Digital Holography & 3-D Imaging 2013
Conference Program and Technical Digest

21—25 April 2013

The Fairmont Orchid

Kohala Coast, Hawaii, USA

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WELCOME

Digital Holography and Three-Dimensional Imaging (DH)

21 April- 25 April, 2013

Kohala Coast, Hawaii

Welcome to the 7th Digital Holography and Three-Dimensional Imaging (DH) Topical Meeting in Kohala Coast, Hawaii. The DH Topical Meeting is the world's premier forum for disseminating the science and technology geared towards 3-D information processing. Since the meeting's inception in 2007, it has steadily and healthily grown to 111 presentations this year.

The four-day program includes a plenary speaker, 20 invited speakers, 65 contributed oral presentations, and 25 poster presentations. At this meeting, expect to hear about the latest research on 3-D imaging, digital holographic microscopy, digital/electronic holography, 3-D displays and systems, integral photography and imaging, and holographic interferometry/ modulators/filters/materials as well as applications in biomedical imaging, optical processing, and metrology.

We look forward to meeting you in Kohala Coast, Hawaii.

Sincerely,

Hiroshi Yoshikawa
Nihon University, Japan
General Chair

Myung K. Kim
Univ. of South Florida, USA
General Co-Chair

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Toyohiko Yatagai, *Utsunomiya Univ., Japan*

Special Events

Plenary Session

Monday, 22 April, 08:00–10:00
Promenade Ballroom I & II

DM1A.1 • Doppler Phase-Shifting Digital Holography, Toyohiko Yatagai, *CORE, Utsunomiya University, Japan*

A novel phase-shifting technique, Doppler phase-shifting is introduced. Its principle, features and advantages are discussed and some applications such as shape measurement, color holography etc. are presented.

Toyohiko Yatagai received the BE and DE degrees in applied physics from the University of Tokyo, in 1969 and 1980, respectively. From 1970 to 1983 he was with the Institute of Physical and Chemical Research, Japan, where he worked on optical instrumentation, computer-generated holography, digital image processing, and automatic fringe analysis. He joined University of Tsukuba, Japan, as a Professor of Applied Physics since 1983. He has been Director of Center for Optical Research and Education at Utsunomiya University since 2007. His current research interests include optical computing and holography, optical measurements, and OCT. He is a member of Optical Society of Japan, Japan Society of Applied Physics, fellows of OSA, SPIE and JSAP. He is now vice-President of SPIE. He is the author of six books and co-authors of fourteen books and more than three hundred academic papers in applied optics.

Welcome Reception and Luau

Monday, 22 April, 19:00–21:00
The Coconut Grove at The Fairmont Orchid

Join us in the Coconut Grove for some of Hawaii's best entertainment and island food. The Welcome Reception/ Luau is included in the registration for Technical attendees. If you would like to bring a guest, Luau tickets can be purchased at OSA's registration table located in the Promenade Foyer.

Conference Program Update Sheet

All Technical program changes will be communicated in the onsite Conference Program Update Sheet. All attendees receive this information with you registration materials and we encourage you to review it carefully to stay informed to changes in the program.

Postdeadline Papers Book

The 2013 Postdeadline Papers book, included with a t technical registration, compiles the postdeadline paper summaries. Technical attendees will receive a copy of this with their registration materials.

Online Access to Technical Digest

Full Technical Attendees now have both EARLY and FREE perpetual access to the digest papers through Optics InfoBase. To access the papers go to www.osa.org/dh and select the "Access digest papers" essential link on the right hand navigation. As access is limited to Full Technical Attendees only, you will be asked to validate your credentials by entering the same login email address and password provided during the conference registration process. If you need assistance with your login information, please use the "forgot password" utility or "Contact Help" link.

Student Awards

OSA Foundation Travel Grants:

We are pleased to announce The OSA Foundation Travel Grant recipients for The Optical Society's (OSA) Digital Holography and 3D Imaging (DH) Topical Meeting. The OSA Foundation Student Travel Grant Program is designed to provide career development opportunities by assisting students who wish to attend conferences and meetings. The grants are given to students working or studying science in qualifying developing nations so they can attend OSA-managed technical meetings and conferences. This year's recipients are:

- **Qing-Long Deng, National Chiao Tung University, Taiwan**
- **Yijie Pan, Beijing Institute of Technology, China**

The students receive $1,500 USD in travel support and are selected by the co-chairs of the meeting. Their applications are judged on the following criteria:

- Work or study in a qualifying developing nation
- Enrollment in an accredited undergraduate or graduate program
- Demonstrated need for travel support
- Statement on the value of attending the conference

The OSA Foundation was established in 2002 to support philanthropic activities that help further The Optical Society's (OSA) mission. The Foundation is concentrating its efforts on programs that provide career and professional development resources and support awards and honors that recognize technical and business excellence. The grants funded by the Foundation are made possible by the generous donations of its supporters as well as the dollar-for-dollar match by OSA.

INTERNATIONAL COMMISION FOR OPTICS

Scientific Associate of the International Council for Science, ICSU Affiliated Commission of the International Union of Pure and Applied Physics, IUPAP.

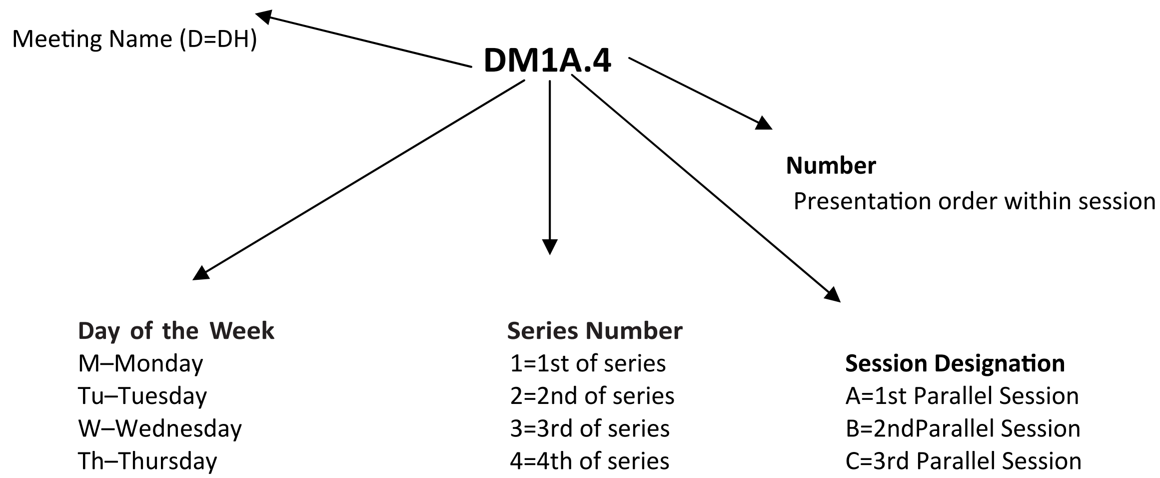
It is a great pleasure to announce the 2013 International Commission for Optics (ICO) Travel Grant winner for Digital Holography 3D Imaging Topical Meeting:

Boaz Jessie Jackin

Received his Doctor of Philosophy in Innovation Systems Engineering in March of 2013 and is from Palappallam, India. He is studying in Japan at the Utsunomiya University under the direction of Dr. Toyohio Yatagai.

The award supports the participation of students and young highly deserving scientists from developing areas. The winner receives $1,000 USD in travel reimbursement costs. The International Commission for Optics was created in 1947. It is an Affiliated Commission of the International Union of Pure and Applied Physics (IUPAP), and a Scientific Associate of the International Council of Science (ICSU). Its objective is to contribute, on an international basis, to the progress and diffusion of knowledge in the field of optics. For more information on ICO, please visit their website: http://e-ico.org

Explanation of Session Codes



The first letter of the code designates the meeting. The second element denotes the day of the week (Sunday =S, Monday=M, Tuesday=Tu, Wednesday=W, Thursday=Th). The third element indicates the session series in that day (for instance, 1 would denote the first sessions in that day). Each day begins with the letter A in the fourth element and since there are no parallel sessions remains an A throughout the week. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.). For example, a presentation coded DM2A.4 indicates that this paper is being presented on Monday (M) in the second series of sessions (2), and is the first parallel session (A) in that series and the fourth paper (4) presented in that session.

Online Access to Technical Digest Now Available!

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Agenda of Sessions

Sunday, 21 April	
15:00 - 18:00	**Registration,** *Promenade Foyer*

Monday, 22 April	
07:00 - 18:00	**Registration,** *Promenade Foyer*
08:00 - 10:00	**DM1A • Plenary Session,** *Promenade Ballroom I & II*
10:00 - 10:30	**Beverage Break,** *Promenade Ballroom III*
10:30 - 12:30	**DM2A • Three-Dimensional Display I,** *Promenade Ballroom I & II*
12:30 - 14:00	**Lunch Break,** *On Your Own*
14:00 - 16:00	**DM3A • Biomedical Applications of Digital Holography,** *Promenade Ballroom I & II*
16:00 - 16:30	**Beverage Break**, *Promenade Ballroom III*
16:30 - 18:30	**DM4A • Digital Holographic Microscopy I,** *Promenade Ballroom I & II*
18:30 - 19:00	**Break**
19:00 - 21:00	**Conference Luau,** *Coconut Grove*

Agenda of Sessions

Tuesday, 23 April	
07:00 - 12:30	**Registration**, *Promenade Foyer*
08:00 - 10:00	**DTu1A • Computer-Generated Holograms,** *Promenade Ballroom I & II*
10:00 - 10:30	**Beverage Break**, *Promenade Ballroom III*
10:30 - 12:15	**DTu2A • Digital Holographic Microscopy II,** *Promenade Ballroom I & II*
	Free Time to Enjoy Hawaii, *On Your Own*

Wednesday , 24 April	
07:00 - 18:00	**Registration**, *Promenade Foyer*
08:00 - 10:00	**DW1A • Digital Holographic Microscopy III,** *Promenade Ballroom I & II*
10:00 - 11:30	**DW2A • Poster Session and Beverage Break (10:00-10:30),** *Promenade Ballroom I & II*
11:30 - 13:00	**Lunch Break,** *On Your Own*
13:00 - 15:00	**DW3A • Metrology and Profilometry,** *Promenade Ballroom I & II*
15:00 - 15:30	**Beverage Break,** *Promenade Ballroom III*
15:30 - 17:30	**DW4A • Three-Dimensional Design II,** *Promenade Ballroom I & II*
17:30 - 18:00	**Beverage Break,** *Promenade Ballroom III*
18:00 - 19:30	**DW5A • Novel Applications of Digital Holography,** *Promenade Ballroom I & II*

Agenda of Sessions

Thursday, 25 April	
07:00 - 18:00	**Registration**, *Promenade Foyer*
08:00 - 10:00	**DTh1A • Digital Holographic Optical Processing,** *Promenade Ballroom I & II*
10:00 - 10:30	**Beverage Break,** *Promenade Ballroom III*
10:30 - 12:30	**DTh2A • Three-Dimensional Display III,** *Promenade Ballroom I & II*
12:30 - 13:30	**Lunch Break,** *On Your Own*
13:30 - 15:30	**DTh3A • Advances in Digital Holography I,** *Promenade Ballroom I & II*
15:30 - 16:00	**Beverage Break**, *Promenade Ballroom III*
16:00 - 18:00	**DTh4A • Advances in Digital Holography II,** *Promenade Ballroom I & II*
18:00 - 18:30	**Break**
18:30 - 19:30	**DTh5A • Post Deadline Papers,** *Promenade Ballroom I & II*

Monday, 22 April

07:00 - 18:00 • Registration, *Promenade Foyer*

08:00 - 10:00
DM1A • Plenary Session, Promenade Ballroom I & II
Presiders: Hiroshi Yoshikawa; Nihon University, Japan and Myung Kim; University of South Florida, United States

08:00 • Chair's Welcome Remarks and Program Kick-Off

DM1A.1 • 08:15 Plenary
Doppler Phase-Shifting Digital Holography: From a Robust Holography to a Wide Band Interferometry, Toyohiko Yatagai[1]; [1]*Utsunomiya University, Japan.* A novel phase-shifting technique, Doppler phase-shifting is introduced. Its principle, features and advantages are discussed and some applications such as shape measurement, color holography etc. are presented.

DM1A.2 • 09:00 Invited
3D Digital Holographics Video System for Real World Scenes, Malgorzata Kujawinska[1], Tomasz Kozacki[1], Grzegorz Finke[1]; [1]*Politechnika Warszawska, Poland.* The paper presents the wide viewing angle digital holographic video system of real world scenes. It describes the full technology chain and main modules of the 3D holographic video system.

DM1A.3• 09:30 Invited
High-resolution Imaging using Scattered Light, Allard Mosk[1]; [1]*Universiteit Twente, Netherlands.* Wavefront shaping and speckle correlation methods have spurred recent advances in focusing and imaging with scattered light. We show speckle correlation imaging at speckle scale resolution without the need of a reference particle or beam.

10:00 - 10:30 • Beverage Break, *Promenade Ballroom III*

10:30 - 12:30
DM2A • Three-Dimensional Display I, Promenade Ballroom I & II
Presiders: Jinwoong Kim; Electronics and Telecom Research Inst., United States and Yasuhiro Takaki; Tokyo Univ. of Agriculture and Technology, Japan

DM2A.1 • 10:30 Invited
Glasses-free 200-view 3D Video System for Highly Realistic Communication, Masahiro Kawakita[1], Shoichiro Iwasawa[1], Robert Lopez-Gulliver[1], Mao Makino[1], Masaki Chikama[1], Mehrdad Panahpour Tehrani[1], Akio Ishikawa[1], Naomi Inoue[1]; [1]*National Inst of Information & Comm Tech, Japan.* We investigate highly realistic communication systems using 3D video and develop a glasses-free 200-view 3D display using a multi-projector and 3D capturing system with a camera array to represent natural 3D moving real objects.

DM2A.2 • 11:00 Invited
Aerial 3D LED Display by use of Crossed-mirror Array, Hirotsugu Yamamoto[1]; [1]*University of Tokushima, Japan.* In order to realize aerial 3D LED signage, we have fabricated a crossed-mirror array for LEDs. Aerial LED signs have been successfully formed. We have investigated image formation with blurring function and accommodations responses.

DM2A.3 • 11:30
Edge-Based Depth-Fused 3D Display, Shiro Suyama[1], Hiroshi Sonobe[1], Tomoki Soumiya[1], Atsuhiro Tsunakawa[1], Hirotsugu Yamamoto[1], Hidenori Kuribayashi[2]; [1]*The Unversity of Tokushima, Japan;* [2]*NIKON Corporation, Japan.* We propose a new type of depth-fused 3D (DFD) display, which employs fusion between a shape and its edge. By changing the luminance ratio between these two images, perceived depth change can be successfully obtained.

DM2A.4 • 11:45
Three-dimensional Screen using Retroreflector, Byoung-Sub Song[1], Hyunsik Sung[1], Sung-Wook Min[1]; [1]*Information Display, Kyung Hee Univertity, Republic of Korea.* The three-dimensional (3D) screen using the retroreflector which reflects the light ray back to the retracing direction is proposed. The proposed method can improve the image visibility of the 3D display system.

DM1A • Three-Dimensional Display I—Continued

DM2A.5 • 12:00
Focus Adjustable Auto-stereoscopic 3D Display System, Kwang-Hoon Lee[1], Yeong-Soen Choe[2], Ha-Mong Sim[1], Yang-Gyu Kim[1], Dong-Kil Lee[1], Youngsik Park[1], Hee-Jung Park[1]; [1]*3DCTRC, Korea Photonics Technology Institute, Republic of Korea;* [2]*Yonsei Univ., Republic of Korea.* To make three different focal planes in the observational space maintaining the number of views in the horizontal direction, a triple segmented-slanted parallax barrier (TS-SPB) in the glasses-off type of 3D display system is proposed.

DM2A.6 • 12:15
Comparison of Perceived Resolution between the Active Retarder and Patterned Retarder 3D Displays, Minyoung Park[1], Hee-Jin Choi[1]; [1]*Physics, Sejong University, Republic of Korea.* In this paper, we study for comparison of perceived resolution between the active retarder and patterned retarder 3D displays using a haploscope to eliminate an additional distortion or noise from the additional optics.

12:30 - 14:00 • Lunch Break, *On Your Own*

14:00 - 16:00
DM3A • Biomedical Applications of Digital Holography, Promenade Ballroom I & II
Presider: Gabriel Popescu; Univ. of Illinois at Urbana-Champaign, United States

DM3A.1 • 14:00 Invited
Wavefront Imaging with a Partitioned Aperture, Jerome C. Mertz[1]; [1]*Boston University, USA.* A microscope add-on is described that measures phase and amplitude in a single shot. The technique is quantitative, light efficient, and works with incoherent illumination. We apply this technique to dynamic biological imaging.

DM3A.2 • 14::30 Invited
Seeing Through Turbid Liquids with Digital Holography and Related Applications for Coherent Imaging in Bio-microfluidics, Pietro Ferraro[1], Vittorio Bianco[1], Melania Paturzo[1], Andrea Finizio[1], Pasquale Memmolo[1]; [1]*Istituto Nazionale di Ottica-CNR Napoli, Italy.* Fluids with suspended colloidal particles hinder imaging through microfluidic channels restricting lab-on-chip's technology for clear liquids. Sharp images and quantitative phase-contrast maps can be obtained in turbid flows through DH thus adding new capability to holographic-microscopy.

DM3A.3 • 15:00
Transport of Intensity Phase Imaging of Hydrogel Microwell Arrays, Nikhil Vadhavkar[1], Ling Xu[1], Adam Pan[1], Justin W. Lee[1], Mary Rhoads[1], Christi Cook[1], Chee Ping Ng[2], Linda G. Griffith[1,2], George Barbastathis[1,2]; [1]*Massachusetts Institute of Technology, USA;* [2]*Singapore-MIT Alliance for Research and Technology, Singapore.* We applied the Transport of Intensity equation for quantitative phase imaging of hydrogel microwells using a commercial bright field microscope. Reconstructions of microwell phase depths are validated computationally and experimentally.

DM3A.4 • 15:15
Digital Holography for Tissue Dynamic Imaging of Cellular Motions in Live Tissue, David D. Nolte[1]; [1]*Purdue University, USA.* Digital holography volumetrically captures subcellular motions inside live tissue that are sensitive indicators of cellular health and cellular response to
applied drugs. Tissue Dynamics Imaging is a new approach to live-tissue functional imaging.

DM3A.5 • 15:30
Label Free Imaging of Neural Network Dynamics, Gabriel Popescu[1]; [1]*Univ of Illinois at Urbana-Champaign, USA.* Using novel quantitative phase imaging and analysis we characterize the properties of a developing neural network in terms of spatial organization, mass transport and growth in a completely label-free manner.

DM3A.6 • 15:45
White Light Fourier Phase Microscopy for Quantitative Phase Imaging, Gabriel Popescu[1]; [1]*Univ of Illinois at Urbana-Champaign, USA.* We present FPM with white light (wFPM) which offers high spatial phase sensitivity due to the white light illumination along with high temporal phase stability due to common path geometry.

16:00 - 16:30 • Beverage Break, *Promenade Ballroom III*

All Technical papers are currently available for online download.
Access paper at
www.osa.org/dh
and click on - **Access digest papers**
Under - **Essential Links**

16:30 - 18:30

DM4A • Digital Holographic Microscopy I, Promenade Ballroom I & II

Presider: Gert von Bally; Westfaelische Wilhelms Univ. Munster, Germany

DM4A.1 • 16:30 Invited

Exploring Neural Cell Dynamics with Digital Holographic Microscopy, Pierre Marquet[1, 3], Pascal Jourdain[1, 3], Daniel Boss[1, 3], Christian D. Depeursinge[2], Pierre Magistretti[2,3, 4]; [1]Département de psychiatrie DP-CHUV, Centre de Neurosciences Psychiatriques, Switzerland; [2]Laboratoire d'Optique Appliquée,, Ecole Polytechnique Federale de Lausanne, Switzerland; [3]Brain Mind Institute, Ecole Polytechnique Federale de Lausanne, Switzerland; [4]Chemical Life Sciences and Engineering Division, King Abdullah University of Science & Technology, Saudi Arabia. In this talk, I will present how digital holographic microscopy, as a powerful quantitative phase technique, can non-invasively measure cell dynamics and especially resolve local neuronal network activity through simultaneous multiple site optical recording.

DM4A.2 • 17:00 Invited

Digital Holographic Microscopy for the study of hematology: red blood cell, malaria, and sickle cell diseases, YongKeun Park[1]; *[1]KAIST, Republic of Korea.* Employing digital holographic imaging techniques, pathophysiology of several red blood cell (RBC) related diseases including malaria and sickle cell disease has been quantitative investigated.

DM4A.3 • 17:30

Dynamics of Red Blood Cells in Shear Flow Using Digital Holographic Microscopy with Reduced Coherence, Christophe Minetti[1], Gwennou Coupier[2], Thomas Podgorski[2], Frank Dubois[1]; *[1]Université Libre de Bruxelles, Belgium; [2]Université Joseph Fourier, France.* Red Blood Cells are deformable objects constituting 50% of the blood. Their 3D repartition, in the smallest capillaries especially, leads to complex flow properties. Those properties are studied under shear flow by DHM under microgravity.

DM4A.4 • 17:45

Real Time Blood Testing using Quantitative Phase Imaging, Gabriel Popescu[1]; *[1]Univ of Illinois at Urbana-Champaign, USA.* We developed a real-time blood testing instrument that combines novel advances in label-free optical imaging with parallel computing. The system can analyze cells in a one-megapixel field of view, at a rate of 40 frames/s.

DM4A.5 • 18:00

Phase Holographic Microscopy and its Biological Applications, Kyung Won Seo[1], Young Ran Ha[1], Eun Seok Seo[1], Sang Joon Lee[1]; *[1]POSTECH, Republic of Korea.* Phase holographic microscopy was applied for the phase imaging of red blood cells (RBCs) and human umbilical vein endothelial cells (HUVECs). HUVECs and its abnormal deformation influenced by collagenase were observed.

DM4A.6 • 18:15

Four Dimensional Motility Tracking of Biological Cells by Digital Holographic Microscopy, Xiao Yu[1], Changgeng Liu[1], Myung K. Kim[1]; *[1]Physics, University of South Florida, USA.* We utilize quantitative phase microscopy by digital holography to track cellular motility in four dimensions. The three-dimensional trajectories have been measured as a function of time at sub-second and micrometer level.

18:30 - 20:30 • Conference Luau, *Coconut Grove*

Notes

07:00 - 18:00 • Registration, *Promenade Foyer*

08:00 - 10:00
DTu1A • Computer-Generated Holograms, Promenade Ballroom I & II
Presiders: Yuji Sakamoto; Hokkaido University, Japan

Tuesday, 23 April

DTu1A.1 • 08:00 Invited

New Devices and Media Technologies for Human-hologram Interaction (HHI) in the Free-space, Eun-Soo Kim[1]; [1]*HoloDigilog Human Media Research Center (HoloDigilog), 3D Display Research Center (3DRC),, Kwangwoon University, Republic of Korea.* Hologram avatars appeared in many SF movies could make emotional interactions with real persons on the same space even though they are not the physical realities. In this talk, new devices and media technologies required for implementation of this interactive holographic virtual reality are presented.

DTu1A.2 • 08:30 Invited

Computer Holography using Wavefront Recording Method, Tomoyoshi Shimobaba[1], Naohisa Okada[1], Takashi Kakue[1], Nobuyuki Masuda[1], Yasuyuki Ichihashi[2], Ryutaro Oi[2], Kenji Yamamoto[2], Tomoyoshi Ito[1]; [1]*Graduate School of Engineering, Chiba University, Japan;* [2]*Universal Communication Research Institute, National Institute of Information and Communications Technology, Japan.* This paper summarizes a wavefront recording method, that is one of fast algorithms for computer generated hologram (CGH), and related works.

DTu1A.3 • 09:00

Fast Polygon-based Method using 2D Fourier Analysis of 3D Affine Transformation, Yijie Pan[1,2], Yongtian Wang[1], Juan Liu[1], Xin Li[1], Jia Jia[1]; [1]*School of Optoelectronics, Beijing Institute of Technology, China;* [2]*Bradley Department of Electrical and Computer Engineering, Virginia Tech, USA.* A polygon-based method is proposed for computer-generated holography. One primitive polygon is used to calculate the diffracted wave of each arbitrary polygon. The method does not have Fast Fourier Transform and saves the computation time.

DTu1A.4 • 09:15

Fast Calculation of Spherical Computer Generated Holograms using Spectral Decomposition of Wave Propagation, Jackin Boaz Jessie[1], Toyohiko Yatagai[1]; [1]*Center for Optical Research & Education, Japan.* A fast calculation method for computer generation of spherical hologram which evaluates wave propagation by spectral decomposition using the derived wave spectrum and transfer function is proposed. It could be evaluated in N(log2N) operations.

DTu1A.5 • 09:30

Aberration Compensation by Digital Holographic Optical Elements used in Optical Trapping, Philip A. Wilksch[1], Anthony Hope[1], Jennifer S. Hartley[1]; [1]*RMIT University, Australia.* Optical aberrations of a 35-mm SLR camera lens used for optical trapping were measured and corrections incorporated into a holographic optical element that generated an array of traps, allowing improved trapping at large working distances.

DTu1A.6 • 09:45

Speckle Suppression in Color Holographic Projection by Pixel Separation, Michal Makowski[1], Izabela Ducin[1], Karol Kakarenko[1], Maciej Sypek[1], Andrzej Kolodziejczyk[1]; [1]*Faculty of Physics, Warsaw University of Technology, Poland.* A simple holographic projection in color is presented along with experimental outcome. Color work is obtained by spatial division of a phase modulator with additional evaluated speckle suppression by avoiding interference between adjacent pixels.

10:00 - 10:30 • Beverage Break, *Promenade Ballroom III*

Tuesday, 23 April

10:30 - 12:15

DTu2A • Digital Holographic Microscopy II, Promenade Ballroom I & II

Presiders: Pierre Marquet; Ecole Polytechnique Federale de Lausanne, France and Marc Georges; Universite de Liege, Belgium

DTu2A.1 • 10:30 Invited

Imaging Colloidal Dynamics with Digital Holographic Microscopy, Vinothan N. Manoharan[1]; [1]*Harvard University, USA.* By fitting electromagnetic scattering models to measured holograms, we image the dynamics of self-assembling nanoparticles with millisecond temporal resolution and nanometer-scale spatial precision. This method also avoids artifacts associated with reconstruction.

DTu2A.2 • 11:00

Discovering Colloid-interface Interactions with Digital Holographic Microscopy, Anna Wang[1], David M. Kaz[2,4], Ryan McGorty[3,4], Vinothan N. Manoharan[1,4]; [1]*School of Engineering and Applied Sciences, Harvard University, USA;* [2]*University of California, Berkeley, USA;* [3]*University of California, San Francisco Mission Bay, USA;* [4]*Department of Physics, Harvard University, USA.* We use digital holographic microscopy to track colloidal microspheres near and at an oil-water interface with 2nm precision in three dimensions. The behavior of a particle as it breaches an oil-water interface is explored.

DTu2A.3 • 11:15

Holographic Microscopy of a Weak Scatterer: A Swimming Malaria Microgamete, Laurence Wilson[1], Sarah E. Reece[2], Lucy M. Carter[2]; [1]*The Rowland Institute at Harvard, USA;* [2]*Institute of Evolutionary Biology; Institute of Immunology & Infection Research, Ashworth Laboratories, University of Edinburgh, United Kingdom.* Weakly-scattering subjects in digital holography may be quickly and accurately localized using the Gouy phase anomaly. We use this to reveal the full 3D geometry of swimming malaria microgametes for the first time.

DTu2A.4 • 11:30

Quantitative Phase Imaging in Turbid Media by Coherence-gated Off-axis Holographic Microscope, Jana Collakova[1], Zbynek Dostal[1], Aneta Krizova[1], Tomas Slaby[2], Michaela Henzlova[1], Martin Antos[1,2], Martin Lostak[2], Vera Kollarova[1], Pavel Vesely[1], Radim Chmelik[1,2]; [1]*Central European Institute of Technology, Brno University of Technology, Czech Republic;* [2]*Institute of Physical Engineering, Faculty of Mechanical Engineering, Brno Univ. of Technology, Czech Republic.* Imaging in turbid media is a challenging problem in biomedical and diagnosis fields. Coherence-Controlled Holographic Microscope design is capable of quantitative phase imaging in turbid media by coherence gating induced by incoherent illumination.

DTu2A.5 • 11:45

New Method of Holographic Three-dimensional Tracking of Living Cells Exploiting their Morphological Properties, Pasquale Memmolo[1,2], Maria Iannone[1], Maurizio Ventre[3], Paolo A. Netti[1], Andrea Finizio[2], Melania Paturzo[2], Pietro Ferraro[2]; [1]*Center for Advanced Biomaterials for Health Care@CRIB, Istituto Italiano di tecnologia, Italy;* [2]*CNR - Istituto Nazionale di Ottica, Italy;* [3]*Department of Materials and Production Engineering University of Naples Federico II, Italy.* We propose a new strategy of three-dimensional (3D) tracking of living cells by digital holography microscopy based on the morphological changes of cells during the migration. A comparison with other 3D tracking methods is accomplished.

DTu2A.6 • 12:00

Topography Measurement of High Numerical Aperture Microlenses with Digital Holographic Microscopy, Tomasz Kozacki[1], Kamil Lizewski[1], Julianna Kostencka[1], Michal Jozwik[1]; [1]*Institute of Micromechanics and Photonics, Warsaw University of Technology, Poland.* This work focuses on the topography measurement of high NA microlenses using digital holography (DH) in microscopic setup. The necessary modifications are discussed to provide DH with capability of accurate characterization microlens of high NA.

12:15 - 20:30

Free Time to Enjoy Hawaii, *On Your Own*

07:00 - 18:00 • Registration, *Promenade Foyer*

08:00 - 10:00
DW1A • Digital Holographic Microscopy III, Promenade Ballroom I & II

Presiders: Vinothan Manoharan; Harvard Univ., United States
and Gabriel Popescu; Univ of Illinois at Urbana-Champaign, United States

Wednesday, 24 April

DW1A.1 • 08:00 Invited

Low-coherence, Common-path, and Dynamic Holographic Microscopy and Nanoscopy Using Portable Systems, Natan T. Shaked[1]; *[1]Tel-Aviv Univ., Israel.* We present compact, portable and inexpensive interferometric systems for obtaining highly stable, easy-to-align holograms under low-coherence illumination, and use them for quantitative, label-free imaging of live cells and transparent elements with nanoscale thickness.

DW1A.2 • 08:30

Surface Topography and Vertical Scanning in Two Color Low Coherence Digital Holographic Microscope, Zahra Monemhaghdoust[1], F. Montfort[1,2], Y. Emery[2], Christian D. Depeursinge[2,3], Christophe Moser[1]; *[1]Lab. of Applied Photonics Devices, Switzerland; [2]Lyncee tec SA, Switzerland; [3]Laboratory of Applied Optics, Switzerland.* A Volume Diffractive Optical Element (VDOE) is placed in the reference arm of an off-axis short coherence DHM enabling nanometric-resolution surface topography in short coherence and high-speed vertical scanning, through field of view enlargement.

DW1A.3 • 08:45

Holographic Time-resolved Particle Tracking using 3D-Deconvolution, Tatiana Latychevskaia[1], Jessica Britschgi[1], Hans-Werner Fink[1]; *[1]Physics Institute, University of Zurich, Switzerland.* When a three-dimensional particle distribution reconstructed from a hologram is deconvolved with a point-spread function, the particle positions are localized. A time series of holograms thus provides the trajectories of all individual particles.

DW1A.4 • 09:00

Table-top Time Resolved Extreme Ultraviolet Fourier Transform Holography, Erik Malm[1], Nils Monserud[1], Chris Brown[1], Przemyslaw Wachulak[3], Huiwen Xu[2], Ganesh Balakrishnan[2], Weilun Chao[4], Erik Anderson[4], Mario Marconi[1]; *[1]Electrical Engineering, Colorado State University, USA; [2]Electrical and Computer Engineering, University of New Mexico, USA; [3]Institute of Optoelectronics, Military University of Technology, Poland; [4]Center for X-Ray Optics, Lawrence Berkeley National Lab, USA.* Extreme ultraviolet Fourier transform holography with 128 nm multi-shot and 169 nm single-shot resolutions were obtained for the purpose of studying nanoscale dynamics.

DW1A.5 • 09:15

Imaging Outside the Box: Resolution Enhancement by Hologram Self-extrapolation, Tatiana Latychevskaia[1], Hans-Werner Fink[1]; *[1]Physics Institute, University of Zurich, Switzerland.* The resolution in digital holography is limited by the hologram size. We present a method of self-extrapolating experimental holograms beyond the actual imaged area leading to reconstructions with enhanced resolution.

DW1A.6 • 09:30

Robustness Evaluation of the Separation of Overlapped Particles in Digital Holographic Microscopy, Ahmed El Mallahi[1], Frank Dubois[1]; *[1]Université Libre de Bruxelles, Belgium.* In this paper, a recent proposed method to separate aggregate of overlapped particles in digital holograms is analyzed. The robustness of the developed method is quantified through simulations and experimental results have been successfully achieved.

DW1A.7 • 09:45

Two-step Distortion-free Reconstruction Scheme for Holographic Microscopy, Michel Gross[1], Fadwa Joud[2], Frederic Verpillat[2], Max Lesaffre[3], Nicolas Verrier[1,3]; *[1]Laboratoire Charles Coulomb - UMR 5221 CNRS-UM2 Université Montpellier II Place Eugène Bataillon, France; [2]Laboratoire Kastler Brossel - UMR 8552 CNRS-ENS- Université Pierre et Marie Curie 24, France; [3]Institut Langevin - UMR 7587 CNRS-ESPCI Paristech 1, rue Jussieu, France.* We propose a three-dimensional holographic reconstruction procedure applicable with no a priori knowledge about the recording conditions enabling distortion-free three-dimensional object reconstruction.

10:00 - 10:30 • Beverage Break and Poster Session, *Promenade Ballroom I & II*

10:00 - 11:30
DW2A • Poster Session, Promenade Ballroom I & II

DW2A.1
Fiber-based Real-Time Color Digital In-line Holography, Adam Kowalczyk[1], Marcin Bieda[1], Michal Makowski[1], Maciej Sypek[1], Andrzej Kolodziejczyk[1]; [1]*Faculty of Physics, Warsaw University of Technology, Poland.* A simple technique of real-time recording and playback of color digital in-line holograms is experimentally validated. The use of single-mode fibers and cross-talk light from a directional coupler facilitates the adjustment and improves robustness.

DW2A.2
A highly sensitive holographic method of analysis of the external influence on the optical fiber, Yuri Zakharov[1], Z. Azamatov[2], Ilya Kulagin[2], Vyacheslav Redkorechev[2]; [1]*Lobachevsky University of Nizhni Novgorod, Russian Federation;* [2]*Applied Physics Institute of National University of Uzbekistan, Uzbekistan.* Digital holographic interferometry techniques is used to highly sensitive measurements of phase distortions of light propagating through optical fiber under external influence. It is shown that its diagnostics and sensitive sensors can be made.

DW2A.3
Holographic Lithography on Vertical Surfaces, Joshua Cowling[1], José J De Jesús Toriz-Garcia[2], Gavin Williams[2], Alan Purvis[1], Richard McWilliam[1], Florian Soulard[1], N. Luke Seed[2], Peter Ivey[3], Daniel Claus[2]; [1]*Engineering and Computing Science, Durham University, United Kingdom;* [2]*Department of Electronic and Electrical Engineering, Sheffield University, United Kingdom;* [3]*Quatretec Ltd, United Kingdom.* Holograms of 3D images are combined with noise suppression and off-axis projection to image arbitrary patterns onto a vertically oriented plane. This has important applications in microfabrication, for instance writing on the edges of silicon chips.

DW2A.4
Coherence Synthesis and Kolmogorov Complexity, Zhengyun Zhang[1], George Barbastathis[1,2]; [1]*Singapore-MIT Alliance for Res & Tech Ct, Singapore;* [2]*Mechanical Engineering, Massachusetts Institute of Technology, USA.* We propose adapting the concept of Kolmogorov complexity for use in characterizing the complexity of partially coherent fields and present a novel coherence synthesis method that bounds the complexity of fields with low spatial coherence.

DW2A.5
A Damage Resistant Holographic QR Code, Shuming JIAO[1], Peter Tsang[1]; [1]*City University of Hong Kong, Hong Kong.* This paper reports the concept and realization of Holographic QR (HQR) code. The digital hologram can be reconstructed optically or numerically, and deciphered with a commodity QR reader with high damage resistant capability.

DW2A.6
Computer Generated Hologram on Long Distance Images for Laser Display Holography, Sumio Nakahara[1], Kyoji Matsushima[2]; [1]*Dept. of Mechanical Engineering, Kansai University, Japan;* [2]*Dept. of Erectrical Engineering, Kansai University, Japan.* To make the person who is situated on long distance recognize images using holograms, we adopted computer generated hologram method. It used a laser direct write lithography system for making of holograms.

DW2A.7
Digital Resizing of Reconstructed Object Images in Digitized Holography, Daichi Fujita[1], Kyoji Matsushima[1], Sumio Nakahara[2]; [1]*Department of Electrical and Electronic Engineering, Kansai University, Japan;* [2]*Department of Mechanical Engineering, Kansai University, Japan.* Three techniques are proposed and examined for resizing optically-reconstructed object images in digitized holography that captures object fields by digital holography and optically reconstructs the object image by computer-generated holograms.

DW2A.8
Hologram synthesis with fast texture update of triangular meshes, Hong-Gi Lim[1], Na-Young Jo[1], Jae-Hyeung Park[1]; [1]*Chungbuk National University, Republic of Korea.* A novel fast method to update the object texture of the triangular mesh hologram is proposed. The angular spectrum of the three-dimensional object represented in triangular meshes is calculated with various pre-defined spectrum shifts.

DW2A.9
Single-pixel holographic 3D imaging system based on compressive sensing, Jun Li[1], Yuping Wang[1], Li Rong[1], Li Yaqin[1]; [1]*South China Normal University, China.* A novel holographic 3D imaging system based on compressive sensing is proposed.

DW2A.10
High-Performance Digital Holographic Video System, Young-Ho Seo[1]; [1]*College of Liberal Arts, Kwangwoon University, Republic of Korea.* We propose a new system which can generate digital holograms using natural color information. The proposed system can generate about 10 digital holographic video frames per a second using about 6K light sources.

DW2A.11 **Eyepiece-type Full-color Electro-holographic Binocular Display with See-through Vision,** Takuo Yoneyama[1], Chanyoung Yang[1], Yuji Sakamoto[1], Fumio Okuyama[2]; [1]*Hokkaido University, Japan;* [2]*Suzuka University of Medical Science, Japan.* We fabricated an eyepiece-type electro-holographic display that can represent full-color images with see-through vision. By using this system, observers can view the reconstructed images binocularly, and real objects can be observed at the same time.

DW2A.12
Wide viewing-angle holographic three-dimensional display using eye-tracking, Yong-Soo Kim[1], Sung-In Hong[1], Jae-Hyeung Park[1]; [1]*Chungbuk National University, Republic of Korea.* In this report, wide viewing angle system with a rotating mirror and eye tracking technique is presented. Holographic three-dimensional images are displayed around a mirror which directs the images to the detected observer position.

DW2A.13
Resolution enhanced three-dimensional display using multiplexed holographic optical element, Jiwoon Yeom[1], Keehoon Hong[1], Byoungho Lee[1]; [1]*Seoul National University, Republic of Korea.* A scheme for the resolution enhancement of three-dimensional display which uses multiplexed holographic optical element is proposed. The proposed method adopts angle multiplexing technique of volume hologram with different angle of reference beams.

DW2A.14
Lenticular lens holographic optical elements for multi-view display system, Keehoon Hong[1], Jiwoon Yeom[1], Youngmo Jeong[1], Byoungho Lee[1]; [1]*Seoul National University, Republic of Korea.* We propose lenticular lens holographic optical elements (HOEs) for multi-view display. The principle is explained and experimental setups for recording and displaying HOEs are presented. Feasibility of the proposed method is verified by experiments.

DW2A.15
Computational 3D Image Reconstruction of Curved Integral Imaging Using Convolution Property Between Periodic Functions, Jae_Young Jang[1], Suk-Pyo Hong[1], Dong-Hak Shin[2], Eun-Soo Kim[1]; [1]*Kwangwoon University, Republic of Korea;* [2]*Dongseo University, Republic of Korea.* An improved 3D image reconstruction using the convolution property between an elemental image and a periodic delta-function array in curved integral imaging is presented.

DW2A.16
Signal and Noise scaling factors in digital holography, Michel Gross[1], Nicolas Verrier[1,2], Michael Atlan[2], Max Lesaffre[2]; [1]*Laboratoire Charles Coulomb - UMR 5221 CNRS-UM2 Université Montpellier II Place Eugène Bataillon, France;* [2]*Institut Langevin - UMR 7587 CNRS-ESPCI Paristech 1, rue Jussieu, France.* An experimental study on how reconstructed image signal and noise scale with acquisition and reconstruction parameters is proposed. Monte-carlo simulation is performed to emphasize that the measured noise is shot-noise.

DW2A.17
Resolution Limits in Broadband Incoherent Correlation Imaging, Petr Bouchal[1,2], Zdenek Bouchal[3], Radim Chmelik[1,2]; [1]*Inst. of Physical Engineering, Brno Univ. of Technology, Czech Republic;* [2]*Central European Inst. of Technology, Czech Republic;* [3]*Depart. of Optics, Palacky Univ., Czech Republic.* A connection between the temporal coherence of light and diffraction is used to determine the resolution limits of a broadband correlation imaging in dependence on the coherence length (CL) and the optical path difference (OPD) of interfering waves.

DW2A.18
Simulation and Experiment of Fourier Transform Digital Holographic Adaptive Optics, Changgeng Liu[1], Xiao Yu[1], Myung K. Kim[1]; [1]*Phyiscs, University of South Florida, USA.* Fourier transform digital holographic adaptive optics imaging system is described. The results from the simulation and experiment are reported that demonstrate the feasibility of this adaptive optics system.

DW2A.19
Oil on the water characterization with coherent fringe projection and digital holographic in-line interferometry, Nickolai Kukhtarev[1], Arkadi Chirita[2], Tatiana Kukhtareva[1], Sonia Galledos[3]; [1]*Physics, Alabama A&M University, USA;* [2]*Physics, Moldova State University, Moldova;* [3]*Naval Research Lab., USA.* We combine optical methods for sensing of oil films: coherent fringe projection (CFP), digital holographic in-line interferometry (DHILI). The methods of CFP and DHILI are described as coherent superposition of partial interference patterns.

DW2A.20
Transport of Intensity Imaging with Wavelet Intensity Derivative Estimation, Adam Pan[1], Justin W. Lee[1], Laura Waller[2], George Barbastathis[3,4]; [1]*Health Sciences and Technology, Massachusetts Institute of Technology, USA;* [2]*Electrical Engineering, UC Berkeley, USA;* [3]*Mechanical Engineering, Massachusetts Institute of Technology, USA;* [4]*Singapore-MIT Alliance for Research and Technology, Singapore.* We demonstrate a method to improve accuracy of Transport-of-Intensity phase retrieval using wavelet derivative operators to estimate axial intensity derivatives, and compare it to derivative estimation via polynomial fitting in simulation/experiment.

DW2A.21
Airy beam generation based on holographic recording and reconstruction, Dawoon Choi[1], Keehoon Hong[1], Kyookeun Lee[1], Jaebum Cho[1], Il-Min Lee[1], Byoungho Lee[1]; [1]*Seoul National Univ., Republic of Korea.* A novel Airy beam generation method based on holography is presented. It is the first report about holographic recording and reconstruction of the Airy beam.

DW2A.22
Synthetic Scanning Holography, Chieh-Cheng Lee[1], Ting-Chung Poon[2,1], Jung-Ping Liu[1]; [1]*Feng Chia University, Taiwan;* [2]*Virginia Tech., USA.* Synthetic scanning holography combines a vertical-bandwidth-limited hologram and a horizontal-bandwidth-limited hologram, which are respectively acquired. The total scanning time is one eighth of the conventional scanning hologram.

DW2A.23
Poly(triphenylamine)-based composites for high-speed photorefractive response time, Kenji Kinashi[1], Hironori Shinkai[1], Wataru Sakai[1], Naoto Tsutsumi[1]; [1]*Kyoto Institute of Technology, Japan.* We first demonstrate the photorefractive (PR) performances of methyl-substituted poly(triarylamine) (PTAA)-based PR device with chemically modified electrodes (CME) of self-assembled monolayer (SAM) coated indium-tin-oxide (ITO) electrodes.

DW2A.24
Triphenylamine-Based Photorefractive Devices for Real-Time Holographic Applications, Sho Tsujimura[1], Kenji Kinashi[1], Wataru Sakai[1], Naoto Tsutsumi[1]; [1]*Macromolecular Science and Engineering, Kyoto Institute of Technology, Japan.* We present here updatable holographic imaging using low electric field driven triphenylamine-based photorefractive polymeric composite device.

DW2A.25
Response of Photorefractive Composite and Real-time Hologram Display, Ngoc Ha Giang[1], Kenji Kinashi[1], Wataru Sakai[1], Naoto Tsutsumi[1]; [1]*Macromolecular Science and Engineering, Kyoto Institute of Technology, Japan.* Photorefractive (PR) responses of a composite are investigated using different operating wavelength. PR composite has better performances at 532nm laser. Holographic application based on PR device operating at low voltage is introduced.

11:30 - 13:00 • Lunch Break, *On Your Own*

Wednesday, 24 April

13:00 - 15:00
DW3A • Metrology and Profilometry, Promenade Ballroom I & II
Presiders: Yoshio Hayasaki; Utsunomiya University, Japan
and *Hoonjong Kang; Korea Electronics Technology Institute, Republic of Korea*

DW3A.1 • 13:00 Invited
Compressive Tomography, David J. Brady[1]; [1]*Duke University, USA.* This talk considers 5D spatial-spectral-temporal imaging from measurements on lower dimensional (typically 2D) manifolds. We compare tomographic imaging using coherent (e.g. holographic), geometric and coherence fields and describe nonlinear regularization strategies for speckle reduction.

DW3A.2 • 13:30 Invited
Sinusoidal Phase Grating as a Diffractive Optical Element for Profilometry, Elena V. Stoykova[1,2], Natalia Berberova[2], Hoonjong Kang[1], Ventseslav Sainov[2]; [1]*1Realistic Media Platform Research Center, Korea Electronics Technology Institute, Republic of Korea;* [2]*Bulgarian Academy of Sciences, Bulgaria.* Profilometry with a sinusoidal phase grating under coherent illumination is analyzed for the case when this diffractive optical element is recorded as a hologram onto a photosensitive material or reproduced by a spatial light modulator.

DW3A.3 • 14:00
Coal Particle Measurement in a Pulverized Coal Flame with Digital Inline Holography, Yingchun Wu[1], Xuecheng Wu[1], Binwu Zhou[1], Jing Yang[1], Linghong Chen[1], Yueyu Peng[1], Kunzan Qiu[1], Gerard Grehan[2], Kefa Cen[1]; [1]*State Key Lab. of Clean Energ. Utiliz., China;* [2]*UMR 6614/ CORIA, LABEX EMC3, France.* Digital inline holography with pulse illumination was applied to measure the 3D position and size of the burning coal particles in a laboratory-scale pulverized coal flame under strong temporal and spatial environment's refractive index variations.

DW3A.4 • 14:15
Digital Holographic Interferometry With CO2 Laser Applied To Aspheric Space Reflector Testing, Marc P. Georges[1], Jean-François Vandenrijt[1], Cédric Thizy[1], Yvan Stockman[1], Patrick Queeckers[2], Frank Dubois[2], Dominic Doyle[3]; [1]*Centre Spatial de Liège, Universite de Liege, Belgium;* [2]*Micrograviy Research Center, Université Libre de Bruxelles, Belgium;* [3]*ESTEC, European Space Agency, Netherlands.* Digital holographic interferometry at long infrared wavelengths allows monitoring large deformations of space reflectors during vacuum-thermal testing. We present different optical schemes and an application to the complex case of elliptic reflector.

DW3A.5 • 14:30
Analyzing Droplets through Digital Holography and a 1D Wavelet Transform Technique, Sam A. Dehaeck[1], Yannis Tsoumpas[1], Pierre Colinet[1]; [1]*Transfers, Interfaces and Processes (TIPs), Universite Libre de Bruxelles, Belgium.* In a Mach-Zehnder interferometer, a droplet is imaged in zero fringe mode. The 1D continuous wavelet transform is used to localize the drop and extract the height at each pixel from a single image.

DW3A.6 • 14:45
Visualization of Pollutant Droplets Solubilization in Seawater by Phase-Only Digital Holography, Pascal Picart[1], Laurent Laurent Aprin[2], Frederic Heymes[2], Pierre Slangen[2]; [1]*LAUM CNRS Université du Maine, France;* [2]*Ecole des Mines d'Ales, France.* An off-axis digital holography set-up leading to the visualization of droplets dissolving in surrounding liquid is presented. The holograms processing relies on the phase-only reconstruction leading to a significant enhancement the image contrast.

15:00 - 15:30 • Beverage Break, *Promenade Ballroom III*

15:30 - 17:30
DW4A • Three-Dimensional Display II, Promenade Ballroom I & II
Presiders: Pascal Picart; Université du Maine, France and Yasuhiro Awatsuji; Kyoto Inst. of Technology , Japan

DW4A.1 • 15:30 Invited
Recent Progress on Three-dimensional Imaging System using Optical Scanning Holography, Taegeun Kim[1], You Seok Kim[1], Sun Ho Jang[1]; [1]*Department of Optical Engineering, Sejong University, Republic of Korea.* Recent process of a 3D imaging system using optical scanning holography (OSH) is presented. A closed loop 3D holographic imaging system is composed of hologram recording stage, digital processing stage and reconstruction stage.

DW4A.2 • 16:00 Invited
Integrated Hologram Optical Head for Holographic Printer, Kyungsuk Pyun[1]; Kyungsuk Pyun[1], Chilsung Choi[1], Alexander Morozov[2], Sunil Kim[1], Jungkwuen An[1], Hong-seok Lee[1], Uni Chung[1]; [1]*Samsung Advanced Institute of Technology, Republic of Korea.* [2]Samsung Moscow Research Center (SMRC), Moscow, Russian Federation. We propose a compact holographic printer using RGB waveguide integrated optics. Our research reduces overall prototype size by 20 times, the number of optical components by 2 times, and improves the efficiency by 3 times.

DW4A.3 • 16:30
New Holographic Polymer Film for the Multicolor and Rewritable Holographic Display, SAKIKO MIURA[1], Satoshi Kobayashi[1]; [1]*TOYO KOHAN CO.,LTD., Japan.* We have developed new holographic polymer film that multicolor images were recorded without adding voltage. When the film is exposed by coherent light, clear images are appeared due to its high diffraction efficiency.

DW4A • Three-Dimensional Display II– Continued

DW4A.4 • 16:45
Quickly Updatable Holographic Display Device Based on Organic Monolithic Compound Dispersed Film, Naoto Tsutsumi[1], Kenji Kinashi[1], Kanako Ogo[1], Takahiro Fukami[1], Wataru Sakai[1], Kodai Fukuzawa[2], Jun-ichi Nishide[2], Yutaka Kawabe[2], Hiroyuki Sasabe[2]; [1]*Kyoto Institute of Technology, Japan;* [2]*Chitose Institute of Science and Technology, Japan.* We have succeeded quickly updatable holographic display based on photorefractive-like optical polymer film device with no external electric field. The device has a capability of real-time recording and simultaneous reconstruction of hologram.

DW4A.5 • 17:00
Giant Refractive-index Modulation of Photoreduction of Graphene Oxide for Digital Holography, Xiangping Li[1], Qiming Zhang[1], Xi Chen[1], Min Gu[1]; [1]*Swinburne University of Technology, Australia.* In this paper, we report on the giant refractive-index modulation of photoreduction of graphene oxide. Applying this finding, we demonstrate its application in digital holography.

DW4A.6 • 17:15
Original Interferometric Out-of-focus Imaging Experiments for the Simultaneous 3D Location and Size Measurement of Spherical Droplets or Bubbles, Huanhuan Shen[1]; [1]*Lab CORIA, France.* Based on generalized Huygens-Fresnel integral, original configurations of interferometric out-of-focus imaging involving cylindrical lenses are designed and proved for simultaneous measurement of the 3D location and the size of droplets or bubbles.

17:30 - 18:00 • Beverage Break, *Promenade Ballroom III*

18:00 - 19:30
DW5A • Novel Applications of Digital Holography, Promenade Ballroom I & II
Presiders: David Nolte; Purdue University, United States and *Jung-Ping Liu; Feng Chia University, Taiwan*

DW5A.1 • 18:00
Proposal of Digital Holographic Reconstruction Method for Fourier VectorWave Memory, Daisuke Barada[1,2], Shigeo Kawata[1,2], Toyohiko Yatagai[2]; [1]*Graduate School of Engineering, Utsunomiya University, Japan;* [2]*Center for Optical Research and Education (CORE), Utsunomiya University, Japan.* A method based on digital holography to reconstruct Fourier vector wave memory is proposed. It is numerically confirmed that the signal vector wave from a recording medium is recorded as a digital hologram and reconstructed.

DW5A.2 • 18:15
Looking through Smoke and Flames by Lensless Digital Holography at Far Infrared, Vittorio Bianco[1], Melania Paturzo[1], Massimiliano Locatelli[2], Eugenio Pugliese[2], Andrea Finizio[1], Anna Pelagotti[2], Pasquale Poggi[2], Lisa Miccio[1], Roberto Meucci[2], Pietro Ferraro[1]; [1]*CNR-National Institute of Optics, Italy;* [2]*CNR-National Institute of Optics, Italy.* Clear imaging of alive people through smoke and flames is possible by Digital Holography at far infrared. While the existing thermographic cameras are obstructed by the flame emission, this technique provides clear images with no blind areas.

DW5A.3 • 18:30
3D Surface Acoustic Waves Made Visible Using Digital Color Holography, Mathieu Leclercq[1], Vincent Tournat[1], Guillaume Penelet[1], Pascal Picart[1]; [1]*LAUM CNRS Universite du Maine, France.* This paper proposes full field visualization of 3D acoustic waves propagating at the surface of a granular medium using digital color holography. Experimental results reveal the existence of the 3D propagative waves.

DW5A.4 • 18:45
Detection of Artificial Satellites Using Optimized Volume Hologram Filters, Hanhong Gao[1], Jonathan M. Watson[2], Joseph S. Stuart[2], George Barbastathis[3, 4]; [1]*Dept. of Electrical Eng. and Computer Science, MIT, USA;* [2]*MIT Lincoln Laboratory, USA;* [3]*Dept. of Mechanical Eng., MIT, USA;* [4]*Singapore-MIT Alliance for Research and Tech. (SMART) Centre, Singapore.* We design and optimize volume hologram filters with telephoto objectives to mitigate the daytime sky background noise in the detection of solar-illuminated artificial satellites. Overall signal-to-noise ratio enhancement of 7.5 has been achieved.

DW5A.5 • 19:00
Laser beam characterization with digital holograms, Andrew Forbes[1], Christian Schulze[2], Daniel Flamm[2], Angela Dudley[1], Michael Duparre[2]; [1]*CSIR, CSIR National Laser Centre, South Africa;* [2]*Institute of Applied Optics, Friedrich Schiller University Jena, Germany.* We show how laser beam characterization may be done in real-time with digital holograms. We illustrate the power of the techniques by applying them to a variety of laser sources, from fibers to solid-state.

DW5A.6 • 19:15
Holographic Three-dimensional Tracking of an Optically-trapped Sub-100nm-gold Particle, Yoshio Hayasaki[1], Akira Sato[1]; [1]*Utsunomiya University, Japan.* We demonstrate three-dimensional tracking of a gold nanoparticle held in optical tweezers in water using an in-line, low-coherence digital holographic microscope. A 60nm-gold nanoparticle had the axial movement of 7 nm in the standard deviation.

07:00 - 18:00 • Registration, *Promenade Foyer*

08:00 - 10:00

DTh1A • Digital Holographic Optical Processing, Promenade Ballroom I & II

Presiders: Gabriel Popescu; Univ. of Illinois at Urbana-Champaign, United States and Guohai Situ; Chinese Academy of Sciences, China

Thursday, 25 April

DTh1A.1 • 08:00 Invited

Resolution Enhancement and Orders Separation in On-axis Nanoparticles based Digital Holography, Zeev Zalevsky1, Amiha Meiri[1], Eran Gur[2], Vicente Micó[3], Javier Garcia[3], Bahram Javidi[4]; [1]*Faculty of Engineering, Bar-Ilan University, Israel;* [2]*Dept. of Electronics Engineering, Jerusalem College of Engineering, Israel;* [3]*Departamento de Óptica, Universitat de València, Spain;* [4]*Electrical and Computer Engineering Dept., University of Connecticut, USA.* A method for eliminating the unwanted terms in an on axis hologram is presented. Free randomly distributed nanoparticles are used to encode and later on to decode/separate the desired term from the unwanted aberrations.

DTh1A.2 • 08:30 Invited

Super-resolution Phase Tomography, Christian D. Depeursinge[1], Yann Cotte[1], Fatih Toy[1], Pascal Jourdain[2], Daiel Boss[1, 2], Pierre Marquet[2, 3], Pierre Magistretti[3, 4]; [1]*Microvision and Microdiagnostic Group (SCI STI CHD), Ecole Polytechnique Federale de Lausanne, Switzerland;* [2]*Brain and Mind Institute, Laboratory of Neuroenergetics and Cellular Dynamics (LNDC) , Ecole Polytechnique Federale de Lausanne, Switzerland; Depart. of Psychiatry- University Hospital (CHUV, Centre de Neurosciences Psychiatriques, Switzerland;* [4]*Chemical Life Sciences and Engineering Division, King Abdullah University of Science & Technology Thuwal, Saudi Arabia.* Digital Holographic Microscopy (DHM) yields reconstructed complex wavefields. It allows synthesizing the aperture of a virtual microscope up to 2◎, offering super-resolution phase images. Live images of

DTh1A.3 • 09:00

Resolution Enhancement of Incoherent Digital Holography using the Super Resolution Image Reconstruction Technique, Jisoo Hong[1], Myung K. Kim[1]; [1]*Department of Physics, University of South Florida, USA.* The reconstruction process of incoherent digital holography, which can overcome the resolution limitation imposed by the imaging device, is proposed based on the super resolution image reconstruction technique.

DTh1A.4 • 09:15

Shack-Hartmann Tomography of Partially Coherent Optical Beams, Bohumil Stoklasa[1], Libor Motka[1], Jaroslav Rehacek[1], Zdenek Hradil[1], Luis Lorenzo Sánchez-Soto[2]; [1]*Department of Optics, Palacky University, Czech Republic;* [2]*Departamento de Optica, Universidad Complutense, Spain.* We show theoretically and experimentally that wavefront detection combined with tomography processing can be used for the complete characterization of the second-order coherence and hence 3D imaging of partially coherent optical beams.

DTh1A.5 • 09:30

Despeckle of Combined MGSA and a Diffuser in Digital Holographic Projection, Qing-Long Deng[1], Yi-Sheng Chang[2], Guan-Syun Huang[2], Wei-Chia Su[3], Chien-Yue Chen[2]; [1]*Institute of Photonic Systems, National Chiao Tung University, Taiwan;* [2]*Graduate School of Electronic and Optoelectronic Engineering, National Yunlin University of Science and Technology, Taiwan;* [3]*Graduate institute of Photonics, National Changhua University of Education, Taiwan.* A low speckle holographic projection display was proposed to calculate random phase modulation in encoding process and rotate diffusers in projection process. After decrypting with coherent light, the despeckle 3D content was successfully projected.

DTh1A.6 • 09:45

Phase Calculation Method Using Spatial derivatives of Quadrature Fringes and Its Application to Digital Holography, Suezou Nakadate[1], Yumeta Suzuki[1], Masato Shibuya[1]; [1]*Tokyo Polytechnic University, Japan.* A phase calculation method using spatial derivatives of quadrature phase-shifted fringes is presented and its applications to interferometry and digital holography are also described.

10:00 - 10:30 • Beverage Break, *Promenade Ballroom III*

10:30 - 12:30
DTh2A • Three-Dimensional Display III, Promenade Ballroom I & II
Presider: Kenji Yamamoto; National Institute of Information and Communications Technology (NICT), Japan

DTh2A.1 • 10:30 Invited

True Color Holographic Display Based on a Super Fast Response Liquid Crystal Film, Hongyue Gao[1], Jicheng Liu[2], Ting-Chung Poon[1]; [1]*Bradley Department of Electrical and Computer Engineering, Virginia Tech, USA;* [2]*Department of Precision Mechanical Engineering, Shanghai University, China.* True color holography is presented based on RGB model using a liquid crystal film with holographic response time under an order of a microsecond. A combination of RGB reconstructions from a hologram realizes color holography.

DTh2A.2 • 11:00

Color Image Generation by Horizontally Scanning Holography, Tatsumi Nakajima[1], Yuji Matsumoto[1], Yasuhiro Takaki[1]; [1]*Institute of Engineering, Tokyo Univ. of Agri. and Tech., Japan.* Improvements in horizontally scanning holography enabled the generation of color images. The time-multiplexing technique made use of a single digital micromirror device illuminated by R, G, and B lasers. Experimental results are shown.

DTh2A.3 • 11:15

Color Holographic Display using a Phase-only Spatial Light Modulator, Xin Li[1], Yongtian Wang[1], Juan Liu[1], Jia Jia[1], Yijie Pan[1], Jinghui Xie[1]; [1]*Beijing Institute of Technology, China.* An analytical method is proposed to generate CGHs for realizing the color holographic display using a phase-only spatial light modulator and a grating. The numerical results show the desired image can be achieved successfully.

DTh2A.4 • 11:30

Colorization Technique for 3D Objects Enlargement Type Electronic Holography using an Optical System and Multiple SLMs, Hisayuki Sasaki[1], Kenji Yamamoto[1], Yasuyuki Ichihashi[1], Takanori Senoh[1]; [1]*Universal Communication Research Institute, National Institute of Information and Communications Technology, Japan.* In electronic holography, methods for increasing the size of monochrome 3D image using an optical system containing a lens array and other components in front of multiple SLMs have been considered. This paper proposes a colorization technique by using time division multiplexing of light sources.

DTh2A.5 • 11:45

Three-Dimensional Image Reconstruction with a Wide Viewing-Zone-Angle Using a GMR-Based Hologram, Kenji Machida[1], Daisuke Kato[1], Tomoyuki Mishina[1], Hidekazu Kinjo[1], Ken-ichi Aoshima[1], Kiyoshi Kuga[1], Hiroshi Kikuchi[1], Naoki Shimidzu[1]; [1]*Science & Technology Research Labs., NHK, Japan.* We have developed a spatial light modulator consisting of giant magnetoresistive (GMR) elements. Three-dimensional images with a wide viewing-zone-angle were successfully reconstructed using a GMR-based binary hologram having a pixel pitch of 1 μm.

DTh2A.6 • 12:00

Binary Holograms for Electro-Holographic Displays, Fu-Hao Chen[1], Li-Yuan Liao[2], Cheng-Huan Chen[2], Chao-Hsu Tsai[1]; [1]*Electronics and Optoelectronics Research Laboratories, Industrial Technology Research Institute, Taiwan;* [2]*Power Mechanical Engineering, National Tsing Hua University, Taiwan.* A binary computer-generated hologram without iteration is proposed. It's advantageous to the transmission and storage of Holo video because of its simplicity. We demonstrate a 3-D animation on an LCoS holographic display and a projection system.

DTh2A.7 • 12:15

Liquid Volumetric Display with Parallel Optical Access by Computer-generated Hologram, Satoshi Hasegawa[1], Yoshio Hayasaki[1]; [1]*Utsunomiya University, Japan.* Parallel optical access liquid volumetric display with computer-generated hologram is demonstrated. The volumetric display is composed of the luminous points excited by femtosecond pulses focused in a fluorescent solution with a XYZ scanner.

12:30 - 13:30 • Lunch Break, *On your Own*

13:30 - 15:30
DTh3A • Advances in Digital Holography I, Promenade Ballroom I & II
Presider: Freddy Monroy Ramirez; Universidad Nacional de Colombia, Colombia

Thursday, 25 April

DTh3A.1 • 13:30 Invited

Unconventional Digital Holography, Dinesh N. Naik[1], Wolfgang Osten[1], Giancarlo Pedrini[1]; [1]*Universität Stuttgart, Germany.* Traditionally, holography requires coherent-light for object illumination and a reference beam for recording its 3-D information as a hologram. We explore the unconventional techniques for digital holography that avoid coherent-light and reference.

DTh3A.2 • 14:00

On the Pixel Paradox in Digital Holography, Pascal Picart[1,2], Mathieu Leclercq[1]; [1]*LAUM CNRS Universite du Maine, France;* [2]*ENSIM, France.* The pixel paradox is related to contradictorily modelling that state 1) the pixel acts on the reconstructed object as a convolution function, 2) that it acts as a multiplicative sinc function. Facet 2) is demonstrated.

DTh3A.3 • 14:15

Digital Holography Using High Dynamic-Range Imaging, Ryosuke Yonesaka[1], Yasuhiro Awatsuji[1], Tatsuki Tahara[1], Peng Xia[1], Shogo Ura[1], Kenzo Nishio[2]; [1]*Department of Electronics, Kyoto Institute of Technology, Japan;* [2]*Advanced Technology Center, Kyoto Institute of Technology, Japan.* We propose a technique for improving the quality of a reconstructed image degraded due to the insufficiency of dynamic range of an image sensor in digital holography. We numerically confirm the effectiveness of the technique.

DTh3A.4 • 14:30

Suppression of Speckle Noise in Digital Holography via Rotating Polarization State, Lu Rong[1], Dayong Wang[1], Yuhong Wan[1], Yunxin Wang[1]; [1]*Institute of Information Photonics Technology and College of Applied Sciences, Beijing University of Technology, China.* We propose a speckle noise suppression method by averaging reconstruction images using different polarized holograms. Statistical evaluation of the experimental results verifies the effectiveness of the proposed concept and recording setup.

DTh3A.5 • 14:45

Vibration Motions studied by Heterodyne Holography, Michel Gross[1], Fadwa Joud[2], Michael Atlan[3], Pierre-Andre Taillard[4], Frederic Verpillat[2], Nicolas Verrier[1,3]; [1]*Universite de Montpellier II, France;* [2]*Laboratoire Kastler Brossel - UMR 8553 CNRS-UPMC-ENS 24 rue Lhomond, France;* [3]*Institut Langevin UMR 7587CNRS ESPCI ParisTech, 1, rue Jussieu, France;* [4]*Conservatoire de musique neuchâtelois, Avenue Léopold-Robert 34; CH-2300, Switzerland.* Playing with amplitude, phase and frequency of both reference and signal arms, heterodyne holography is well adapted to vibration analysis. Vibration sidebands can be imaged and stroboscopic measurement sensitive to mechanical phase can be made.

DTh3A.6 • 15:00

Design and Optimization of Point Spread Functions in Volume Holographic Imaging Systems, Hanhong Gao[1], George Barbastathis[2,3]; [1]*Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, USA;* [2]*Department of Mechanical Engineering, Massachusetts Institute of Technology, USA;* [3]*Singapore-MIT Alliance for Research and Technology (SMART) Centre, Singapore.* We present how to optimize and locate the best combination of point indenters exerted on the exterior of the holograms to achieve the desired point-spread-functions (PSFs) in volume holographic imaging systems.

DTh3A.7 • 15:15

Compensating Systematic Chromatic Errors in Digital Color Holography, Mathieu Leclercq[1], Pascal Picart[1]; [1]*LAUM CNRS Universite du Maine, France.* This paper proposes a robust and efficient method to compensate for the chromatic aberrations induced by optical elements in digital three-color holography. Experimental results confirm and validate the proposed approach.

15:30 - 16:00 • Beverage Break, *Promenade Ballroom III*

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16:00 - 18:00

DTh4A • Advances in Digital Holography II, Promenade Ballroom I & II

Presiders: Marc Georges; Universite de Liege, Belgium and Pascal Picart; LAUM CNRS Universit Ã du Maine, France

DTh4A.1 • 16:00
Digital Three-wavelength Holographic Interferometry using Wollaston Prisms, Jean-Michel Desse[1], Pascal Picart[2]; [1]*ONERA, France;* [2]*LAUM, France.* A new method of digital three-wavelength holographic interferometry using Wollaston prisms is présented. The optical arrangement makes it easy to introduce three high spatial carrier frequencies which can be analyzed with and without flow.

DTh4A.2 • 16:15
Experimental Methods to Quantify the Accuracy of 3D Particle Field Measurements via Digital Holography, Daniel Guildenbecher[1], Phillip L. Reu[1], Jian Gao[2], Jun Chen[2]; [1]*Sandia National Laboratories, USA;* [2]*School of Mechanical Engineering, Purdue University, USA.* In-line digital holograms are obtained of particles immersed in a clear viscous liquid. Comparison of reconstructed particle sizes and displacements to their known values reveals good agreement with theory while highlighting needs for development.

DTh4A.3 • 16:30
Full Amplitude and Phase Retrieval in In-Line Digital Holography With a Spatial Phase Modulation, Mokrane Malek[1], Pascal Picart[1]; [1]*LAUM CNRS Universite du Maine, France.* This paper presents a reference-free digital holographic system for 3D transparent objects analysis. The set-up is able to produce full amplitude and phase reconstruction without any reference wave, in an in-line configuration.

DTh4A.4 • 16:45
Digital Holography with Nonlinear Diffusion Regularization, Lei Tian[1], Jonathan C. Petruccelli[1], George Barbastathis[1,2]; [1]*Massachusetts Institute of Technology, USA;* [2]*Singapore--MIT Alliance for Research and Technology (SMART) Centre, Singapore.* We experimentally demonstrate a new digital holography reconstruction method based on nonlinear diffusion regularization.

DTh4A.5 • 17:00
Study of a Seal Whisker-inspired Flow Sensor using Compressive Holography, Yi Liu[1], Lei Tian[1], George Barbastathis[1,2]; [1]*MIT, USA;* [2]*Singapore-MIT Alliance for Research and Technology (SMART) Centre, Singapore.* We apply compressive holography to study the vibration of a seal whisker-inspired flow sensor.

DTh4A.6 • 17:15
Positivity-induced Implicit Compressed Sensing, Zhengyun Zhang[1], George Barbastathis[1,2]; [1]*Singapore-MIT Alliance for Res & Tech Ct, Singapore;* [2]*Mechanical Engineering, Massachusetts Institute of Technology, USA.* Positivity can be as powerful as the traditional 1-norm prior used in compressed sensing; we show this via an example and theory for the noiseless case, and a simulated holography application for the noisy case.

DTh4A.7• 17:30
Wavefront Reconstruction by Hybrid Phase Retrieval Using Two Intensity Measurements, Dayong Wang[1], Lu Rong[1], Yunxin Wang[1]; [1]*Institute of Information Photonics Technology and College of Applied Sciences, Beijing University of Technology, China.* We propose a hybrid phase retrieval algorithm for recovering a complex-valued object from two axially displaced holograms. Experimental results demonstrate the effectiveness of twin image elimination at a significantly reduced computational cost.

DTh4A.8 • 17:45
Phase Retrieval from Multi-plane Intensity Measurements with Wavefront Sensing, Karl-Heinz Brenner[1], Xiyuan Liu[1]; [1]*Chair of optoelectronics, ziti, University of Heidelberg, Germany.* The proposed technique is a combination of phase retrieval and wavefront sensing with diffractive elements. The diffractive element enhances the convergence of phase retrieval and offers advantages, which are not achievable with micro lenses.

18:00 - 18:30 • Break

18:30 - 19:30 • Postdeadline Papers, Promenade Ballroom I & II

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