

ADVANCE PROGRAM

International Workshop on Holography and Related Technologies 2021

IWH2021

March 11 to 12, 2022
Held Online



WELCOME TO IWH2021

This year, International Workshop on Holography and related technologies (IWH2021) is held on line, from March 11 to 12, 2022. This is the fifteenth 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 and IWHM&D2009-2010 were successfully held in Japan, which include overall aspects on holographic memories and display. Since 2011, this workshop has extended the scope furthermore, and IWH covers the holographic display, holographic optical elements, as well as holographic memory. Last year, IWH2020 was held at Sun Moon Lake in Taiwan with great success.

Due to COVID-19, this year's IWH was delayed and will be held in March 2022, although it is called IWH2021. Although it would have been preferable for participants to meet together for further discussion, the pandemic has not yet been contained, and we had no choice but to hold the meeting online. However, with a number of very interesting keynote speeches, substantial invited lectures, and contribution papers presenting the latest research results, the conference promises to be very productive. There will also be a poster session using the oVice system, and COVID-19 is not all bad, but also a good opportunity to learn about a new style of the conference. We see it as a test case to see if we can continue to have poster sessions at international conferences in this format after the pandemic is over. We look forward to your candid feedback on this endeavor.

Finally, I would like to take this opportunity to thank all of the sponsoring organizations that helped make this conference possible.

Tsutomu Shimura
General Chair of IWH2021

INTRODUCTION

International Workshop on Holography and related technologies (IWH2021) will be held on line, from March 11 to 12, 2022. This is the fifteenth 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 and IWHM&D2009-2010 were successfully held in Japan, which include overall aspects on holographic memories and display. Since 2011, this workshop has extended the scope furthermore, and IWH covers the holographic display, holographic optical elements, as well as holographic memory. Last year, IWH2020 was held at Sun Moon Lake in Taiwan with great success. This time, IWH2021 will be held on line (head quarter is placed at IIS, The University of Tokyo). owing associations:

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. Meta-holography, Meta-lens, Meta-surface
7. Holography Arts and Design
8. Recording Materials
9. Signal Processing for Holography
10. Devices for Holography
11. Simulation for Holography
12. AR, MR, HUD and HMD with Holography
13. Applications
14. Related technologies to Holography

IWH2021 TIME TABLE

	11 Mar.	12 Mar.
10:00	Opening (10:00~10:10)	Oral 9:45~10:55 (70 min)
	Keynote 10:10~10:50 (40 min)	
11:00	Oral 10:50~11:15 (25 min)	Break (10:55~11:10)
	Break (11:15~11:30)	Poster session 11:10~12:40 (90 min)
12:00	Oral 11:30~12:20 (50 min)	
	Lunch (12:20~13:15)	Lunch (12:40~13:30)
13:00		
14:00	Oral 13:15~15:00 (105 min)	Oral 13:30~14:50 (80 min)
15:00	Break (15:00~15:15)	Break (14:50~15:05)
	Oral 15:15~16:50 (95 min)	Oral 15:05~16:20 (75 min)
16:00		Break (16:20~16:35)
		Closing (16:35~17:05)
17:00		

PRESENTATION SCHEDULE

Friday Mar. 11th

Times are shown in Japan standard time.

Start	End	No	Presenter	Affiliation	Country /Region	Title
10:00	10:10	Opening				
10:10	10:50	11-A01	Michael CHENG	Zemax	Taiwan	Simulation of holographic imaging system in Zemax OpticStudio
10:50	11:15	11-A02	Lambertus HESSELINK	Stanford University	U.S.A.	Holographic X-ray Detector
11:15	11:30	Break				
11:30	11:55	11-A03	Kentaro IWAMI	Tokyo University of Agriculture and Technology	Japan	Metasurface holographic movie based on a cinematographic approach
11:55	12:20	11-P01	Hiroshi YOSHIKAWA	Nihon University	Japan	How to make hologram calculation dramatically fast
12:20	13:15	Lunch				
13:15	13:40	11-P02	Shuhei YOSHIDA	Kindai University	Japan	Fast full-color electro-holography with digital micromirror device
13:40	14:05	11-P03	Kazuhiro YAMAGUCHI	Suwa University of Science	Japan	Wireless Communication System for Computer Generated Holography : Trends and Key Technologies in Wireless Communication System
14:05	14:30	11-P05	Jung-Ping LIU	Feng-Chia University	Taiwan	Binary computer-generated holograms for high-quality display
14:30	14:45	11-P04	Zehao HE	Tsinghua University	China	Angular-spectrum algorithm for holographic 3D display based on 2D-to-3D approach
14:45	15:00	11-P06	Yeh-Wei YU	National Central University	Taiwan	Four-level Phase Retrieved by Double-frequency grating Shearing Interferometer
15:00	15:15	Break				
15:15	15:40	12-A01	Yifan (Evan) PENG	Stanford University	U.S.A	Next-generation holographic display systems incorporating optics and machine intelligence
15:40	15:55	11-P08	Masanori TAKABAYASHI	Kyushu Institute of Technology	Japan	Hyperparameter tuning for accurate image classification using self-referential holographic neural network
15:55	16:10	11-P09	Yoshio HAYASAKI	Utsunomiya University	Japan	Holographic optical engine (HoOE) for laser processing using spatially-shaped beams
16:10	16:25	11-P10	Harutaka SHIOMI	Chiba University	Japan	Proposal of a fast computation method with maintaining depth of field using a wavelet transform : WASABI-2
16:25	16:50	11-P11	Hiroki KIKUCHI	Sony Group Corporation	Japan	Holographic Technologies for Co-creation

Saturday Mar. 12th

Start	End	No	Presenter	Affiliation	Country /Region	Title
9:45	10:10	11-P07	Tomoyasu SAIGO	MAXIS Engineering Inc.	Japan	Lighting System with Hologram for Factory Automation
10:10	10:25	12-A02	Naru YONEDA	Wakayama University	Japan	Experimental Verification of Common-path Off-axis Single-pixel Holographic Imaging
10:25	10:40	12-A03	Yuta YAMAMOTO	Toyohashi University of Technology	Japan	Improved image quality of magneto-optical 3D display using micro lens array
10:40	10:55	12-A04	Kazuya TASHIRO	Fukuoka University	Japan	Basic Feasibility Confirmation of Single-shot SQAM Signal Detection with Transport of Intensity Equation Method using SLM for Defocus
10:55	11:10	Break				

Start	End	No	Presenter	Affiliation	Country /Region	Title
11:10	12:40	Poster session				
		P01	Yi-Wei ZHENG	Beihang University	China	Method of enlarging viewing area in holographic display system based on Pancharatnam-Berry lens
		P02	Xiaolei ZHANG	Hebei University of Engineering	China	Deep Learning-Based Phase Imaging for Digital Holography
		P03	Takayuki HARA	Chiba University	Japan	Design of Special-Purpose Computer for Incoherent Color Digital Holography
		P04	Juan MANUEL Franco SANCHEZ	Utsunomiya University	Japan	Extension of axial operating range using optical time-of-flight for optical-coherence tomography
		P05	Kota KUMAGAI	Utsunomiya University	Japan	Holographic-laser-excited volumetric display with re-projected aerial graphics based on drawing space separation
		P06	Ping SU	Tsinghua Shenzhen International Graduate School	China	Fast particle fields restoration based on digital holography
		P07	Kenta TANAKA	Maxis Engineering Inc.	Japan	Line Type HOE Machine Vision Lighting System
		P08	Jinyu WANG	Fujian Normal University	China	Factors affecting the polarization state of the reconstructed wave in polarization holography
		P09	Peiliang QI	Fujian Normal University	China	A new method of making equivalent polarizer by polarization holography
		P10	Kyoka SHIMOMURA	Tokyo Institute of Technology	Japan	Integration of Holographic Light Field Display and 2D Display for 3D-touch user interface
		P11	Koosuke HATTORI	Chubu University	Japan	Development of Microscope for Glossy Surface using Holographic Optical Elements
		P12	Motoyasu SANO	National Institute of Technology, Numazu College	Japan	Preformatted Holographic Screen Development for Real 3D Display
		P13	Daisuke BARADA	Utsunomiya University	Japan	Development of Flexible and Elastic Volume Hologram
		P14	Soki HIRAYAMA	Institute of Industrial Science, The University of Tokyo	Japan	Analysis and evaluation of the memory characteristics in the surface shift-multiplexing holographic memory
12:40	13:30	Lunch				
13:30	13:55	12-P01	Tetsuhiko MUROI	Japan Broadcasting Corporation (NHK)	Japan	Acquisition of Three-Dimensional Information of an Object using Incoherent Digital Holography
13:55	14:10	12-P02	Teruyoshi NOBUKAWA	Japan Broadcasting Corporation (NHK)	Japan	Depth-of-field control through transformation of coherence-dependent bokeh in incoherent digital holography
14:10	14:25	12-P03	Katsunori NAKAGAWA	Maxis Engineering Inc.	Japan	3D observation of biological tissues using single-shot digital holographic microscopy
14:25	14:50	12-P04	Wen QIAO	Soochow University	China	Planar optical elements based glasses-free 3D display
14:50	15:05	Break				
15:05	15:30	12-P05	Ryushi FUJIMURA	Utsunomiya University	Japan	Iterative Phase Determination Method using Pixel Spread Function
15:30	15:55	12-P06	Xiao LIN	Fujian Normal University	China	When deep learning meets holographic data storage
15:55	16:20	12-P07	Guohai SITU	Shanghai Institute of Optics and Fine Mechanics	China	Physics-enhanced deep neural networks for computational imaging
16:20	16:35	Break				
16:35	17:05	Closing				

TECHNICAL PROGRAM

Friday 11-Mar-2022 (Day 1)

10:10 [11-A01] Simulation of holographic imaging system in Zemax OpticStudio

Han-Hsiang (Michael) CHENG **(Keynote Talk)**

Zemax (An Ansys Company)

In this talk, we will discuss, in Zemax OpticStudio, how we integrate coupled wave theory into raytracing engine for the holistic simulation of holographic imaging systems. We will show a few application examples using this model.

10:50 [11-A02] Holographic X-ray Detector

Lambertus HESSELINK **(Invited Talk)**

Stanford University

We describe a holographic detector using a photo refractive recording medium to detect X-ray differential phase contrast images with high fidelity and high quantum efficiency.

11:15 Break

11:30 [11-A03] Metasurface holographic movie based on a cinematographic approach

Kentaro IWAMI **(Invited Talk)**

Tokyo University of Agriculture and Technology

We report metasurface holographic movies based on a cinematographic approach which enables high frame rate and wide viewing angle. Both monochromatic and color holographic movie will be presented achieved by metallic and dielectric metasurfaces, respectively.

11:55 [11-P01] How to make hologram calculation dramatically fast

Hiroshi YOSHIKAWA **(Invited Talk)**

Nihon University

Real-time calculation of 4K image hologram is realized on PC without special hardware such as GPU or FPGA. Full color holograms can be generated over 10 frames per second with sub-million point cloud of object.

12:20 Lunch

13:15 [11-P02] Fast full-color electro-holography with digital micromirror device

Shuhei YOSHIDA (Invited Talk)

Kindai University

This study proposes a full-color 3D video reconstruction technique using a digital micromirror device (DMD). The proposed technique can reconstruct full-color 3D video at a sufficient frame rate even when using the time-division multiplexing method.

13:40 [11-P03] Wireless Communication System for Computer Generated Holography

: Trends and Key Technologies in Wireless Communication System

Kazuhiro YAMAGUCHI (Invited Talk)

Suwa University of Science

Computer generated holography can provide us a virtual and natural 3D scene. In this paper, we discuss wireless communication system for transmitting hologram data for realizing holographic television in the future.

14:05 [11-P05] Binary computer-generated holograms for high-quality display

Jing-Ping LIU (Invited Talk)

Feng-Chia University

We applied multiple adaptive masks to produce many binary holograms of the same scene. The holograms were fast display on a DMD. As a result, a high-quality image was displayed by intensity accumulation.

14:30 [11-P04] Angular-spectrum algorithm for holographic 3D display based on 2D-to-3D approach

Zehao HE

Tsinghua University

We successfully demonstrate an angular-spectrum holographic algorithm by 2D images with the 2D-to-3D approach. The holographic 3D images are reconstructed successfully with obvious depth cues in simulations and experiments.

14:45 [11-P06] Four-level Phase Retrieved by Double-frequency grating Shearing Interferometer

Yeh-Wei YU

National Central University

We proposes and demonstrates a pre-integral double-frequency grating shearing interferometer (pre-integral DFGSI) with the utilization of a built-in phase-shifting function, to retrieve multi-level phase signals and eliminate slow-varying phase errors.

15:00 Break

**15:15 [12-A01] Next-generation holographic display systems incorporating optics
and machine intelligence**

Yifan (Evan) PENG (Invited Talk)

Stanford University

Holographic displays promise unprecedented capabilities for virtual and augmented reality (VR/AR) systems. However, the image quality achieved by traditional holographic displays is limited, and algorithms for computer-generated holography (CGH) are slow. We investigate emerging artificial intelligence-enabled holographic near-eye displays that promise to solve these long-standing challenges.

**15:10 [11-P08] Hyperparameter tuning for accurate image classification
using self-referential holographic neural network**

Masanori TAKABAYASHI

Kyushu Institute of Technology

To achieve highly accurate image classification by self-referential holographic neural network (SR-HNN), the dependence of how to modulate input images, i.e, intensity or phase and its modulation range, on the classification accuracy have been investigated.

15:25 [11-P09] Holographic optical engine (HolOE) for laser processing using spatially-shaped beams

Yoshio HAYASAKI

Utsunomiya University

The holographic optical engine composed of a spatial light modulator, image sensors, relay optics, and a control computer performs parallel laser processing with high quality through an in-system optimization of a computer-generated hologram.

16:10 [11-P10] Proposal of a fast computation method

with maintaining depth of field using a wavelet transform : WASABI-2

Harutaka SHIOMI

Chiba University

Holograms calculations are time-consuming. The wavelet shrinkage-based superposition is fast but deepens the depth of field. In this study, we improved it and verified that the proposed method does not change the depth of field.

16:25 [11-P11] Holographic Technologies for Co-creation

Hiroki KIKUCHI (Invited Talk)

Sony Group Corporation

In this talk, Sony's unique holographic technologies are introduced which serve for the enhancement of co-creation. The prospects for the evolution of these technologies will also be presented.

Saturday 12-Mar-2022 (Day 2)

9:45 [11-P07] Lighting System with Hologram for Factory Automation

Tomoyasu SAIGO (Invited Talk)

Maxis Engineering Inc.

Lighting system with HOE for visual inspection of glossy surfaces has been proposed. By effectively utilizing the angular selectivity of holograms, small defects on the surface that have height variation can be identified by color.

10:10 [12-A02] Experimental Verification of Common-path Off-axis Single-pixel Holographic Imaging

Naru YONEDA

Wakayama University

To reduce the number of measurements for common-path single-pixel digital holography, common-path off-axis single-pixel holographic imaging (COSHI) is proposed. In this presentation, the experimental results of the proof-of-principle experiment are shown.

10:25 [12-A03] Improved image quality of magneto-optical 3D display using micro lens array

Yuta YAMAMOTO

Toyohashi University of Technology

We developed a magneto-optical 3D display. By investigating writing process of computer-generated hologram pattern, we have shortened the hologram writing time and improved the quality of 3D image.

10:40 [12-A04] Basic Feasibility Confirmation of Single-shot SQAM Signal Detection

with Transport of Intensity Equation Method using SLM for Defocus

Kazuya TASHIRO

Fukuoka University

We investigate a single-shot TIE method to detect the phase- and intensity- modulated signal using a SLM for polarization-dependent defocusing and a polarization camera. The feasibility of the method is shown by a proof-of-principle experiment.

10:55 Break

[P01] Method of enlarging viewing area in holographic display system

based on Pancharatnam-Berry lens

Yi-Wei ZHENG

Beihang University

A method utilizing polarization responses of the Pancharatnam-Berry (PB) lens to extend the viewing area is proposed. Optical experiments are conducted to verify the feasibility of the method.

[P02] Deep Learning-Based Phase Imaging for Digital Holography

Xiaolei ZHANG

Hebei University of Engineering

In this paper, a quantitative phase imaging method based on the deep learning is realized. U-Net is used to process the digital holograms, and phase images are directly obtained from them.

[P03] Design of Special-Purpose Computer for Incoherent Color Digital Holography

Takayuki HARA

Chiba University

We designed a special-purpose computer using FPGA for high-speed image reconstruction and for taking the computer outdoors. The images calculated by the circuit simulation and by the software show the equivalent image quality.

[P04] Extension of axial operating range using optical time-of-flight

for optical-coherence tomography

Juan MANUEL Franco SANCHEZ

Utsunomiya University

The optical time-of-flight and optical coherence tomography systems operate in sync. First, time of flight locates and tracks a target on the optical axis. Then, an optical coherence tomography begins to work to obtain the measurement.

[P05] Holographic-laser-excited volumetric display

with re-projected aerial graphics based on drawing space separation

Kota KUMAGAI

Utsunomiya University

We introduce a color volumetric display that combines the spatial generation of femtosecond-laser-excited voxels using a computer-generated hologram and a 3D beam scanning with the drawing space separation (DSS) method.

[P06] Fast particle fields restoration based on digital holography

Ping SU

Tsinghua Shenzhen International Graduate School, Tsinghua University

In this manuscript, digital holography (DH) is utilizing to restore particle fields. Machine learning is used to eliminate noise in the raw-reconstructed images. A characterization method is also applied.

[P07] Line Type HOE Machine Vision Lighting System

Kenta TANAKA

Maxis Engineering Inc.

We report the principle of the Line Type HOE Machine Vision Lighting System, which can expand the inspection area by adding in the length direction by using line-type lighting.

**[P08] Factors affecting the polarization state of the reconstructed wave
in polarization holography**

Jinyu WANG

Fujian Normal University

In holographic storage, the multidimensional information page of the amplitude, phase and polarization properties of light can further improve the density of holographic storage.

[P09] A new method of making equivalent polarizer by polarization holography

Peiliang QI

Fujian Normal University

This paper is based on the polarization holography of tensor theory, we use polarization holography to realize the function of equivalent polarizer.

**[P10] Integration of Holographic Light Field Display and 2D Display
for 3D-touch user interface**

Kyoka SHIMOMURA

Tokyo Institute of Technology

We proposed a system that integrates a light-field 3D display and a 2D display for a 3D-touch user interface, displaying information in high-resolution and allowing users to directly touch and operate the aerial 3D image.

[P11] Development of Microscope for Glossy Surface using Holographic Optical Elements

Koosuke HATTORI

Chubu University

In this paper, we present our new type of microscope by using HOEs. As a result of experiments, it was confirmed that the HOEs microscope works well compared with normal light source.

[P12] Preformatted Holographic Screen Development for Real 3D Display

Motoyasu SANO

National Institute of Technology, Numazu College

We are developing a large-screen Real-3D-display that can be viewed by multiple people without any special eye-glasses. In this paper, we proposed a control technology that accurately projects a parallax image on a hologram screen.

[P13] Development of Flexible and Elastic Volume Hologram

Daisuke BARADA

Utsunomiya University

In this paper, a flexible and elastic volume holographic medium is fabricated. Holographic recording in the medium is demonstrated. In reconstruction, recorded object image was observed after bending the volume hologram.

**[P14] Analysis and evaluation of the memory characteristics
in the surface shift-multiplexing holographic memory**

Soki HIRAYAMA

Institute of Industrial Science, The University of Tokyo

The surface shift-multiplexing holographic memory was proposed, and the qualitative relationship between the independent system parameters of this system and memory characteristics was clarified. Then, these characteristics were evaluated quantitatively with signal to noise ratio.

12:20 Lunch

13:30 [12-P01] Acquisition of Three-Dimensional Information of an Object

using Incoherent Digital Holography

Tetsuhiko MUROI (Invited Talk)

Japan Broadcasting Corporation (NHK)

Incoherent digital holography can reconstruct depth images by applying back propagation calculations to holograms. We have discussed the distortion compensation that occurs in the reconstructed image due to lens aberration and the hologram acquisition method suitable for capturing moving images.

13:55 [12-P02] Depth-of-field control through transformation of coherence-dependent bokeh

in incoherent digital holography

Teruyoshi NOBUKAWA

Japan Broadcasting Corporation (NHK)

A transformation method of coherence-dependent bokeh with DOF control is proposed and demonstrated. The results show the proposed method enables the reconstruction of 2D images with a natural bokeh and arbitrary DOF from recorded holograms.

14:10 [12-P03] 3D observation of biological tissues using single-shot digital holographic microscopy

Katsunori NAKAGAWA

Maxis Engineering Inc.

In the section of Related technologies to Holography, we talk about 3D observation of biological tissues, i.e. red blood cell and blue-green algae, using single-shot digital holographic microscopy.

14:25 [12-P04] Planar optical elements based glasses-free 3D display

Wen QIAO (Invited Talk)

Soochow University

In this talk, the current status, future direction and potential applications of glasses-free 3D display based on planar optical elements are summarized. The micro-/nano- fabrication methods used in 3D display are highlighted.

14:50 Break

15:05 [12-P05] Iterative Phase Determination Method using Pixel Spread Function

Ryushi FUJIMURA (Invited Talk)

Utsunomiya University

The signal phase in holographic data storage system is iteratively determined by using pixel spread function. Taking into account the influence of distant pixels, error rates can be greatly reduced compared with the conventional method.

15:30 [12-P06] When deep learning meets holographic data storage

Xiao LIN (Invited Talk)

Fujian Normal University

Deep learning is showing its advantages in many fields such as artificial intelligence, detection and imaging. When deep learning meets holographic data storage, new modulation ways and decoding methods were born.

15:55 [12-P07] Physics-enhanced deep neural networks for computational imaging

Guohai SITU (Invited Talk)

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

We report our recent works on physics-driven untrained deep neural networks (PhysenNet) for computational imaging. PhysenNet employs a strategy that incorporates a physical imaging model into a conventional DNN. We will take phase imaging and computational ghost imaging as examples to demonstrate the principle.

16:20 Break

16:35 Closing

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REGISTRATION FEES

	Early-bird registration fee before Feb. 28	Registration fee after Feb. 28
Regular	¥ 20,000	¥ 25,000
Student	¥ 7,000	¥ 10,000

All payments, should be made in Japanese Yen by bank transfer or by credit card.

For details of the transfer account, please see the downloaded "Registration Form".

Instructions for the presentation

All presentations are going to be conducted online.

- Invited presentation: Presentation: 20 min / Discussions: 5 min.
- Contributed oral presentation: Presentation: 10 min / Discussions: 5 min.
- Poster presentation: Presentation in online virtual communication tool "oVice".

MEMO

MEMO

IWH2021