microelectronics Center (IMEC), Belgium. Before he joined Shanghai Jiao Tong University, he was a senior researcher in IMEC (2010-2013) supported by the Postdoctoral Fellowship of the Research Foundation–Flanders (FWO) in Belgium. In 2011 (Mar–Sep), he worked in the nanophotonics group of Prof. Naomi Halas at Rice University as a visiting scholar. Now he is a full professor in the School of Biomedical Engineering in Shanghai Jiao Tong University. He has received the "Outstanding Youth Fund" from National Natural Science Foundation of China (2016), Scholar of "Thousand Talent Program for Young Outstanding Scientists" from the Chinese Government (2013), the 2009 Chinese Government Award for Outstanding Self-Financed Students Abroad, and the 2009 IMEC Scientific Excellence Award. He has authored or ca-authored more than 55 peer-reviewed journal papers, 1 book chapter, and 10 patents. His research interests include design, fabrications and biomedical applications of plasmonic nanostructures and

surface-enhanced Raman spectroscopy.

**Phototheranostic nanoagents active in near and short-wave infrared spectral ranges**

**Tymisg Ohulchanskyy**
Shenzhen University

***Abstract*** — Applications of biophotonics in biomedical field, such as optical diagnostics (e.g., optical imaging) and phototherapy (e.g., photodynamic therapy, PDT) are significantly determined by the ability of light to penetrate a biological tissue. An existence of the "optical transparency windows" for biological tissues in the near and short-wave infrared (NIR-SWIR) spectral region is known to allow for noninvasive optical bioimaging of small animals in biomedical research. It is now becoming clear that NIR-SWIR imaging delivers a great promise as a powerful yet feasible and non-expensive imaging technique for imaging guided surgery, therapy and drug delivery. A deep tissue NIR- SWIR imaging can be assessed through the development of the exogenous imaging contrasts. Furthermore, with involvement of nanochemistry, NIR-SWIR imaging nanoprobes can be developed and equipped with other imaging, therapeutic or sensing modalities. With the nanotechnology-enabled combination of diagnostics and therapeutic capabilities, imaging guided theranostic nanovehicles for drug delivery are among the most intensively developed subjects in the medical application of nanotechnology, nanomedicine.

This talk will introduce our work on development of the heterogeneous nanoparticles for NIR-SWIR bioimaging in conjunction of other type of medical imaging and imaging guided drug delivery, therapy and sensing. We design and synthesize heterogeneous nanoparticles of different morphology, size and composition and introduce them as NIR-SWIR imaging nanoplatforms, which can also be furnished with other modalities and medical imaging contrasts. Combination of NIR-SWIR imaging capabilities with targeted delivery of phototherapy enables new paradigm in the development of phototheranostic nanoagents.

**Biography**

Tymish Ohulchanskyy holds his B.S./M.S. (Physics) and Ph.D. (Optics and Laser Physics) degrees from Taras Shevchenko National University of Kyiv (Kyiv, Ukraine). After obtaining Ph.D. in 2001, Dr. Ohulchanskyy has joined the University at Buffalo (Buffalo, NY, USA) as a post-doctoral associate, later advancing to the position of Deputy Director at the University at Buffalo's Institute for Lasers, Photonics and Biophotonics. Since 2016, Dr. Ohulchanskyy is in the position of Distinguished Professor in the College of Optoelectronic Engineering of Shenzhen University, Shenzhen, Guangdong, China. He has published more than 120 articles in peer-reviewed journals (>11000 citations, h-index of 47, according to Google Scholar) and has a number of patents and patent applications. Dr. Ohulchanskyy is a member of the international Society for Optics and Photonics (SPIE) and American Chemical Society (ACS), he serves on editorial boards of several journals.

**Cancer Cell Membrane-Modified Multifunctional Nanoparticles for Tumor Imaging and Photodynamic Therapy**

**Xiaolong Liu**
Mengchao Hepatobiliary Hospital of Fujian Medical University, Fuzhou, China

***Abstract*** — Theranostic nanoprobes integrated with dual-modal imaging and therapeutic functions like photodynamic therapy (PDT) have enabled an enormous potency in cancer treatments, due to their high imaging accuracy and non-invasive advantages for cancer elimination. However, the good biocompatibility and highly efficient tumor accumulation of these nanoprobes are still undesirable in clinical applications. In this study, we designed a photosensitizer-loaded magnetic nanobead with surface further coated with a layer of cancer cell membrane (SSAP-Ce6@CCM) for improving the biocompatibility and cellular uptake, and ultimately leading to the enhanced MR/NIR fluorescence imaging and PDT efficacy. The physicochemical property was carefully characterized by transmission electron microscopy (TEM), dynamic light scanning (DLS), fourier transform infrared (FT-IR) spectra, UV-vis-NIR absorption spectra, fluorescence emission spectra, as well as western blot analysis. The crosslinked SPIONs have a good T2-MR contrast ability, and the loaded Ce6 could emit NIR fluorescence for imaging and generate ROS under 670 nm laser irradiation. Compared with the similar nanobeads but without CCM coating, the SSAP-Ce6@CCM showed a significantly enhanced cellular uptake, as evidenced by prussian blue staining, confocal laser scanning microscope (CLSM) and flow cytometric analysis. Consequently, the SSAP-Ce6@CCM displayed a more distinct MR/NIR image and a more obvious photo-cytotoxicity toward cancer cells under 670 nm laser. Furthermore, the enhanced PDT effect benefited from the surface coating of cancer cell membrane, was also demonstrated in the SMMC-7721 tumor-bearing mice, through the tumor growth observation and tumor tissue pathological examination. Therefore, this CCM disguising nanobead that integrated the abilities of MR/NIR fluorescence dual-modal imaging and photodynamic therapy might be a promising theranostic platform for tumor treatment.

**Biography**

Xiaolong Liu, currently is a Professor and the Director of Liver Disease Research Institute at Mengchao Hepatobiliary Hospital of Fujian Medical University. He received the Ph.D. degree in biophysics from Xi'an Jiaotong University, Xi'an, China, in 2008. His current research is focusing on biophotonics and nanomedicine for cancer diagnosis and therapy. He has published more than 70 scientific papers in the world recognized academic journals. He currently is also the adjunct Professor of Xi'an Jiaotong University, Fuzhou University and Chinese Academy of Sciences. He has received the "Alexander von Humboldt fellowship" in 2008, the "Youth top creative talent of Fujian Province" in 2014, and the "Young Scientist Award" of Japanese Cancer Association in 2015.

## ---------- Oral ----------

OGC 2018 – G0094

**Two-photon Excited Fluorescence of Small Squaraine Dye and Its Application in Long-term Near-infrared II Bioimaging**

**Rongxing Yi, Liwei Liu, and Junle Qu**
College of Optoelectronic Engineering
University of Shenzhen, Shenzhen, China

***Abstract* —** Two-photon excited fluorescence (TPEF) play an important role in bioimaging, the longer excitation wavelength improves its imaging depths, which gives us deeper biological information. The key of TPEF is small organic dyes with excellent two-photon effect and stability against photobleaching. Here, we reported the two-photon absorption of a small squaraine dye (SD), and we found that the TPEF of the small SD can be enhanced significantly using albumin, the TPEF of SD in water was enhanced 20 times by adding bull serum albumin (BSA) in the solution. Meanwhile, the cell imaging results indicated that the SD can enter cell effectively in less than 30 min and emit bright TPEF. Furthermore, the SD showed excellent stability against photobleaching in near-infrared II (1200 nm). The cytotoxicity experiment showed that the cytotoxicity of SD is relatively low. Our work demonstrates the excellent two-photon effect of QD in cells, potential application value of QD in two-photon bioimaging, protein detection and near infrared sensing.

OGC 2018 – G0057

## In Vitro on-chip Oxygen Sensing Platform for Study the Hypoxia Effect on Tumor Cells

**Yihua Zhao, Liang Hong, Shaoqiang Li, Liwei Liu, Junle Qu**
Key Lab of Optoelectronic Devices and Systems of Ministry of Education/Guangdong Province, College of Optoelectronic Engineering, Shenzhen University, Shenzhen, China

***Abstract* —** Oxygen is essential in mammalian cells for metabolism and energy generation. Most cells in tissue are exposed to 3%-9% level O2 (O2 tension) due to a combination of limited O2 transportation through blood circulation system, O2 consumption, and diffusion. Changes in O2 tension levels are related to certain pathological conditions. Cells located in the periphery of tumors are well nourished by diffusion of oxygen and nutrients due to effective diffusion through blood vessels, whereas cells in the center of the tumors are exposed to varying levels of hypoxia. Here, we present a microfluidic platform integrating phosphorescence lifetime imaging (PLIM) based oxygen sensing device to create and analyze distinct tumor niches by varying O2 tension. First, a novel PLIM-based oxygen sensing device was fabricated using a thermal/UV curable poly(perfuoroether) (PFPE), which allowed further integration with the microfluidic platform. Second, a microfluidic device integrating O2 sensor was installed to form O2 gradient in the middle chamber, where tissue-mimicking collagen embedded with ovarian tumor cells. The whole system enables precise control of O2 concentration and measurement, and also *in vitro* modeling of tumor microenvironment.

OGC 2018 – G0014

## A Novel Type of Visual Gas Sensing Technology

**Wenli Zhang and An Song**
College of Communication Engineering,
Chongqing University, Chongqing, China

***Abstract* —** After combining the basic features of lightabsorption gas sensing technology (LA-GST) and spatial heterodyne spectroscopy (SHS), a novel visual gas sensing technology (V-GST) based on light

absorption and SHS was proposed. Firstly, a theoretical model of the V-GST was constructed and the corresponding experimental platform was built. Then different concentrations of NO2 were detected to verify the performance of the system. Results show that the system has different output maps when input spectra or concentrations of NO2 are different, verifying the feasibility and effectiveness of gas detection.

OGC 2018 – G0025

**Multi-channel Optical Coherence Tomography (MC-OCT): A Daisy-Chained Sensing Approach**

**Taye Mekonnen[1], Shaokoon Cheng1, Agisilaos Kourmatzis[2] and Jason Amatoury[3]**

[1] Department of Engineering Macquarie University, Sydney, Australia; [2] School of Aerospace, Mechanical and Mechatronic Engineering University of Sydney, Sydney, Australia; [3] Biomedical Engineering Program,
Maroun Semaan Faculty of Engineering and Architecture, American University of Beirut, Lebanon

***Abstract*** **—** Optical Coherence Tomography (OCT) has emerged as a promising tool in biomedical applications aimed at visualizing biological conduits of the human body, including the upper airway and blood vessels. Conventional OCT endoscopy focuses a light beam to a distal point on the lumen surface to obtain an interferogram (light interference fringe) with sample information corresponding to a single axial scan (A-scan). However, the probe pull-back technique is required to obtain the overall structure of a lumen from averaged static images. This approach, however, is unable to provide accurate measurements of lumen deformation, which changes dynamically and non-uniformly along the lumen length during physiological function. Measuring dynamic changes in lumen geometry provides information on changes in soft (muscle) tissue motion. Quantifying tissue motion has become a priority, given there is increasing evidence that tissue movement and deformation is altered in disease. For example, change in tongue tissue (genioglossus) motion, measured with MRI, has shown strong potential as a disease biomarker for sleep apnoea. Accordingly, an OCT device capable of measuring tissue motion simultaneously at multiple sites along the lumen length has potential to provide a more accurate, cost-effective and simplified tool for the clinic and research.

In this study we present a multi-channel OCT (MC-OCT) design that involves a linear array of imaging units distributed along the length of the sample arm of an interferometer. In this design, the sample arm beam is split into multiple beams with different wavelengths at each imaging unit using systematically arranged wavelength-selective filters. The purpose of the filters is not only to focus light of a given wavelength range on to the imaging sample, but also to transmit the beams of other wavelength ranges to subsequent imaging units. In addition, these filters collect and transmit the reflected light from the sample to the interferometer. The difference in optical paths of the imaging units in this single-interferometric design is compensated by introducing channel-specific optical delay lines either in the reference or sample arm. By doing so, single reference arm reflector is used to form multiple concurrent interference fringes from the daisy-chained imaging units.

We have established a three-channel benchtop MC-OCT system using a broadband light

source of 50nm bandwidth and 840 nm center wavelength. The channel-specific optical delay lines were introduced by defining distinct free space beam paths for each channel. In the detection unit, a similar configuration of wavelength-based filtering units was repeated, which was also followed by an array of photodiodes. The performance of the system was validated using a 3D printed phantom that has a refractive index of ~1.465 - an optical property comparable to human soft tissue.

The experimental results demonstrated that multiple interference signals can be simultaneously collected from the longitudinally distributed different sensing units. Making use of the characteristic data of the broadband source and filters, the OCT system has been simulated in LabVIEW and the average per channel axial resolution of ~21.63μm (corresponding to Full Width at Half Maximum bandwidth of ~16.5nm) have demonstrated similar results to the acquired signals. The experimental study showed that the channel-interferograms were able to reproduce interferograms that can be produced by distinct light sources of equivalent bandwidths. While the axial resolution of the MC-OCT dropped proportionally with the number of channels (imaging units) due to the sharing of the source spectrum among multiple imaging units, results from our study suggest that an MC-OCT endoscope probe, manufactured using micro-optics and the proposed configuration, is capable of quantifying the dynamic changes of internal geometries in biological conduits.

OGC 2018 – G0091

**Hyperspectral Stimulated Raman Scattering Microscopy Facilitates Accurate Diagnosis of Clear Cell Renal Cell Carcinoma**

**Shuhua Yue, Sishan Cui[1], Shuai Yan, Ping Wang[2]**

[1] Beihang University, Beijing, China; [2] Huazhong University of Science and Technology, Wuhan, China

***Abstract* —** Clear cell renal cell carcinoma (ccRCC) accounts for about 90% kidney cancer. Molecular marker is desirable for accurate and efficient diagnosis of ccRCC. Here, we employed hyperspectral stimulated Raman scattering (SRS) microscopy, which renders compositional information for every pixel in the image, to quantitatively map different chemical components in intact human kidney tissues. Specifically, a stack of 50 SRS images at Raman shift between 2800~3030cm-1 were taken, and multivariate curve resolution algorism was used to retrieve concentration images of different chemical components. Our data showed abundant intracellular accumulation of lipid droplets in ccRCC, but no detectable lipid droplets in normal kidney tissues. Moreover, cholesteryl ester is the dominant form of lipid in ccRCC. We also found that such accumulation of cholesteryl ester is significantly higher in low grade (Furhman Grade≤2) ccRCC compared that in high grade (Furhman Grade≥3) ccRCC. Besides, the height ratio between the C=C band at 3008 cm-1 and the CH2 stretching band at 2850cm-1 was significantly higher in high grade ccRCC compared to low grade ccRCC, which suggests that unsaturated lipids takes up a larger proportion in high grade ccRCC. Thus, our study offers an opportunity towards more accurate ccRCC diagnosis via hyperspectral SRS imaging of lipid accumulation.

# Sub-session 2 - C

# < Optical Communication and Networks >

## ---------- Invited ----------

**Output Power Enhancement in Photonic-Based RF Generation by Optical Pulse Compression with a Dispersion Managed Fiber**

**Hiroyuki Toda**
Doshisha University, Japan

***Abstract*** **—** In photonic-based radio frequency (RF) generation method, if the average optical power to the photodiode (PD) is kept constant and the optical pulse width is narrow, RF output power is enhanced. In this presentation, I first review our previous studies about output power enhancement with a constant dispersion fiber. However, the existence of the fiber dispersion results in degradation of the RF output quality. In order to suppress this degradation, I present results, obtained by means of numerical simulations, about output power enhancement with a dispersion managed fiber (DMF) with zero average dispersion.

**Biography**

Hiroyuki Toda was born in Osaka, Japan, on March, 1962. He received the B. Eng., M. Eng., and D. Eng. degrees in electronic engineering from Osaka University, Osaka, Japan, in 1984, 1986, and 1989, respectively. From 1988 to 1990, he was a fellowship at the Japan Society for the Promotion of Science for Japanese Junior Scientists, and continued research on guided-wave devices for heterodyne interferometers at Osaka University.

From 1990 to 1992, he was a post-doctoral fellow in the School of Electrical Engineering, Georgia Institute of Technology, Atlanta, U. S. A., and engaged in the research on nonlinear optics and guided-wave devices for optical communications. In 1992, he joined the Department of Communications Engineering, Faculty of Engineering, Osaka University, where he held the positions of Research Associate (1992-1998) and Assistant Professor (1998-2005). In 2005, he joined the Department of Electronics, Faculty of Engineering, Doshisha University as an Associate Professor. He is currently a full professor of the department and engaged in research on microwave photonics and optical fiber communications.

## ---------- Oral ----------

OGC 2018 – G0084

**Electromechanical Co-simulation of Car-mounted Optical Termina in Laser Communication**

**Yangyang Bai[1,2] , Ming Liu[2], Dongming Sun[1], Lizhong Zhang[1,3] , Lixin Meng[1,4]**
[1] College of Mechanical and Electrical Engineering, Changchun University of Science and Technology ; [2] NUERC of Space Optoelectronics Technology, Changchun University of Science and Technology ; 3 Key Disciplines Laboratory of Space-Ground Laser Communication Technology, Changchun University of Science and Technology; [4] Jilin Province Key Laboratory of Space Optoelectronics Technology,

Changchun University of Science and Technology, Jilin, China

***Abstract*** **—** In order to reduce the servo control error, Solidworks, ADAMS and MATLAB are adopted to jointly simulate the electromechanical control system of the system.Based on Solidworks, the physical model of optical end machine is built in combination. The system dynamics model is established in ADAMS and the servo control model is established in MATLAB.Through the analysis of the simulation results of the system model, it is shown that the system has fast response speed, small overshoot, better apparent axial direction accuracy than 5 ", better steady state tracking accuracy than 10 ", and meets the requirements of system indicators.Simulation analysis establishes the feasibility of the system.In addition, the servo control simulation parameters provide a reliable reference for the control and debugging of the actual system and improve the efficiency of equipment research and development.

OGC 2018 – G0092

**A Laser Communication Antenna with Integrated Optical Hood**

**Xiang Li and Ming Liu**

National and Local Joint Engineering Research Center of Space and Optoelectronics Technology, Changchun University of Science and Technology, Changchun, China

***Abstract*** **—** In order to improve the dynamic rigidity of optical antennas of the laser communication system, a laser communication optical antenna with integrated optical hood is proposed. The integrated design of the primary mirror room and the hood was carried out, which improves the overall rigidity of the laser communication antenna and has the function of hood. The front surface of the primary mirror room is connected with disc type secondary mirror support to reduce the debugging difficulty of the optical system. The primary mirror is fixed in the primary mirror room by six bonding points. The back surface of the primary mirror room is connected with the primary mirror room backboard to provide a mounting interface for the lens assembly ， the primary mirror auxiliary support and the back optical path assembly of laser communication system. The finite element analysis results showed that the first order modal frequency of the structure was 345 Hz, the root-mean-square (RMS) value of the primary mirror surface shape error is better than λ/ 28 in the ambient operating temperature range of 20±5 ℃. The system wavefront aberration was tested using an 4D interferometer, test results showed that the RMS value of the system wavefront aberration is better than λ/14. It can satisfy the requirements of the laser communication system and provide the technical basis for the following works of the project.

OGC 2018 – G0093

**Research on Effect of Multiple Factors on BER in Quantum Key Distribution System Based on Movable Platform**

**Zhu Yu, Yang Ru, Zhu Qiuli[1], Shi Lei, Wei Jiahua[2], Zhao Guhao[3]**

[1] Graduate College, Air Force Engineering University, Xi'an, China; [2] Information and Navigation College, Air Force Engineering University, Xi'an, China; [3] Air Traffic Control and Navigation College, Air Force Engineering University, Xi'an, China

***Abstract*** **—** Free space quantum key distribution has come into practical engineering stage, and the quantum key

distribution system based on movable platform like airplane and satellite is the crucial research interest. The effect of atmospheric turbulence intensity, extinction coefficient and optical antenna aperture on quantum key distribution performance based on movable platform is studied. Calculation model of quantum bit error rate is built and BER changing curve on the effect of each factor is simulated. The results indicate that leaving out the directional error of ATP system in both transmitter and receiver, extinction coefficient and optical antenna aperture have more effect on BER. At 5km transmission distance, when transmitter/receiver antenna aperture increase one times/decrease half, BER raises about 3 times; when extinction coefficient being 1dB/km and 2dB/km, BER is as far as ten times approximately.

OGC 2018 – G0097

**An Asymmetric Key Distribution Scheme Based on Physical Characteristics of Optical Fiber Channel**

**Yingwen Fu, Yajie Li, Yongli Zhao, Jie Zhang**

State Key Lab of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications, Beijing, China

***Abstract* —** The increase of high-capacity transmission demand leads to the rapid development of optical fiber communication. At the same time, the security of fiber channel also faces some serious threats. In order to improve the security of fiber channel, the existing optical fiber communication system should provide security guaranty mechanism. To solve these problems, the traditional approach is to use complex mathematical algorithms, such as decomposition of large integers (RSA public key system) and calculation of discrete logarithms (DH key exchange). However, with the development of quantum computers, the computing ability of attackers can be greatly enhanced, and the security of such encryption technologies has significantly reduced.

The security mechanism based on physical features has been introduced to solve this problem. Because the physical layer security mechanism cannot be affected by the attack of quantum computer, the mechanism has received widespread attention. Its security performance is strongly related to the inherent noise and physical location of the transmission system. Therefore, it has the innovative security capability that other optical communication methods do not have. In this system, the variation of physical characteristics in fiber channel leads to the randomness of key, which ensures the security performance. In the existing methods of key distribution in physical layer, only Quantum Key Distribution (QKD) protocols can achieve theoretically absolute security. However, QKD system has many difficulties to overcome in transmission distance and key rate. In addition, the QKD system is not compatible with the existing communication system, which results in the high cost of QKD deployment.

In this paper, an asymmetric key distribution scheme is proposed based on physical characteristics of fiber channel, which applies the technology of feature extraction to achieve high performance in terms of key security and key generation rate. To evaluate the performance and feasibility of the proposed scheme, we conduct the key distribution experiment over 200km optical transmission. According to the experimental results, the key generation rate can be as high as 1Mbit/s. The 0/1 ratio of key sequence is about 0.5027, which can prove the system is of great security performance. In addition, the key error rate of the system is 0.0101. Thus, we can get the conclusion that the proposed key distribution scheme can maintain high security performance.

## Sub-session 1 – B

## < Laser Technology >

## ---------- Invited ----------

### Ultra-Short-Pulsed Mid-Infrared Optical Parametric Oscillators

**Zhaowei Zhang**
Huazhong University of Science & Technology, China

***Abstract*** — Mid-infrared ultra-short-pulsed lasers are spatially coherent light sources with a broad spectrum coverage and high peak power, and have numerous applications in scientific research, material processing, environment measurement, quality control, and biomedical imaging. In this talk, I will introduce mid-infrared laser technologies and their applications. Then I will review our recent progress in developing optical-parametric-oscillator-based mid-infrared ultra-short pulsed lasers, including a 3 μm femtosecond OPO based on PPLN and its spectroscopic applications, a 6 μm femtosecond OPO based on CdSiP2, a 5-10 μm wavelength-tunable femtosecond OPO based on orientation-patterned GaP.

**Biography**

Zhaowei Zhang, received the B. Eng. degree in Optoelectronics in Huazhong University of Science & Technology, Wuhan, China in 1998, the M. Sc degree in Optics in Shanghai Jiaotong University, Shanghai, China in 2001, and the PhD degree in Optoelectronics in Southampton University, Southampton, UK in 2007.

He is currently a professor in the School of Optical and Electronic Information, Huazhong University of Science & Technology, Wuhan, China. His research interests include mid-infrared photonics, optical parametric oscillators and their applications in healthcare, environment, and manufacturing.

### Ultrafast Fiber Lasers and Their Applications

**Xiaohui Li**
Shaanxi Normal University, China

***Abstract*** — Ultrafast fiber lasers have been applied in many fields, such as military, medical treatment, communications, and industrial processing. In this talk, fast emerging research area of ultrafast fiber laser and novel 2-D materials for the ultrafast photonics will be introduced. I will introduce some progresses in the field of ultrafast fiber lasers, such as the dissipative soltion resonance in fiber laser, near-transform-limited pulse generation in Yb-doped fiber laser, self-compression pulse in Tm-doped fiber laser, and the carbon material based material for the ultrafast photonics. In addition, I would like to talk about the high-power pulsed fiber lasers and the supercontinuum generations as well as their applications.

**Biography**

Xiaohui Li obtained his Ph. D. degree in Physics from Xi'an Jiaotong University in 2012. Then he worked as research fellow at School of Electronic and

Electronics Engineering in Nanyang Technological University from 2012 to 2015. He currently holds research professor position at School of Physics and Information Technology, Shaanxi Normal University. His research interest includes ultrashort pulsed fiber laser, soliton pulse dynamics in fibers, photonics dynamics of 2-D materials, and high power fiber lasers.

## ---------- Oral ----------

OGC 2018 – G0050

**Characteristics research on cross-media interaction and transmission of ultrashort pulse laser**

**Lihua Lei，Ju Zhou[1], Guixing Cao, Cong Li[2]**

[1] China Academy of Space Technology Qian Xuesen Laboratory of Space Technology, Beijing, China

[2] China Academy of Space Technology Department of Communications Satellite, Beijing, China

***Abstract*** **—** The characteristics on cross-media (from air to water) interaction and transmission of ultrashort pulse laser are studied numerically and experimentally. After the analysis on the theories and measurement results of the laser induced sound by breakdown mechanism, influencing factors on atmospheric transmission of laser and plasma effect of ultrashort pulse laser transmission in the atmosphere are studied as well as the effect of sound transmission under water.

OGC 2018 – G0051

**Tunable Nanosecond Pulse Fiber Laser with High Beam Quality and All Fiber Structure**

**Wen Yao[1], Zhang Fan, Zhang Xinhai[2]**

[1] Department of electronic and electrical engineering Southern University of Science and Technology & Harbin Institute of Technology, Shen zhen, China

[2] Department of electronic and electrical engineering Southern University of Science and Technology, Shen zhen, China

***Abstract*** **—** A high-power fiber laser with a master oscillator power amplifier (MOPA) structure is constructed by using pump sources and large mode area ytterbium doped fiber (LMA). Lasers include three parts: seed laser source, preamplifier and main amplifier. The fiber laser is integrated with air cooling structure. When the pulse is set to 200 ns 100 kHz, the fiber laser has an air cooling structure, the maximum pump power is 210 W, the 124 W is obtained. The wavelength is the stable output of the 1064 nm laser, the conversion efficiency is 59 %, the single pulse energy is 1.24 mJ, the peak power is 6.2 kW, the laser beam quality is $M^2$ = 1.38, and the power stability is within 2 %. At present, the output power of laser is limited by pump power, and the increase of pump source is expected to further improve output power.

OGC 2018 – G0088

**High Precision Echo laser simualtor for Perfomance Detection of Individual Soldier Fire-control Device**

**Liu Ming, Wen Guanyu, Li Zhenwei, Zhang Nan**

Changchun Observatory, NAO,CAS, Changchun, China

***Abstract*** **—** Aiming at the measurement requirement of fast and accurate measuring precision for Individual Soldier Fire-control Equipment in laboratory, an echo laser

simulator based on Phase Locked Loop technology is presented in this paper. The simulator adopts Positive Input Negative to receive the narrow pulse-width laser emitted by the fire-control equipment to complete the laser acquisition and photoelectric transformation. The simulator uses PLL module in FPGA to carry out 15 times frequency operation and high precision delay of electric signal. The laser radiation module uses MOSFET's switch nature to produce the narrow pulse signal, the function of the radiation module is to modulate laser and simulate the echo laser in the actual measurement. The simulation distance of the simulator is calibrated by high frequency oscilloscope. The results of multiple measurements show that the simulator has high stability and the range simulation accuracy can reach 0. 2 m, the repeatability error is ±. 015 m.

OGC 2018 – G0095

**Saturable Absorber Based on Black Phosphorus-Polymer Composites for High-Power Operation of Pulsed Er-doped Fiber Laser**

**Wei Song, Huanhuan Liu*, Qiao Jiang, Ye Yu, Fufei Pang, and Tingyun Wang**
Fiber Optics and Advanced Communication, Shanghai Institute for Advanced Communication and Data Science Shanghai University, Shanghai, China.

***Abstract*** — Recently, the rise of two-dimensional (2D) materials such as graphene, transition-metal dichalcogenides (TMDCs) and topological insulator (TI) has showed large potential in photonic and optoelectronic applications due to their out-standing physical and chemical properties. However, the low modulation depth (~1%) of graphene limits its modulation ability. Owe to the large bandgap (1 eV for bulk and 2 eV for monolayer) of TMDCs, it is not suitable for the bandgap of communication band (0.8 eV). The complex preparation process of TI as a result of compound with two different elements limits their application. Black phosphorus (BP), another new 2D materials, has attracted a lot of attention due to its thickness-dependent direct bandgap (0.3 eV for bulk and 2 eV for monolayer). On the other word, BP can fill up the gap between graphene and TMDCs. As a result of the broad spectral range, fast recovery time, and low saturation intensity of BP, saturable absorber (SA) based on BP has been widely studied. Here we demonstrate a stable Q-switched Er-doped fiber (EDF) laser by using a BP/polyvinyl alcohol (PVA) film as the SA.

BP exhibits many excellent optical and electronic properties, however, it is easy to be oxidized by the $O_2$ and $H_2O$ in atmosphere. Here, poly dimethyl diallyl ammonium chloride (PDDA) is selected to adsorb on the surface of BP to protect it. Briefly, PDDA was added into ultra-water and sonicated for 5 minutes. Then, 5 mg of black phosphorus powder was exfoliated in as-prepared water (0.5 mg/mL) using bath ultrasonication for two hours. After exfoliation, the mixture dispersion was centrifuged at 7000 rpm to remove thick and non-exfoliated bulk BP. Finally, the BP solution was dropped on the PVA film. After the water evaporated, another PVA film was covered with BP. The PVA-BP-PVA film was attached on the end of optical ferrule to work as SA.

The high compact all-fiber erbium-doped fiber laser (EDFL) consists of a piece of 7.62m erbium-doped fiber (Er30), a 980/1550 nm wavelength-division multiplexing (WDM), a polarization-independent isolator and a 10:90 optical coupler. The total length is 23 m and all fiber work at anomalous dispersion regime.

The output pulse is analyzed by an optical analyzer (Aokogawa AQ6370) and a real time oscilloscope (Tektronix MSO 4104) via a fast photodetector.

In the experiment, the EDF laser generates the continuous wave (CW) at the pump power of 49.1 mW. When pump power reaches 171.1 mW, Q-switching performance is observed at a repetition rate of 25.5 kHz, with a single pulse energy of 154.51 nJ. The spectrum is centered at 1597 nm. The repetition rate increases from 25.5 kHz to 35.14 kHz with the increasing pump power from 171.1 mW to 384 mW. The shortest pulse duration of 15.4 μs is achieved at the pump power of 371 mW. The largest pulse energy of 344.59 nJ is achieved at the pump power of 358 mW. The pulse is stable when the pump power increases from 171.1 mW to 384 mW. Our experimental result shows that BP/PVA film can work as an ideal SA for large pulse energy.

# Conference Venue

**Shenzhen Convention & Exhibition Center | 深圳会展中心**

## About the Venue:

The Shenzhen Convention & Exhibition Center was designed by German architects and provides modern exhibition facilities. Located in the downtown area of Shenzhen, it is connected to all major transportation systems and easily accessible from all parts of the city. Many four-star and five-star hotels and top restaurants are within short walking distance.

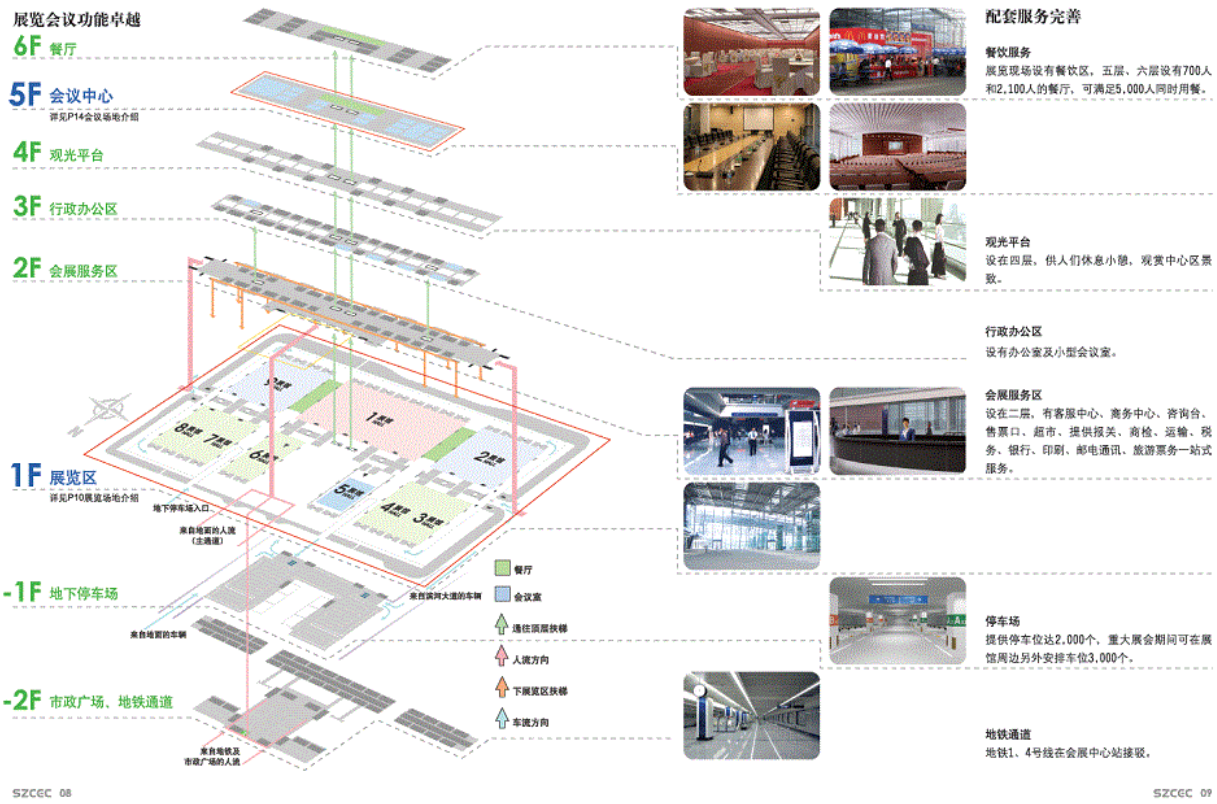
SZCEC website: http://www.szcec.com/

## Map & Address

Address: Fuhua Third Road, Futian District, Shenzhen City, Guangdong, China.
In Chinese: 中国广东省深圳市福田区福华三路深圳会展中心。

## Hall Structure & Services

Conference rooms will be located on the 5F of the center.




**Chinese Restaurants:** Chinese restaurants are located in the Food and Beverage Square, 1st Floor and B1 Floor, SZCEC.

**Western Food:** Western restaurants are located in the Food and Beverage Square, 1st Floor and B1 Floor, SZCEC.

**Washroom:** Locate on the 2nd floor, SZCEC, and each exhibition hall has Man and Woman Washrooms. Please pay attention to the washroom logo.

**Rest Area:** Each hall has specified rest area.

**Wifi Service:** Wireless wifi is available in the whole Convention & Exhibition Center. Users can have two hours free Wifi service with the verified mobile phone number.

**Business Service:** Room 212, 2nd Floor, SZCEC.

**ATM:** ATM Counter is located at left and right sides of main entrance hall, 2nd Floor, SZCEC.

**Storage:** Hall 1, Gate 8, 1-109.

**Locker Service:** Both sides of Exhibition Hall North Entrance, 2nd Floor, SZCEC.

**Big Locker:** RMB 5/Time.

**Small Locker:** RMB 1/Time.

**Medical Aid:** The temporary Medical Aid locates in room 207, 2nd Floor, SZCEC. The organizing committee office has medicine chest. If any emergency, please call 120.

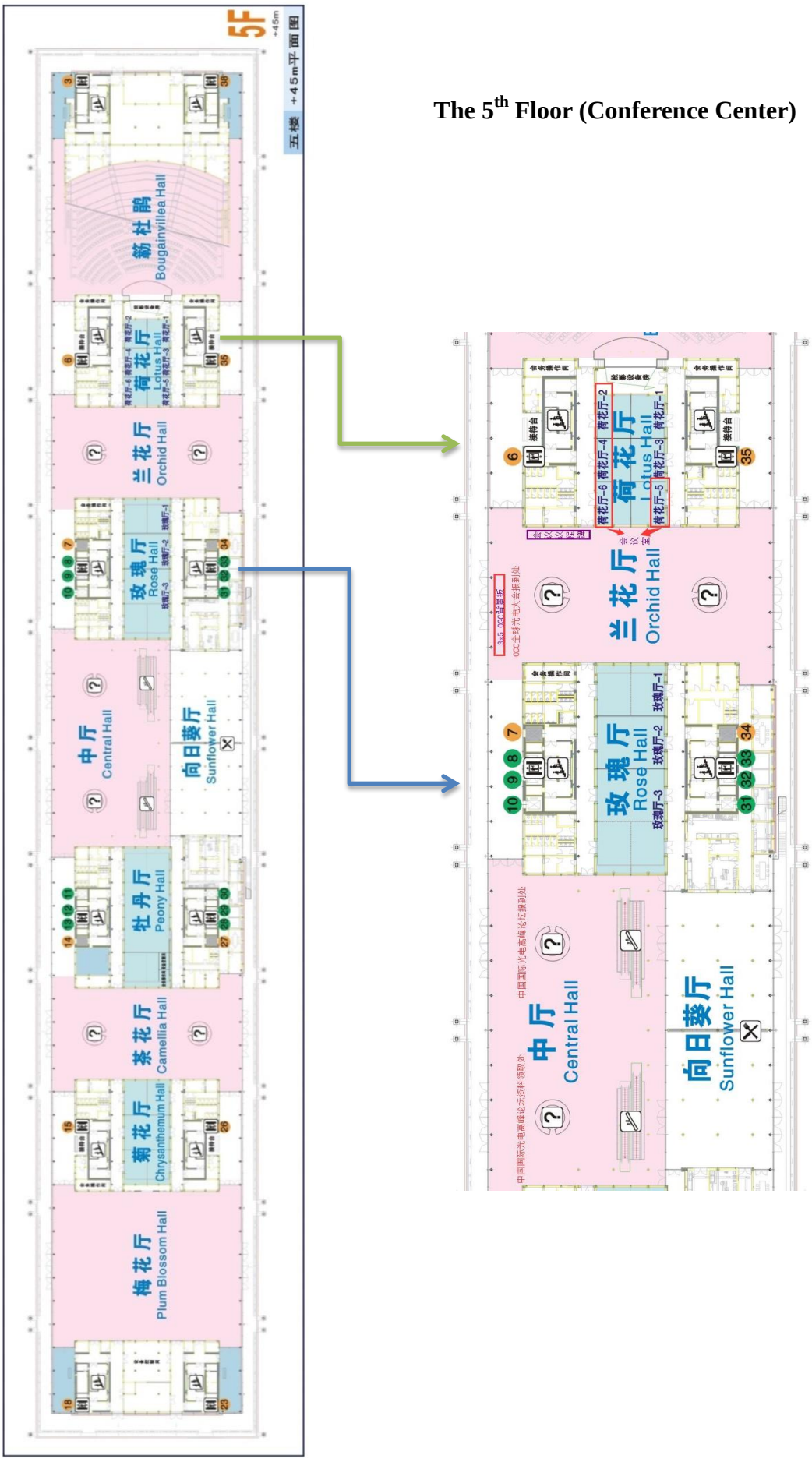
**ART (Alarm Recording Telephone):** 110

**Hotel Service:** Room 205,2nd Floor, SZCE

**Floor Plan ( SZCEC )**

**The 1st Floor (Exhibition Halls)**

**The 5th Floor (Conference Center)**



# Dinner Venue


Dinner Venue: Hua Tang
Address: B1 Floor, Wongtee Plaza (a shopping mall near to the exhibition center), No. 118th, Fu Hua San Lu (next to BONA Cinema)

晚餐地点：花堂（皇庭广场店）
地址：福华三路 118 号皇庭广场 B1 层（博纳影院旁）

# Travel Information

------- Traffic Guide to Venue -------

## From Shenzhen Airport

Shenzhen Bao'an International Airport is 32km form downtown.

By Metro

We highly recommended you to take metro to Expo.

• Departure station: Airport East
• Destination Station: Shenzhen Convention and Exhibition Center
(Chinese pronunciation: Hui Zhan Zhong Xin)
• Duration: 50 mins
• Cost: RMB 7

By Airport bus

• Bus No. : Line 9
• Departure station: Airport
• Destination Station: Shenzhen Convention and Exhibition Center
(Chinese pronunciation: Hui Zhan Zhong Xin)
• Duration: 1 hour (depend on traffic situation)
• Cost: RMB 20

By Taxi

• Destination Station: Shenzhen Convention and Exhibition Center
(Chinese pronunciation: Hui Zhan Zhong Xin)
• Duration: 40 mins (depend on traffic situation)
• Cost: about RMB 120

**From Guangzhou international airport**

• You can take Airport Express at Gate7 of the Arrival Hall in the airport.
• Bus leaves every hour to Shenzhen from 09:50-20:50.
• After arriving in Shenzhen, taxi is the best way to the Convention, which costs less than RMB 30, and within 20 mins

**From downtown Guangzhou**

By Train

There are direct trains every 15 mins from Guangzhou to Shenzhen which you can take at both Guangzhou Eastern Railway Station and Guangzhou Railway Station.

• The ticket is about RMB 70 ~ 85 per person.
• All High-speed trains begin with the letter "D".
• The trip is around 50-70 mins.
• Service hours are 06:30-21:30.

By Bus/Coach

There are direct bus/coach services every 10 mins from Guangzhou to Shenzhen which you can take at the below stations:

• Guangdong Provincial Bus Station

No. 145 Huangshi Road West, Guangzhou
Tel: 86-20-86661297/86692865-2091

• Guangyuan Passenger Transport Station
No. 283 Guangyuan Road, Guangzhou
Tel: 86-20-86376666/86379888

• Guangzhou Jinhan Passenger Transport Station
Tianhe Building, Tiyu Xi Road, Guangzhou
Tel: 86-20-38864843/33437883

- There are several destinations in Shenzhen. Please choose Luo Hu (罗湖) as the final destination for the convenience of transportation after arrival.
- The journey is about 75-120 mins,
- which costs RMB 60-70.
- The service hours are 06:00-22:30.
- After you arrive at Luo Hu, you can take the Shenzhen Metro to the Expo whose station name is Hui Zhan Zhong Xin (Shenzhen Convention & Exhibition Center).
- Of course, you can take a taxi, which costs around RMB 30
-

**From Hong Kong Airport**

By Bus/Coach

- There are very frequent bus and coach services that can take you from the Hong Kong airport to Huanggang border and most hotels in Shenzhen. The duration is 45-60 mins.
- Bus/coach companies have counters inside the airport. The staff at the information booth should be able to direct you to their counters.
- Cost around HKD 90~160.

By Ferry

- This is an easy way to come to Shenzhen from HK Airport, if the schedule suits you.
- There are signs all over the place inside the Airport showing you how to get to the Ferry Transfer Desk after you arrive at the airport.
- It is located just before the immigration processing area as well as before the luggage pickup area.
- b) Taking the ferry to Shenzhen will by-pass entering Hong Kong altogether from the immigration point of view and the ferry will take you from the airport directly into China via the ferry port called Shekou in Shenzhen.
- c) After you purchase the ticket, you can give them the tags of your checked luggage and they will transfer them for you onto the ferry.
- d) It will cost HKD 220 for this 30-40 minute journey.
- e) After you arrive in Shekou, pick up your checked luggage and do the immigration and custom processes.
- f) Then, go outside to take a taxi to your hotel. Please go to take a public taxi with taxi sign marked on the car. It costs around RMB 60-80 from Shekou port to the Expo by taxi.

| HK International Airport Departure | Shenzhen Shekou |
|---|---|
| 9:00 | 7:45 |
| 10:15 | 8:45 |
| 11:00 | 10:00 |
| 12:30 | 11:15 |
| 13:30 | 12:15 |
| 14:30 | 13:30 |
| 15:30 | 14:30 |
| 16:30 | 15:30 |
| 17:30 | 16:30 |
| 18:30 | 17:30 |

**From Downtown Hong Kong**

By Train

- Getting to Shenzhen from downtown Hong Kong is simple, as it takes less than an hour on a KCR train.
- The KCR train connects East Tsim Sha Tsui to Lo Wu and Lok Ma Chau with several intermediate stops. It interchanges with the urban section of the MTR at Kowloon Tong Station and East Tsim Sha Tsui Terminal.
- The journey from East Tsim Sha Tsui to Lo Wu or Lok Ma Chau takes 40-60 mins and costs HK$33-36.50, first class is charged double. Trains depart every few minutes but some short trips are operated in rush hour, so check the destination screen before boarding. The train can be crowed during rush hours as it serves millions of commuters along the line as well.
- After you go through the immigration at Lo Wu or Lok Ma Chau, you can take the Shenzhen Metro (Line 1 at Lo Wu costing RMB 4, and Line 4 at Lok Ma Chau costing RMB 2) to the Expo whose station name is Huizhan Zhongxin (Shenzhen Convention & Exhibition Center). Of course, you can take a taxi. It costs around RMB 30 from Lo Wu, and less than RMB 20 from Lok Ma Chau).

By Bus

- There are very frequent bus services that can take you from the Hong Kong downtown to Huanggang border. You can take such buses in Mong Kok, Prince Edward, Jordon, Kwun Tong. The journey takes 40-60 mins, costs around HKD 30-40. Services hours are 0:00-24:00.

# Note

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# Note