November 30, 2020 (Monday)

Mo-A: Keynote

Presider: Takanori Nomura (Wakayama University, Japan)

Mo-A-01 Keynote

9:00 **Scanless three-dimensional fluorescence imaging techniques for bioapplications**

Osamu Matoba[1], Manoj Kumar[1], Xiangyu Quan[1], Sudheesh K. Rajput[1], Yasuhiro Awatsuji[2], Yosuke Tamada[3]

[1]Kobe University (Japan), [2]Kyoto Institute of Technology (Japan), [3]Utsunomiya University (Japan)

Scanless three-dimensional fluorescence imaging techniques are important to measure the 3D behavior of living cells or cellular networks in neuroscience and biology. Conventional two-photon microscopy can measure only one point at a time and then 3D fluorescence distribution can be obtained by scanning a focused point. Experimental results are presented.

09:35 - 09:50 Break

Mo-B: Sensing I

Presider: Akinori Furuya (Tokushima Bunri University, Japan)

Mo-B-01 Invited

9:50 **Study of Optical Sensing Technologies in Evaluating Short-Range Wireless Systems with Quasistatic Fields**

Ai-ichiro Sasaki

Kindai University (Japan)

The use of optical sensing technologies for evaluating certain wireless systems is investigated. The advantage of optical sensing is that the effects of the measurement apparatus on the systems being evaluated are eliminated. The basic concepts and applications of optical sensing are also explained.

Mo-B-02

10:15 Optical Balance Adjustment for Electro-Optic Probe by Changing Laser Diode Wavelength

Riku Okada[1], Mitsuru Shinagawa[1], Jun Katsuyama[2], Yoshinori Matsumoto[2]

[1]Hosei University (Japan), [2]Yokogawa Electric Corporation (Japan)

This paper describes the improvement of the signal-to-noise ratio (SNR) of an electro-optic probe. Differential detection is used to improve the SNR by optical balance adjustment. The optical balance is adjusted by changing the wavelength of the laser source. We simulated the optical balance adjustment using a Jones matrix.

Mo-B-03

10:30 Two-dimensional Waveguide Grating for Sensing Three-dimensional Angle Fluctuation

Shogo Ura[1], Ryugo Tsuji[1], Junichi Inoue[1], Kenji Kintaka[2]

[1]Kyoto Institute of Technology (Japan), [2]National Institute of Advanced Industrial Science and Technology (AIST) (Japan)

A microoptic angle-fluctuation sensor is proposed. Transmission spectra of a two-dimensional waveguide grating are investigated for simultaneous sensing of fluctuations in three angle directions. Sensitivities by a design example are estimated to be 5 and 11 nm/deg. for incidence angles and 0.3 dB/deg. for a polarization angle.

Mo-B-04

10:45 Polarization Noise Analysis of Electro-optic Sensor System

Mai Tominaga[1], Mei Okajima[1], Mitsuru Shinagawa[1], Jun Katsuyama[2], Yoshinori Matsumoto[2]

[1]Hosei University (Japan), [2]Yokogawa Electric Corporation (Japan)

We studied the effect of noises of electro-optic (EO) sensor by using a Jones vector and FFT. The applied voltage noise to the EO crystal and the circuit noise cannot be reduced by differential detection.

11:00 - 11:15 Break

Mo-C: Advanced Optics and Device I

Presider: Daisuke Barada (Utsunomiya University, Japan)

Mo-C-01

11:15 Improving the reconstruction quality of spatial mode exchange technique by adjusting the diffusion angle of diffuser

Shuanglu Zhang[1], Atsushi Okamoto[1], Kazuhisa Ogawa[1], Akihisa Tomita[1], Taketoshi Takahata[2], Satoshi Shinada[3], Yuta Goto [3], Naoya Wada[3]

[1]Hokkaido University (Japan), [2]OPTOQUEST Co., Ltd. (Japan), [3]National Institute of Information and Communications Technology (NICT) (Japan)

To achieve higher exchange performance in the spatial mode exchange technique using volume holograms, we confirm the dependence of the reconstruction quality on the diffusion angle of the random optical diffuser. The numerical simulation results showed a considerable reconstruction quality enhancement for the two-mode group by adjusting the diffusion angle.

Mo-C-02 Invited

11:30 Topological source of quantum light

Sunil Mittal[1], Venkata Vikram Orre[1], Elizabeth A. Goldschmidt[2], Mohammad Hafezi[1]

[1]University of Maryland (U.S.A.), [2]University of Illinois (U.S.A.)

We will present a topological source of quantum light where edge states are used for enhanced generation of energy-time entangled photon pairs, and for robust engineering of the quantum correlations between generated photons. We will show that this spectral engineering allows us to achieve tunable quantum interference between generated photons.

Mo-C-03

11:55 Mode Compensation using Progressive Phase Conjugation Technique

Zeyu Shen, Atsushi Okamoto, Shuanglu Zhang, Kazuhisa Ogawa, Akihisa Tomita

Hokkaido University (Japan)

In order to compensate the mode coupling of the spatial mode beam in the multimode fiber, we conducted a numerical analysis to evaluate the effect of mode compensation using progressive

phase conjugation (PPC). The simulation results showed that PPC can effectively compensate the mode without requiring external reference beam.

Mo-C-04

12:10 Non-contact Thickness Measurement for Dielectric Plate using Electro-Optic Probe

Takumi Horikawa[1], Mitsuru Shinagawa[1], Jun Katsuyama[2], Yoshinori Matsumoto[2]

[1]Hosei University (Japan), [2]Yokogawa Electric Corporation (Japan)

This paper describes a thickness measurement method for a dielectric plate using an electro-optic probe system. The thickness is measured by a signal source with a parallel electrode using two copper plates. The output voltage increases monotonically as the thickness of the dielectric sample plate increases.

12:25 - 13:15 Lunch

Mo-D: Imaging

Presider: Yusuke Nakamura (Hitachi, Ltd., Japan)

Mo-D-01 Invited

13:15 Optical-frequency-comb microscopy for multivariate spectroscopic imaging utilizing amplitude and phase information

Takeo Minamikawa

Tokushima University (Japan)

We propose a novel optical microscopy employing optical-frequency-comb (OFC). The OFC microscopy enables spatio-temporal imaging with comprehensive optical information such as amplitude, phase and polarization spectra and temporal waveform based on mechanically-scanless Fourier transformation spectroscopy.

Mo-D-02 Invited

13:40 Efficient full-color computational imaging by utilizing human vision property - “giving in to the blues”

Ziheng Qiu, Zibang Zhang, Jingang Zhong

Jinan University (P.R.China)

The high performance of computational imaging is generally at the expense of imaging efficiency (such as, measurements and computational time).

Psychologists found that human eyes have a lower resolving power in blues than reds and greens. Is it possible to exploit such a property to achieve efficient full-color computational imaging?

Mo-D-03 Invited

14:05 Toward a Thinking Microscope: Deep Learning-enabled Computational Microscopy and Sensing

Aydogan Ozcan

UCLA (U.S.A.)

We will discuss recently emerging applications of the state-of-art deep learning methods on optical microscopy and microscopic image reconstruction, which enable new transformations among different modalities of microscopic imaging, driven entirely by image data.

Mo-D-04

14:30 Super-resolution Measurement By Virtual Phase Conjugation Using A Small Number Of Pixels For Optical Detection

Satoshi Kawashima, Atsushi Okamoto, Kazuhisa Ogawa, Akihisa Tomita

Hokkaido University (Japan)

To maximize the performance of super-resolution measurement using virtual phase conjugation without using a noise reduction method that consumes extra imaging resources, relationships between the size of the signal light area, resolution of the image sensor, and the amount of noise are quantified and evaluated.

Mo-D-05

14:45 Spatial Characteristics of Guided-mode Resonance Filter in Oblique Incidence

Shinichiro Okamoto, Kotaro Yoshimoto, Junichi Inoue, Shogo Ura

Kyoto Institute of Technology (Japan)

A subwavelength waveguide grating on a transparent substate can provide a narrowband reflection spectrum. Position shift and deformation of a reflection beam in oblique incidence were discussed with the coupling strength of the grating.

Mo-D-06

15:00 Single Shot Phase Imaging Based on Higher Order Transport-of-Intensity Equation Using a Computer-Generated Hologram

Aoi Onishi, Naru Yoneda, Yusuke Saita, Takanori Nomura

Wakayama University (Japan)

Measurement accuracy of the transport-of-intensity phase imaging is improved by using multiple defocused images which is usually captured with mechanical scanning. To acquire these images without scanning, a computer-generated hologram technique has been introduced. In this study, the feasibility of the proposed method is confirmed by numerical and optical experiments.

15:15 - 15:30 Break

Mo-E: Digital Holography II

Presider: Xiaodi Tan (Fujian Normal University, China)

Mo-E-01 Invited

15:30 Incoherent-holography-based computational imaging system for 3D imaging and infinite depth-of-field imaging

Teruyoshi Nobukawa, Yutaro Katano, Tetsuhiko Muroi, Nobuhiro Kinoshita, Norihiko Ishii

Japan Broadcasting Corporation (NHK) (Japan)

Incoherent digital holography (IDH) is an attractive approach to passive computational imaging. We previously proposed a bimodal IDH system, which implements both 3D imaging and infinite depth-of-field imaging. This presentation reviews the basic operation of the proposed system and provides proof-of-principle experimental results.

Mo-E-02 Invited

15:55 Tomographic imaging of blood coagulation structures in flow cytometry using digital holographic microscopy

Hideki Funamizu

Muroran Institute of Technology (Japan)

Blood coagulation is an important role in hemostasis process. Aggregation structures of red blood cells indicate the degree of blood coagulation. Digital holographic microscopy (DHM) is a

powerful tool for quantitative phase imaging of biological cells. We report tomographic imaging of blood coagulation structures in flow cytometry using DHM.

Mo-E-03

16:20 Twin-Image Reduction of Low-Coherence In-Line Digital Holography Using a Diffuser

Kenya Kawano, Takanori Nomura

Wakayama University (Japan)

A twin-image reduction method of digital holography using an LED and a diffuser was proposed. As the size of the optical system is compact against a conventional system, it has portability. Simulation results show that the proposed method can obtain the reconstructed image comparable to the laser-based conventional method.

Mo-E-04

16:35 Compressed Sensing Based Holographic Particle Velocimetry for Complex Microflow Measurement

Kan Itakura, Shuhei Yoshida

Kindai University (Japan)

In this study, we applied compressed sensing (CS) to holographic particle tracking velocimetry (HPTV) for measurement of the complex microflow. In the proposed method, the particle distribution can be directly reconstructed with high accuracy by applying the compressed sensing based on the sparse particle distribution.

Mo-E-05

16:50 Evaluation of Spatial Resolution in Motionless Optical Scanning Holography

Naru Yoneda, Yusuke Saita, Takanori Nomura

Wakayama University (Japan)

Motionless optical scanning holography (MOSH) has been proposed to realize single-pixel 3D incoherent imaging.In MOSH, a reproduced hologram is expressed as a convolution between an object and a Fresnel zone plate.In this study, a point spread function of MOSH is evaluated by numerical simulation.

17:05 - 17:20 Break

Mo-F: Optical Memory II

Presider: Kimihiro Saito (Kindai University Technical College, Japan)

Mo-F-01 **Invited**

17:20 **Phase data acquisition and multiplexing techniques for in-line holographic data storage based on computer-generated holograms**

Yusuke Saita, Naru Yoneda, Aoto Matsumoto, Takanori Nomura

Wakayama University (Japan)

Holographic data storage using a computer-generated hologram has been researched. Our recent studies about phase data acquisition and multiplexing techniques to improve its recording capacity are based on a digital holographic technique and the reference wave correlation. In this presentation, details and evaluations of respective approaches are introduced.

Mo-F-02

17:45 **Convolutional Neural Network Based Demodulation for Constant-Weight Codes in Holographic Data Storage**

Kurokawa Shinya, Shuhei Yoshida

Kindai University (Japan)

We systematically examined the improvement effect of CNN based demodulation method for constant-weight codes and analyzed the types of salient errors.

Mo-F-03

18:00 **Transport of Intensity Phase Data-Page Acquisition with Polarization Directed Flat Lens in Coaxial Holographic Data Storage**

Yuta Takahashi, Yusuke Saita, Naru Yoneda, Takanori Nomura

Wakayama University (Japan)

Storage capacity of coaxial holographic data storage can be increased by using phase information. A polarization directed flat lens is introduced to system for phase measurement based on transport of intensity equation. Simulation results confirm the feasibility of the proposed method.

Mo-F-04

18:15 CNN Demodulation for Complex Amplitude Modulation Code in Holographic Data Storage

Yutaro Katano, Teruyoshi Nobukawa, Tetsuhiko Muroi, Nobuhiro Kinoshita, Norihiko Ishii

Japan Broadcasting Corporation (NHK) (Japan)

We have proposed a demodulation method using two convolutional neural networks (CNNs) for complex amplitude modulation code in holographic data storage. Our compact CNNs individually and accurately demodulate the symbol position in modulation block and complex amplitude signal without the four-step phase-shift method, respectively.