International Workshop on Holography and Related Technologies 2017

I.W.H

November 22 to 24, 2017

Plaza Verde, 1-1-4 Otemachi, Numazu City, Shizuoka, 410-0801, Japan

COSPONSORED BY
- Optical Society of Japan (OSJ)
- International Workshop on Holography
- Center for Optical Research and Education (CORE), Utsunomiya University
- Research Group on Volume Holographic Memory Technology (VHM), OSJ
- Holographic Display Artists and Engineers Club (HODIC), OSJ
- Group of Information Photonics, OSJ
- Digital Optics Research Group, OSJ
- The Institute of Electronics, Information and Communication Engineers
- The Institute of Image and Television Engineers
- Tochigi Optoelectronic Industry Promotion Conference.

SUBJECT AREAS
- Holographic Memory
- Holographic Optical Elements
- Computer Generated Holography
- Digital Holography
- Holographic Display
- Holography Arts and Design
- Recording Materials
- Signal Processing for Holography
- Devices for Holography
- Simulation for Holography
- AR, MR, HUD and HMD with Holography
- Applications
- Others
## Wednesday 22-Nov-17

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<td>Chiba Univ.</td>
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<td>22p5</td>
<td>Yutaro Katano</td>
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<td>Tsutomu Shimura</td>
<td>Univ. Tokyo</td>
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<td>Takanori Nomura</td>
<td>Wakayama Univ.</td>
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<td>Daisuke Barada</td>
<td>Utsunomiya Univ.</td>
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<td>Spatial Sampling Theory for Holographic Data Storage with Low-Spatial Frequency Data Page Pattern under Nyquist Frequency</td>
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<td>23a5</td>
<td>Hiroshi Yoshikawa</td>
<td>Nihon Univ.</td>
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<td>Yih-Shyang Cheng</td>
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<td>23p1</td>
<td>Liangcai Cao</td>
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<td>Nobukazu Yoshikawa</td>
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<td>Qingdao Univ.</td>
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P2 Fumiya Mizukawa  Hokkaido Univ.  Japan  Improvement of Conversion Accuracy in Volume Holographic Mode-Demultiplexing Converter Using Shaped Beams


P5 Ryo Omori  Tokyo Univ.  Japan  Principle and characteristics of phase modulated time series collinear holographic memory

P6 Satoshi Tagami  Utsunomiya Univ.  Japan  Vectorial Light Propagation Analysis of Scalar Holographic Data Storage Using a Vector Diffraction method

P7 Siti Nabilah Hassan  Utsunomiya Univ.  Japan  Hyperspectral digital holography for observing biological stained sample

P8 Takemitsu Mizuki  Hokkaido Univ.  Japan  Analysis of Transient Visual Evoked Potential on Electro-holographic Image

P9 Tomohiro Maeda  Hokkaido Univ.  Japan  Design of Complex Amplitude Modulation for Suppressing Optical Loss in Mode Conversion by Considering Radiation Modes

P10 Yuta Goto  Hokkaido Univ.  Japan  Multiplexing and Demultiplexing of Digital Images using Virtual Phase Conjugation for High-Density Holographic Data Storage

P11 Yuya Nakamura  Utsunomiya Univ.  Japan  Improvement of Signal to Noise Ratio in Phase-multiplexed Holographic Data Storage by Limiting Aperture Opening of Imager Pixels

P12 Ze Hao He  Tsinghua Univ.  China  Design of Color LED Holographic Display System Based on DMD

P13 Yuki Kunii  Utsunomiya Univ.  Japan  Phase-encoded signal detection by using inter-pixel crosstalk

17:00  End of session

Friday  24-Nov-17

09:30  24a1  Yuan Luo  National Taiwan Univ.  Taiwan  Engineered Volume Holographic Pupil for Imaging and Manipulation” with authorship of Yuan Luo, Chen Yen Lin, and Sunil Vyas.

10:00  24a2  Osamu Matoba  Kobe Univ.  Japan  Fluorescence imaging by common-path off-axis digital holography

11:00  24a3  Toshihiro Kasezawa  Egarim Co., Ltd.  Japan  Imm-thick Holographic Polarized Beam Splitter ~Ega-rim PBS~

11:30  24a4  Yusuke Sando  Osaka Res. Inst. of Ind. Sci. and Tech.  Japan  Calculation method for computer-generated hologram considering parabolic mirror reflection for viewing zone enlargement

11:45  24a5  Yuki Oguro  Hokkaido Univ.  Japan  Automatic Lens Distortion Correction Method for Compact Holographic HMD

12:00  24a6  Yeh-Wei Yu  National Central Univ.  Taiwan  Producing Opposite Virtual Objective inside Mimic Bio-tissue using Holography-based optical phase conjugation

12:30  Lunch

14:00  24p1  Yuichi Nakamura  Toyohashi Univ. of Tech.  Japan  Development of Heat Sink Multi-Layered Media for Magnetic Hologram with Errorless Reconstruction

14:30  24p2  Ryushi Fujimura  Utsunomiya Univ.  Japan  Influence of Media Shrinkage in Phase Encoded Holographic Memory

15:00  24p3  Xiaodi Tan  Beijing Inst. of Tech.  China  Dual-channel Holographic Recording with Orthogonal Linear Polarization Holography

15:30  Award & Closing
Advanced optical technology brings us many optical devices and systems in our information age. Optical memory and display are most significantly developing areas in optical technology closely related to our life. Because of the growth in demand of information capacity in optical memory, holographic technologies are again in the spotlight. In the display technology, holography is going to be of importance. This technology is expected as a key in virtual reality and augmented reality display.

The International Workshop on Holography in 2017 (IWH2017) is the eleventh workshop which covers all the aspects on holographic memories and display ranging from their fundamental physics and technologies to practical systems. The goals of this workshop are three-fold. First it should provide a forum for the exchange of information between participants in this interdisciplinary meeting. This workshop series have also served excellently in strengthening the optical imaging, material and devices. Second, it should be provide an opportunity to establish and renew old friendship and make new acquaintances. And finally, it should stimulate the interest and ambition of participants to cooperate in their efforts.

IWH2017 is jointly organized by Center for Optical Research and Education (CORE), Utsunomiya University and Optical Society of Japan. I would like to express sincere thanks to Research Group on Volume Holographic Memory Technology (VHM), Holographic Display Artists and Engineers Club (HODIC), Group of Information Photonics, Group of Digital Optics, and Tochigi Optoelectronic Industry Promotion Conference for their support to our activities.

Toyohiko Yatagai
Chair of Organizing Committee
INTRODUCTION

International Workshop on Holography and related technologies (IWH2017) will be held in Plaza Verde, Numazu City, Shizuoka, Japan, from November 22 to 24, 2017. This is the eleventh workshop which covers overall aspects on holography and related technologies, holographic memories, displays, holographic measurement, computer generated holograms and digital holography, ranging from their fundamental physics and technologies to practical systems. The first International Workshop on Holographic Memories (IWHM2007) was held in Penang, Malaysia. IWHM2008, IWHM&D2009-2010 were successfully held in Japan, which includes overall aspects on holographic memories and display. Since 2011, this workshop have extend the scope furthermore, IWH covers the holographic display as well as holographic memory. Last year, IWH2016 was held at Jiaoxi, Yilan, Taiwan with great success. IWH2017 is jointly organized by the following associations in Japan:

- Optical Society of Japan (OSJ)
- International Workshop on Holography
- Center for Optical Research and Education (CORE), Utsunomiya University.
- in corporate with the following societies
- Research Group on Volume Holographic Memory Technology (VHM), OSJ
- Holographic Display Artists and Engineers Club (HODIC), OSJ
- Group of Information Photonics, OSJ
- Digital Optics Research Group, OSJ
- The Institute of Electronics, Information and Communication Engineers
- The Institute of Image and Television Engineers
- Tochigi Optoelectronic Industry Promotion Conference.
SCOPE

All topics related to holography including memories, displays, digital holography, computer generated holography, and holographic optical elements are going to be discussed, ranging from their basic physics and technologies to practical applications, such as materials, components, measurements, basic theory and physics, system design, simulations and devices. In what follows is the list of subject areas, which are not restrictive but suggestive:

1. Holographic Memory
2. Holographic Optical Elements
3. Computer Generated Holography
4. Digital Holography
5. Holographic Display
6. Holography Arts and Design
7. Recording Materials
8. Signal Processing for Holography
9. Devices for Holography
10. Simulation for Holography
11. AR, MR, HUD and HMD with Holography
12. Applications
13. Others

REGISTRATION FEES

Before November 10 : 35,000 yen
On site : 45,000 yen
Student : 20,000 yen

All payments, should be made in Japanese Yen and only by bank transfer, and are non-refundable. On-site registration should be made with cash in Japanese Yen. The detail of which will be informed to the pre-registered participants through e-mail.

For details of the transfer account, please see the registration form.

UGENT ANNOUNCEMENT!! to the participant from abroad.

Due to the handling commission is considerably high because of the revision of the Japanese bank, please stop the remittance from abroad.

Instead, the participant from abroad are recommended to registrate by e-mail to IWH, and pay the registration fees, determined by registrated date, by only cash (Japanese Yen) at Conference Site on conference date.
Instructions for the presentation

- Invited presentation: Presentation: 25 min. Discussions: 5 min.
- Contributed oral presentation: Presentation: 12 min. Discussions: 3 min.
- Poster presentation: The size of a poster board is Height: 210 cm Width: 120 cm

Hands-On Event of Microsoft HoloLens

Experience of HoloLens from Microsoft is scheduled on 22 November.

- 22 Wed. Nov., 2017
- 10 am – 4:30 pm
- Conference room 403 in Plaza Verde, Numazu

We look forward to your participation.

Free Event for Hologram Exposure

We will hold an event of exposure experience of hologram in this conference so as to spread around its fascination, targeting at general visitors in addition to conference participants. Recorded hologram could be brought with you after the exposure event. We look forward to your participation.

- 23 Thu. – 24 Fri. Nov., 2017
- 10 am - 4 pm for each date
- Conference room 403 in Plaza Verde, Numazu
- Free for participation of this event

For application, kindly send an e-mail; iwh2017@i-w-holography.org

VENUE

Plaza Verde, 1-1-4 Otemachi, Numazu City, Shizuoka, 410-0801, Japan
Wednesday 22-Nov-17

13:20  22p1  Microsoft HoloLens in the Modern Workplace

Shinji Hayashi
Microsoft Japan

Microsoft HoloLens is changing the way how people interact with computers and each other. This session will share how HoloLens is used by commercial customers in their business as part of their digital transformation.

14:00  22p2  Volumetric bubble display

Yoshio Hayasaki and Kota Kumagai
Center for Optical Research and Education (CORE), Utsunomiya University 7-1-2 Yoto, Utsunomiya 321-8585, Japan

Volumetric display with microbubble voxels was developed. The microbubbles were formed by focused femtosecond laser pulses. The three-dimensional bubble graphics was erased by ultrasonic.

14:30  22p3  Holographic Optical Elements in Machine Vision Lighting

Tomoyasu Saigo¹², Susumu Shibata², Koosuke Hattori³, Hideyoshi Horimai⁴ and Taizo Umezaki¹⁴⁵

¹)Nagoya Institute of Technology, Gokiso-cho, Showa-ku, Aichi 466-8555, Japan, ²)Maxis Engineering Inc., 2-13 Tashiro-Hondori, Chikusa-ku, Nagoya-City, Aichi 464-0827, Japan, ³)Chubu University, 1200 Matsumoto-cho, Kasygai City, Aichi 487-0027, Japan, ⁴)3Dragons LCC, 2-13 Tashiro-Hondori, Chikusa-ku, Aichi 464-0827, Japan, ⁵)The University of tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan

We propose a new machine vision lighting system with a holographic diffractive optical element (HOE). We show result for defect on glossy surface by prism layout HOE and show the HOE layout for edge inspection.

14:45  22p4  Development of Auto-focus System of Holographic Projector Using RGB-D Camera

Yuki Nagahama¹, Tomoyoshi Shimobaba¹, Takashi Kakue¹ and Tomoyoshi Ito¹

¹)Graduate School of Engineering, Chiba University 1-33 Yayoi-cho, Inage-ku, Chiba, Chiba, 263-8522, Japan

In this research, using a RGB-D camera, kinoform and spherical wave illumination, we developed the auto-focus system of the holographic projector with increasing the projective area.

15:00  Break
15:30  22p5  Deep-Learning Based Data Demodulation for High Density Holographic Data Storage
Yutaro Katano, Tetsuhiko Muroi, Nobuhiro Kinoshita, and Norihiko Ishii
Japan Broadcasting Corporation (NHK), 1-10-11 Kinuta, Setagaya-ku, Tokyo, 157–8510 Japan
We present our investigation of the applicability of a deep-learning based data modulation method to a high density holographic data storage system with a recording density of 1 Tbit/inch².

16:00  22p6  Servo Compensation method of position error on Volume Holographic Disc
Po-Kai Hsieh¹), Yeh-Wei Yu²), and Ching-Cherng Sun¹)
¹)Department of Optics and Photonics, National Central University, Chung-Li, Taoyuan City 32001, Taiwan, ²)Optical Science Center, National Central University, Chung-Li, Taoyuan City 32001, Taiwan
In this paper, we propose a scheme to compensate the position error so that the reading of the holographic disc can be on the correct position and to prevent from large decay of the signal.

16:15  22p7  Simultaneous Recording and Reading of Multiple Data Pages for Coaxial Holographic Data Storage Using Computer-Generated Hologram
Yusuke Saita¹), Masahiro Karaike²) and Takanori Nomura¹)
¹)Faculty of Systems Engineering, Wakayama University, 930 Sakaedani, Wakayama, 640-8510, Japan, ²)Graduate School of Systems Engineering, Wakayama University, 930 Sakaedani, Wakayama, 640-8510, Japan
The method to record and read multiple data pages simultaneously using a computer-generated hologram technique is proposed in a coaxial holographic data storage. The feasibility of the proposed method is confirmed by numerical simulations.

16:30  22p8  Tutorial: Multiplexed Volume Holography and Polarization
Tsuotomo Shimura
The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505
Light wave diffraction for vector waves and multiplexed gratings are summarized. The diffraction for p- and s-polarized light is quite different. Also, we must be careful to consider the diffraction efficiencies for the multiplexed gratings.

17:00  Break
18:00  Banquet
09:30 23a1  Computational Optical Sensing and Imaging Based on Information Photonics

Takanori Nomura

Faculty of Systems Engineering, Wakayama University, 930 Sakaedani, Wakayama, 640-8510, Japan

Some methods to realize computational optical sensing and imaging based on information photonics are introduced. Digital holography, transport of intensity equation, refractive index tomography, and computational ghost imaging are applied.

10:00 23a2  Spatial Sampling Theory for Holographic Data Storage with Low-Spatial Frequency Data Page Pattern under Nyquist Frequency

Daisuke Barada\(^{1(2)}\), Shaqueeb Sarwar\(^{1}\) and Toyohiko Yatagai\(^{2}\)

\(^{1}\) Graduate School of Engineering, Utsunomiya University, Japan, \(^{2}\) Center for Optical Research and Education (CORE), Utsunomiya University, Japan

In our recent study, it was numerically verified that the data page pattern could be restored although the aperture size is much smaller than Nyquist size. In this paper, the reason is explained.

10:30 23a3  Optimization of Volume Holographic Spatial Mode Demultiplexer with a Phase Plate Using Simulated Annealing

Shimpei Shimizu\(^{1}\), Atsushi Okamoto\(^{1(4)}\), Fumiya Mizukawa\(^{1}\), Kazuhisa Ogawa\(^{1}\), Akihisa Tomita\(^{1}\), Taketoshi Takahata\(^{2(4)}\), Satoshi Shinada\(^{3}\) and Naoya Wada\(^{3}\)

\(^{1}\) Graduate School of Information Science and Technology, Hokkaido University, N14-W9 Kita-ku, Sapporo, 060-0814, Japan, \(^{2}\) OPTOQUEST Co., Ltd., 1335 Haraichi, Ageo-city, Saitama, 362-0021, Japan, \(^{3}\) National Institute of Information and Communications Technology (NICT), 4-2-1 Nukuikitamachi, Koganei, Tokyo, 184-8795, Japan, \(^{4}\) OPTOQUEST Advanced Optical Device Development Research Division, Hokkaido University, N21-W11 Kita-ku, Sapporo, 001-0021, Japan

We have proposed the mode demultiplexing technique using multiplexed volume holograms and a phase plate. In this work, we drastically improved mode-separation characteristics by making use of simulated annealing for optimizing the phase plate.

10:45 23a4  Development of Holo-HMD and Remaining Issue

Yuji Sakamoto

Graduate School of Information Science and Technology, Hokkaido University, Sapporo, 060-0814, Japan

Some holographic head mounted displays (holo-MHDs) have been developed in our lab. This paper introduces our developed holo-MHDs and explains what we have revealed. Moreover, remained issues are described to realize holo-HMDs.

11:15 Break
11:30  23a5  A Study on Objective Image Quality Evaluation of Computer-Generated Hologram  
Hiroshi Yoshikawa, Hiroki Uetake, and Takeshi Yamaguchi  
Dept. Computer Engineering, Nihon University, 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan  
Reconstructed image quality of computer-generated hologram is evaluated objectively by structural similarity index (SSIM). Since SSIM shows good agreement with the subjective evaluation results, the proposed objective evaluation can replace the subjective evaluation.

12:00  23a6  Transmission Spherical-Type Multiplex Holography: Theory  
Yih-Shyang Cheng and Yuan-Ping Sung  
Department of Optics and Photonics, National Central University, Chungli, Taiwan 32001, R.O.C.  
Using a diverging object wave and a converging reference wave, a model of spherical multiplex holography is proposed. Image blur and spectral bandwidth under white-light illumination are simulated.

12:15  23a7  Reconstruction Reference Wave Design for the Copying System in Normal Viewing Disk-type Multiplex Holography  
Chih-Hung Chen, Yih-Shyang Cheng and Yu-Hsin Tu  
Department of Optics and Photonics, National Central University, Chungli, Taiwan 32001, R.O.C.  
In this paper, design of the optical setups for replication of the normal-viewing IPDTMH is introduced. A simple optical replication system for real-image generation is then described.

12:30  Lunch

14:00  23p1  Block-wise Compressive Digital Holography  
Liangcai Cao, Hao Zhang, and Guofan Jin  
State Key Laboratory of Precision Measurement Technology and Instruments. Department of Precision Instruments, Tsinghua University, 100084, Beijing, P. R. China  
An effective block-wise compressive holography is proposed to locate the precise search space and reduce the calculation time while keeping the reconstruction quality.

14:30  23p2  Object wave reconstruction by generalized phase-shifting digital holography using normalized interference fringe  
Nobukazu Yoshikawa, Syouma Namiki and Atsushi Uoya  
Graduate School of Science and Engineering, Saitama University, 255 Shimo-Okubo, Saka-Ku, Saitama, 338-8570, Japan  
We propose an object wave retrieval method by the normalization method. We show that the norm approximate condition can be satisfied using the phase randomness condition used in the statistical generalized phase-shifting method.
14:45  23p3 Development of color digital holographic microscope system using multiple light sources
Qiyue Yu¹, Tomoyasu Saigo², Katsunori Nakagawa², Ichirou Koike², Hideyoshi Horimai,³ and Taizou Umezaki³

¹Qingdao University, 308 Ningxia Road, Shinan District, Qingdao, Shandong, 266071, China
²MAXIS-Engineering Inc., 2-13 Tashiro-hondori, Chikusa-ku, Nagoya-city, Aichi, 464-0827, Japan
³³Dragons LLC, Nagoya Institute of Technology, Gokiso-chou, Syouwa-ku, Nagoya-city, Aichi, 466-8555, Japan

A new a new color single-shot phase-shift digital holographic microscope equipping an additive white light source is proposed. Using two light sources high-speed switching, real time digital holographic 3D measurement with color texture is realized.

15:00  23p4 Full-parallax light-field and holographic displays for enriched 3D visual experience
Masahiro Yamaguchi¹, Tomoya Nakamura¹,² and Shunsuke Igarashi¹

¹School of Engineering, Tokyo Institute of Technology, 4259-G2-28 Nagatsuta, Midori-ku, Yokohama 226-8503, Japan, ²JST PRESTO

Integrating holography and light-field enables enriched 3D visual experience. In computational holography, a high-resolution and deep 3D image with enriched material appearance is reproduced. An interactive light-field display with 3D touch interface is also demonstrated.

15:30  Poster session

P1 A Comparison of Beam Shaping by DOE and ROE
Xuan-Hao Lee¹, Yeh-Wei Yu¹, Tung Wu², Wei-Jeh Kao² and Ching-Cherng Sun¹

¹Optical Science Center, National Central University, Chung-Li 32054, Taiwan
²Department of Optics and Photonics, National Central University, Chung-Li 32054, Taiwan

Optical projection technology becomes more and more important because of its impact on 3D imaging. In this paper, we present a study of comparison for beam shaping characteristic through refractive optical element (ROE), and DOE.

P2 Improvement of Conversion Accuracy in Volume Holographic Mode-Demultiplexing Converter Using Shaped Beams
Fumiya Mizukawa, Atushi Okamoto, Yuta Goto, Shimpei Shimizu, Kazuhisa Ogawa, and Akihisa Tomita

Graduate school of Information Science and Technology, Hokkaido University, N14-W9, Kita-ku, Sapporo, 060-0814, Japan

We propose an improvement method of conversion accuracy in volume holographic mode-demultiplexing converter using shaped beams. In a numerical simulation, we achieved great improvement of both the conversion fidelity and the modal crosstalk.
Photopolymer Film, FIGURA: Contribution of Development of High Holographic Technologies.

Hiroshi Tabuchi\textsuperscript{1)}, Toshitaka Nara\textsuperscript{1)}, Haruka Kojima\textsuperscript{1)}, Toshihiro Kasezawa\textsuperscript{2)}, Hideyoshi Horimai\textsuperscript{2)} and Tsutomu Shimura\textsuperscript{3)}

\textsuperscript{1)} Okamoto Glass Co., Ltd., 380, Toyofuta, Kashiwa-shi, Chiba 277-0872, Japan, \textsuperscript{2)} Egarim Co., Ltd., 330 Shibukawa, Shimizu-ku, Shizuoka City, Shizuoka, 424-0053, Japan, \textsuperscript{3)} The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan

The existence of recording media is indispensable for the development of high holographic technologies. We will introduce a new photopolymer film under development, called “FIGURA”.

Experimental demonstration of twin-image reduction method using a diffuser for in-line digital holography

Kazusa Oe\textsuperscript{1)} and Takanori Nomura\textsuperscript{2)}

\textsuperscript{1)} Graduate School of Systems Engineering, Wakayama University, 930 Sakaedani, Wakayama, 640-8510, Japan, \textsuperscript{2)} Faculty of Systems Engineering, Wakayama University, 930 Sakaedani, Wakayama, 640-8510, Japan

Twin-image reduction method using a diffuser is proposed for in-line digital holography. A preliminary experimental result using a specimen and a diffuser which are realized by spatial light modulators confirms the proposed method.

Principle and characteristics of phase modulated time series collinear holographic memory

Ryo Omori\textsuperscript{1)}, Hajimu Nishimoto\textsuperscript{1)}, Xiao Lin\textsuperscript{2)}, Yoshito Tanaka\textsuperscript{1)(3)}, Ryushi Fujimura\textsuperscript{4)}, Masao Endo\textsuperscript{1)} and Tsutomu Shimura\textsuperscript{1)}

\textsuperscript{1)} Institute of Industrial Science, the University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan, \textsuperscript{2)} School of Optoelectronics, Beijing Institute of Technology, 5 South Zhongguancun Street, Haidian District, Beijing 100081, China, \textsuperscript{3)} Japan Science and Technology Agency, PRESTO, 4-1-8 Honcho, Kawaguchi, Saitama 332-0012, Japan, \textsuperscript{4)} Department of Optical Engineering, Graduate School of Engineering, Utsunomiya University, 7-1-2 Yoto, Utsunomiya, Tochigi 321-8585, Japan

We propose phase modulated time series collinear holographic memory (PTCH). We investigate the characteristics of PTCH by numerical simulation and do experiment to confirm the possibility of PTCH.

Vectorial Light Propagation Analysis of Scalar Holographic Data Storage Using a Vector Diffraction method

Satoshi Tagami\textsuperscript{1)}, Daisuke Barada\textsuperscript{1)(2)} and Toyohiko Yatagai\textsuperscript{2)}

\textsuperscript{1)} Graduate School of Engineering, Utsunomiya University, Japan, \textsuperscript{2)} Center for Optical Research and Education (CORE), Utsunomiya University, Japan

In this study, we express vectorial light propagation in holographic data storage analytically using a parameter. It could be realized by solving the vector wave equation in hologram using power series.
P7  Hyperspectral digital holography for observing biological stained sample
Siti Nabilah Hassan\textsuperscript{1)}, Misato Okamoto-Miyakawa\textsuperscript{2)}, Yoshio Hayasaki\textsuperscript{1)}
\textsuperscript{1)}Center for Optical Research and Education (CORE), Utsunomiya University, \textsuperscript{2)}Graduate School of Applied Biological Sciences and Faculty of Applied Biological Sciences, Gifu University

Some biological applications are required to specify a three-dimensional structure of the sample. To speed up the observation, the structure of stained biological sample is observed using the digital holography with the hyperspectral imaging.

P8  Analysis of Transient Visual Evoked Potential on Electro-holographic Image
Takemitsu Mizuki\textsuperscript{1)}, Masataka Fujiwara\textsuperscript{1)} and Yuji Sakamoto\textsuperscript{1)}
\textsuperscript{1)}Graduate School of Information Science and Technology, Hokkaido University, Sapporo, 060-0814, Japan,

We measured the Transient Visual Evoked Potential (TRVEP) with normal monitor and electro-holography to examine whether EEG is effective in electro-holography. As a result, measurement of the TRVEP was possible in electro-holography.

P9  Design of Complex Amplitude Modulation for Suppressing Optical Loss in Mode Conversion by Considering Radiation Modes
Tomohiro Maeda, Atsushi Okamoto, Kazuhisa Ogawa, and Akihisa Tomita
Graduate School of Information Science and Technology, Hokkaido University, Kita 14, Nishi 9, Kita-ku, Sapporo, Hokkaido, 060-0814, Japan

We propose a new design of the complex amplitude modulation for the mode conversion. In a numerical simulation, we confirmed that the designed modulation suppressed the optical loss while maintaining the conversion accuracy.

P10 Multiplexing and Demultiplexing of Digital Images using Virtual Phase Conjugation for High-Density Holographic Data Storage
Yuta Goto, Atsushi Okamoto, Kazuhisa Ogawa and Akihisa Tomita
Graduate School of Information Science and Technology, Hokkaido University, N14-W9, Kita-ku, Sapporo 060-0814, Japan

For realizing the high density holographic memory, digital image multiplexing/demultiplexing method using virtual phase conjugation has been proposed. In this paper, we experimentally verified that multiplexed digital images can be independently and correctly reconstructed.
P11  Improvement of Signal to Noise Ratio in Phase-multivalued Holographic Data Storage by Limiting Aperture Opening of Imager Pixels

Yuya Nakamura\textsuperscript{1)}, Anna Odanaga\textsuperscript{3)}, Ryushi Fujimura\textsuperscript{12)2)

\textsuperscript{1)}Department of Optical Engineering, Graduate school of Engineering, Utsunomiya University, \textsuperscript{2)}Center for Optical Research and Education (CORE), Utsunomiya University, \textsuperscript{3)}Faculty of Engineering, Utsunomiya University,7-1-2 Yoto, Utsunomiya, Tochigi 321-8585, Japan

We numerically and experimentally investigate influence of limiting aperture of Imager Pixels on the signal to noise ratio (SNR) degraded by Nyquist aperture in the phase-encoded signal and discuss its effectiveness.

P12  Design of Color LED Holographic Display System Based on DMD

Zehao He\textsuperscript{1)}, Liangcai Cao\textsuperscript{1)}, Ping Su\textsuperscript{2)} and Guofan Jin\textsuperscript{1)}

\textsuperscript{1)}State Key Laboratory of Precision Measurement Technology and Instruments, Department of Precision Instruments, Tsinghua University, Beijing 10084, China, \textsuperscript{2)}Graduate School at Shenzhen, Tsinghua University, Shenzhen 518055, China

A simple and low-cost color display system based on DMD with RGB LEDs is proposed. Properties of DMD are considered and desired effects are obtained by holographic coding and filtering.

P13  Phase-encoded signal detection by using inter-pixel crosstalk

Yuki Kunii\textsuperscript{1)}, Tsutomu Shimura\textsuperscript{2)}, Yuya Nakamura\textsuperscript{1)} and Ryushi Fujimura\textsuperscript{13)3) }

\textsuperscript{1)}Department of Optical Engineering, Graduate school of Engineering, Utsunomiya University, 7-1-2 Yoto, Utsunomiya, Tochigi 321-8585, Japan, \textsuperscript{2)}Institute of Industrial Science, The University of Tokyo, 4-6-1 Komaba, Meguro, Tokyo 153-8505, Japan, \textsuperscript{3)}Center for Optical Research and Education (CORE), Utsunomiya University

We propose a method to detect the phase of signal beam with single shot without using phase-detection reference beam by using inter-pixel crosstalk and discuss its effectiveness.

17:00  End of Session

Friday 24-Nov-17

09:30  24a1  Engineered Volume Holographic Pupil for Imaging and Manipulation

Yuan Luo\textsuperscript{12)(3)}, Chen Yen Lin\textsuperscript{12)} and Sunil Vyas\textsuperscript{12)1)}

\textsuperscript{1)}Institute of Medical Device and Imaging, National Taiwan University College of Medicine, Taipei, Taiwan,10051, \textsuperscript{2)}Molecular Imaging Center, National Taiwan University, Taipei, Taiwan,10055, \textsuperscript{3)}Yong Lin Institute of Health, National Taiwan University, Taipei, Taiwan,10087

Volume holographic gratings incorporating multiplexing methods to better manipulate light for state-of-the-art imaging as well as orbital angular moment for beam shaping will be addressed.
10:00  24a2  Fluorescence imaging by common-path off-axis digital holography
Osamu Matoba¹, Xiangyu Quan¹, and Yasuhiro Awatsuji²

¹Graduate School of System Informatics, Kobe University, Rokkodai 1-1, Nada, Kobe 657-8501, Japan, ²Graduate School of Science and Technology, Kyoto Institute of Technology, Matsugasaki, Sakyoku, Kyoto 606-8585, Japan

We have presented a method of common-path off-axis digital holography and preliminary experiment. The results are promising to observe the fluorescence light even for biological tissues.

10:30  Break

11:00  24a3  1mm-thick Holographic Polarized Beam Splitter ~Ega-rim PBS~
Toshihiro Kasezawa¹, Hideyoshi Horimai¹ ², Shinobu Yamamoto² and Tsutomu Shimura³

¹Egarim Co. Ltd., 330 Shibukawa, Shimizu-ku, Shizuoka-shi, Shizuoka 424-0533, Japan, ²HOLOMEDIA LLC, B-2, 725-1 Okaishiki, Numazu-shi, Shizuoka 410-0012, Japan, ³The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan

1mm thick Ega-rim PBS was proposed and its characteristics was investigated by experimentally. Extinction ratio was over 100:1. Ega-rim PBS was applied to the LCOS Display Device and sufficient color image was observed.

11:30  24a4  Calculation method for computer-generated hologram considering parabolic mirror reflection for viewing zone enlargement
Yusuke Sando³, Daisuke Barada¹ ² and Toyohiko Yatagai¹

¹Center for Optical Research & Education, Utsunomiya University, 7-1-2 Yoto, Utsunomiya, Tochigi 321-8585, Japan, ²Graduate School of Engineering, Utsunomiya University, 7-1-2 Yoto, Utsunomiya, Tochigi 321-8585, Japan, ³Osaka Research Institute of Industrial Science and Technology, 2-7-1 Ayumino, Izumi, Osaka 594-1157, Japan

This study presents a method to enlarge both the horizontal and vertical viewing zone by using a convex parabolic mirror and an efficient and fast calculation method considering the parabolic mirror reflection.

11:45  24a5  Automatic Lens Distortion Correction Method for Compact Holographic HMD
Yuki Oguro¹, Yuji Sakamoto¹

¹Graduate School of Information Science and Technology, Hokkaido University, Sapporo, 060-0814, Japan

We proposed the method of automatically correcting lens distortion for compact holographic HMD. We conducted experiments comparing reconstructed images with real objects and confirmed the corrective effect.
12:00  24a6  Producing Opposite Virtual Objective inside Mimic Bio-tissue using Holography-based optical phase conjugation

Yeh-Wei Yu\textsuperscript{1,2}, Szu-Yu Chen\textsuperscript{1}, Che-Chu Lin\textsuperscript{1}, Ching-Cherng Sun\textsuperscript{1}

\textsuperscript{1}Department of Optics and Photonics, National Central University, Chung-Li, Taoyuan City, 32001 Taiwan, \textsuperscript{2}Optical Science Center, National Central University, Chung-Li, Taoyuan City, 32001 Taiwan

A method for creating an opposite virtual objective (OV-Obj) inside optically thick turbid media through holography-based optical phase conjugation mirror (HOPCM) was proposed and demonstrated in this research.

12:30  Lunch

14:00  24p1  Development of Heat Sink Multi-Layered Media for Magnetic Hologram with Errorless Reconstruction

Yuichi Nakamura\textsuperscript{1}, Zen Shirakashi\textsuperscript{1}, Naoki Hoshiba\textsuperscript{1}, Taichi Goto\textsuperscript{1,2}, Hiroyuki Takagi\textsuperscript{1}, Pang Boey Lim\textsuperscript{1}, Hironaga Uchida\textsuperscript{1} and Mitsuteru Inoue\textsuperscript{1}

\textsuperscript{1} Toyohashi University of Technology, 1-1 Tempaku-cho, Toyohashi, Aichi, 441-8580, Japan, \textsuperscript{2} JST PRESTO, 4-1-8 Honcho, Kawaguchi, Saitama, 332-0012, Japan

We designed and fabricated magnetic garnet/SiO\textsubscript{2} multilayered media. This showed diffraction efficiencies higher than that of the single layer medium, and non-error recording and reconstruction was achieved using collinear system with magnetic assist technique.

14:30  24p2  Influence of Media Shrinkage in Phase Encoded Holographic Memory

Ryushi Fujimura\textsuperscript{1,2} and Kenta Fukura\textsuperscript{1}

\textsuperscript{1} Department of Optical Engineering, Graduate school of Engineering, Utsunomiya University, \textsuperscript{2} Center for Optical Research and Education (CORE), Utsunomiya University 7-1-2 Yoto, Utsunomiya, Tochigi 321-8585, Japan

The influence of the media shrinkage on phase-encoded signals was numerically investigated. The media shrinkage considerably affects the diffracted phases as well as the intensity. To recover the deteriorated signals, a correction method was proposed.

15:00  24p3  Dual-channel Holographic Recording with Orthogonal Linear Polarization Holography

Jinliang Zang\textsuperscript{1}, Fenglan Fan\textsuperscript{1}, Ying Liu\textsuperscript{1}, Long Shao\textsuperscript{1}, Xiaodi Tan\textsuperscript{1}, Tsutomu Shimura\textsuperscript{2} and Kazuo Kuroda\textsuperscript{1,3}

\textsuperscript{1} School of Optoelectronics, Beijing Institute of Technology, 5 South Zhongguancun Street, Haidian District, Beijing 100081, China, \textsuperscript{2} Institute of Industrial Science, The university of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan, \textsuperscript{3} Center for Optical Research and Education (CORE), Utsunomiya University, 7-1-2 Yoto, Utsunomiya, Tochigi 321-8585, Japan

We report a dual-channel holographic recording method with orthogonal linear polarization holography based on null reconstruction effect. Two polarization encoded holograms were recorded in dual-channel recording system with negligible inter-channel crosstalk. The two polarization multiplexed holograms could then be sequentially or simultaneously readout by shifting the polarization state of reference wave.

15:30  Award & Closing
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Plaza Verde Floor Map
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