Digital Holography Session Guide

Disclaimer: this guide is limited to technical program with abstracts and author blocks as of 28 May. For updated and complete information with special events, reference the online schedule or mobile app.

Monday, 3 June

08:30 -- 10:30
Room: Tuffatore B
M1A • Three-dimensional Holographic Imaging and Applications
Presider: Pietro Ferraro; Inst. of Intelligent Systems ISASI, Italy

M1A.1 • 08:30 (Invited)
Optical Diffraction Tomography Using the MaxwellNet, Demetri Psaltis[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* I will describe imaging of 3D objects using a neural network trained with an error signal derived from compliance with Maxwell's equations. This approach eliminates the need for a labeled training set.

M1A.2 • 09:00
Multi-Spectral Reflection Matrix for 3D Label-Free Microscope Imaging, Victor J. Barolle[1], Paul Balondrade[1], Nicolas Guigui[1], Claude Boccara[1], Mathias Fink[1], Alexandre Aubry[1]; [1]*Institut Langevin, France.* Label-free microscopy uses light scattering to obtain a tri-dimensional image of biological tissues but light undergoes aberrations and multiple scattering. We present a multi-spectral matrix approach to solve these problems in the most efficient way known today.

M1A.3 • 09:15
Computational Segmentation of Nuclei and Vacuoles Based on Statistical Inference for Tomographic Phase Microscopy in Flow Cytometry, Daniele Pirone[1]; [1]*CNR-ISASI, Italy.* Identifying intracellular organelles within the 3D label-free tomograms of cells' refractive indexes recorded in flow cytometry is challenging. Here we present a method for the 3D statistical segmentation of nuclei and vacuoles in flowing cells.

M1A.4 • 09:30
Monitoring Preimplantation Embryo Development Using a 3D Holographic Video Microscope and AI-Assisted Image Analysis, Guillaume Godefroy[1], Cecile Fiche[1], Sylvia Desissaire[1], Hervé Lionel[1], Tigrane Cantat-Moltrecht[1], Célia Tebbakh[2], Corinne Loeuillet[2], Christophe Arnoult[2], Edgar Del Llano[2], Pierre Ray[2,3], Chiara Paviolo[1]; [1]*38000, Univ. Grenoble Alpes, CEA, LETI, France;* [2]*38000, Univ. Grenoble Alpes, CEA, INSERM U1209, CNRS UMR 5309, Inst. for Advanced Biosciences, France;* [3]*38000, CHU Grenoble Alpes, UM GI-DPI, France.* Selecting viable embryos for in vitro fertilization is challenging. We propose a workflow involving a 3D holographic video system and AI-assisted image analysis combining segmentation and tracking to monitor the morphological characteristics of embryo development.

M1A.5 • 09:45
Three-Dimensional Refractive Index Estimation Based on Non-Interferometric Optical Diffraction Tomography with Angular and Axial Illumination Scanning, George Nehmetallah[1], Brad Bazow[1], Christopher Raub[1]; [1]*Catholic Univ. of America, USA.* We present computational inverse scattering to achieve three-dimensional refractive index reconstructions of biological specimens with sub-micron resolution in an optical diffraction tomography system with angular and axial illumination scanning and constrained optimization.

M1A.6 • 10:00 (Invited)
Advanced Label-Free 3D Imaging Approaches and Application to the Pre-Implantation Embryo, Kishan Dholakia[1]; [1]*Univ. of St. Andrews, UK.* This talk will describe advanced label-free approaches of digital holography microscopy and light sheet imaging that capture morphological and molecular information. The application to imaging the pre-implantation embryo will be demonstrate the applicability.

08:30 -- 10:30
Room: Sala Convegni
M1B • Recent Progresses in Computer Generated Holography
Presider: Yaping Zhang; Kunming Univ of Sci. and Tech., China

M1B.1 • 08:30 (Invited)
NeRF-Based Computer-Generated Holography, Tomoyoshi Shimobaba[1], Minsung Kang[1], Fan Wang[1], Kai Kumano[1], Tomoyoshi Ito[1]; [1]*Chiba Univ., Japan.* This study introduces hologram generation from two-dimensional images using neural radiance fields (NeRF). The proposed method enables the generation of holograms capable of reproducing 3D images viewing at arbitrary.

M1B.2 • 09:00
Low Bitrate Compression of bi-Level Holograms Using INTERFERE: an STFT-Based Codec, Raees Kizhakkumkara Muhamad[1,2], David Blinder[1,2], Peter Schelkens[1,2]; [1]*Vrije Universiteit Brussel, Belgium;* [2]*imec, Belgium.* We propose a lossy compression technique for bi-level holograms by utilizing INTERFERE, an STFT-based codec in concert with the DFT's conjugate symmetry property for real-valued signals. At high compression ratios, this framework outperforms all other known solutions.

M1B.3 • 09:15
Theoretical and Practical Aspects for Generation of Helix Beams With Required Shape, Intensity, Phase and Polarization Distributions, Jose A. Rodrigo[1], Tatiana Alieva[1]; [1]*Universidad Complutense de Madrid, Spain.* Theoretical and practical aspects of holographically generating beams with the required 3D curved shapes, intensity, phase, and polarization distributions are explored, using the example of a helix beam.

M1B.4 • 09:30
Generalized HoloTile and its Applications in Industry and Academia, Andreas Madsen[1], Jesper Glückstad[1]; [1]*Univ. of Southern Denmark, Denmark.* HoloTile is an innovative holography technique for CGH, utilising sub-holograms and PSF shaping for high-resolution, speckle-reduced reconstructions. The paper introduces new HoloTile modalities and discusses applications like optical trapping, volumetric 3D printing, and quantum communication.

M1B.5 • 09:45
Contrast Enhancement via Residual Energy Adjustment and Effect of Non-Linear Exponent in Gerchberg-Saxton Algorithm, Jiaqi Liu[1], Mike Pivnenko[1], Daping Chu[1]; [1]*Univ. of Cambridge, UK.* Residual energy adjustments was introduced into Gerchberg-Saxton (GS) algorithm for contrast enhancement with improved highlighted details and visual clarity facilitated by a non-

linear exponent that expedites convergence. Experimental validation shows our method outperforms traditional techniques.

M1B.6 • 10:00
Implementation of Cylindrical Computer-Generated Hologram Using Object Light With Hidden Surfaces Removed, Akifumi Kashiwagi[1], Kodai Ono[1], Yuji Sakamoto[1]; [1]*Graduate School of Information Science and Technology, Hokkaido Univ., Japan.* We developed a method for calculating a cylindrical computer-generated hologram using hidden-surface-removed object light, and we succeeded in reconstructing three-dimensional images optically with the hologram. This method is based on the concept of WARP.

M1B.7 • 10:15
Neural Encoder for 3D Computer-Generated Hologram, Runze Zhu[1], Lizhi Chen[1], Jiasheng Xiao[1], Hao Zhang[1]; [1]*State Key Laboratory of Precision Measurement Technology and Instruments, Department of Precision Instrument, Tsinghua Univ., China.* In this work, we have developed a hologram encoder using a deep neural network. To effectively train this neural encoder, a novel training dataset composed of three-dimensional (3D) Fourier basis functions is adopted.

11:00 -- 13:00
Room: Tuffatore B
M2A • AI-powered Holographic Imaging I
Presider: George Nehmetallah; Catholic Univ. of America, USA

M2A.1 • 11:00 (Invited)
Improvement and Application of Digital Holography on use of Deep Learning, Jianglei Di[1], Ju Tang[2], Ping Wang[3]; [1]*Guangdong Univ. of Technology, China;* [2]*Northwestern Polytechnical Univ., China;* [3]*Sun Yat-sen Univ., China.* This report presents our recently work on holographic reconstruction, phase unwrapping, aberration compensation and denoising in digital holography on use of deep learning, and it also discusses the physical enhancement models and self-supervised learning.

M2A.2 • 11:30
Neural Network Based Subspace Analysis for Estimation of Phase Derivatives From Noisy Interferograms, Dhruvam Pandey[1], Viren S Ram[1], Rajshekhar Gannavarpu[1]; [1]*Indian Inst. of Technology, Kanpur, India.* This article introduces a robust phase derivative estimation method using deep learning-assisted subspace analysis. Simulation results validate the performance of the proposed approach under severe noise conditions.

M2A.3 • 11:45
Fast Deep Coherence Holography (FDCH) for 3D Object Reconstruction, Quang S. Trieu[1], George Nehmetallah[1]; [1]*Catholic Univ. of America, USA.* We propose a fast and position independent deep learning based coherence holography method to reconstruct the total 3D object from two interferograms at a fixed camera location yielding a better result in terms of accuracy and time.

M2A.4 • 12:00
Missing Cone Problem Correction With Deep Learning Based Segmentation, Michal T. Gontarz[1], Wojciech Krauze[1], Vibekananda Dutta[1], Malgorzata Kujawinska[1]; *[1]Warsaw Univ. of Technology, Poland.* The missing cone problem comes from limited angle scanning in Holographic Tomography. It causes an object elongation along the optical axis. This paper proposes creating a mask of the object via segmentation of reconstruction.

M2A.5 • 12:15
Model-Driven Neural Network for Compressive Holographic Reconstruction, Jiachen Wu[1], Fangyu Liu[1], Hongyuan Wang[1], Liangcai Cao[1]; *[1]Tsinghua Univ., China.* Compressive holography enables multilayer reconstruction by single hologram. However, the iterative reconstruction methods are time-consuming. We proposed a model-driven neural network for compressive holographic reconstruction. The experiment demonstrates the compelling reconstruction with fast computational speed.

M2A.6 • 12:30 (Invited)
On the use of Deep Learning for Computational Optical Imaging: From Data Driven to Physics Driven, Guohai Situ[1]; *[1]Shanghai Inst. of Optics and Fine Mechanics, China.* Conventionally, DNN is trained by a large set of data. The most critical issue with this paradigm is that the DNN inference has no physical interpretation or limited generalization. To resolve these issues, one solution is to incorporate the physics of the problems in hand into the training of DNN. Here we present a brief review of recent works in this regard with the use cases of phase imaging and ghost imaging.

11:00 -- 13:00
Room: Sala Convegni
M2B • Contemporary Imaging Techniques
Presider: Tatiana Alieva; Universidad Complutense de Madrid, Spain

M2B.1 • 11:00 (Invited)
Lensless Microscopy and Endoscopy Enabled by Coded Ptychography, Guoan Zheng[1]; *[1]Univ. of Connecticut, USA.* Abstract not available.

M2B.2 • 11:30
Interferometric Multi-Beam Photon-Counting Enhanced Lidar, Kai-Ting Ting[1], Benjamin Scheck[1], Dan Feldkhun[1,2], Joshua Combes[1], Kelvin H. Wagner[1]; *[1]Univ. of Colorado at Boulder, USA; [2]Lambdametrics, USA.* A non-redundant array of frequency-shifted beams is transmitted to overlap and interfere on the target for Fourier-BASIS structured-illumination computational lidar imaging. Time-tagged photons are detected and Fourier analyzed to demonstrate a quantum advantage of multi-beam interferometry.

M2B.3 • 11:45
Raman Imaging Through a Multimode Fiber With Principal Component Analysis, Liam Collard[1], Mohammadrahim Kazemzadeh[1], Linda Piscopo[1], Filippo Pisano[1], Massimo De Vittorio[1], Ferruccio Pisanello[1]; *[1]Italian Inst. of technology, Italy.* We evaluate the use of principal component analysis to analyze Raman images made through a multimode fiber using holographic wavefront shaping.

M2B.4 • 12:00
Morphological Imaging of 3D Cultured Kidney Mesangial Cells Using Gradient Light Interference Microscopy, Ankit Butola[1,2], Biswajoy Ghosh[1], Jaena Park[2], Minsung Kwon[2], Alejandro De la Cadena[2], Sudipta Mukherjee[2], Rohit Bhargava[2], Stephen Boppart[2], Krishna Agarwal[1]; *[1]UiT The Arctic Univ. of Norway, Norway; [2]Beckman Inst. for Advanced Science and Technology, Univ. of Illinois at Urbana-Champaign, USA.* We present a gradient light interference microscopy system to visualize 3D quantitative imaging of kidney mesangial cells. We used the system to obtain the morphology of 3D cultured kidney cells of thickness 200 um.

M2B.5 • 12:15
Holographic Focusing Schlieren Imaging (HFSI) for Three-Dimensional Flow Visualization, Zhiming Lin[1], Yiqin Li[1], Aimin Xie[2], Kaihui Liu[1], Zhiliang Xue[1], Qiwen Jin[1], Yingchun Wu[1], Xuecheng Wu[1]; *[1]Zhejiang Univ., China; [2]China Aerodynamics Research and Development Center, China.* Holographic focusing schlieren imaging is proposed, offering a single-view, single-shot approach to three-dimensional flow visualization. A proof-of-concept experiment demonstrates its effectiveness, revealing its ability to analyze transient flow field across multiple depths.

M2B.6 • 12:30 (Invited)
Lensless on-Chip Super-Resolution Microscopy Based on Array Illumination and Phase Recovery Algorithm, Su Ping[1]; *[1]Tsinghua Univ., China.* We present a lensless on chip microscopy system based on array illumination and a super-resolution reconstruction algorithm based on sub-pixel displacement, the resolution of which breaks through the limitation of pixel size.

14:00 -- 16:00
Room: Tuffatore B
M3A • Quantitative Phase Microscopy
Presider: Chao Zuo; Nanjing Univ of Science and Technology, China

M3A.1 • 14:00 (Keynote)
Advances in Speckle Quantitative Phase Microscopy and Beyond, Peter So[1]; *[1]NE47-279, 77 Mass Ave, Massachusetts Inst. of Technology, USA.* Abstract not available

M3A.2 • 14:45
Bedrosian Theorem Problem in Quantitative Phase Imaging, Piotr Zdankowski[1], Maksymilian Chlipala[1], Mikolaj Rogalski[1], Maciej Trusiak[1]; *[1]Warsaw Univ. of Technology, Poland.* In this study we highlight the significance of the Bedrosian theorem, stating that strong sample-induced amplitude variations can impact the result of the phase demodulation, challenging the often-overlooked assumptions in phase reconstruction.

M3A.3 • 15:00
Quantitative Phase Microscopy of Hypoxic Epithelial Cells Using the Transport of Intensity Equation, Alejandro Silva[1], Miguel Arocena[1], Ariel Fernández[1], Julia Alonso[1]; *[1]Universidad de la República, Uruguay.* Quantitative Phase Imaging of epithelial cells under different levels of

hypoxia can be achieved by acquiring a multifocus stack with a 3D printed microscope and using the Transport of Intensity Equation. Experimental results are provided.

M3A.4 • 15:15
Reflection Matrix Imaging for Refractive Index Tomography, Flavien Bureau[1], Victor Barolle[1], Paul Balondrade[1], Nicolas Guigui[1], Alexandre Aubry[1]; [1]*Institut Langevin, France.* This study introduces a new approach using holography to map spatial variations in the refractive index within unknown media. Beyond offering quantitative perspectives, it considerably improves digital confocal imaging. Preliminary results on a macaque cornea are presented.

M3A.5 • 15:30 (Invited)
Novel Digital Holographic Approaches for a Non-Invasive and Complete Detection of Biological Samples Features, Maria Antonietta Ferrara[1]; [1]*Inst. of Applied Sciences and Intelligent Systems, Italian National Research Council, Italy.* Holotomography and polarization-sensitive digital holography improve the typical morphological characterization obtained by digital holography by adding information about the 3D refractive index distribution and the polarization state within biological samples, allowing fast and straightforward diagnostic.

14:00 -- 15:45
Room: Sala Convegni
M3B • Multimodal Imaging
Presider: Lisa Miccio; Inst. of Intelligent Systems ISASI, Italy

M3B.1 • 14:00 (Invited)
Off-Axis Fluorescent Digital Holography Using Polarization Optical Elements and Other 3D Fluorescent Imaging Techniques, Osamu Matoba[1]; [1]*Kobe Univ., Japan.* Abstract not available.

M3B.2 • 14:30
Automation of Gram Stain Imaging with Multispectral In-Line Holography, Dylan Brault[2], Thomas Olivier[2], Ferréol Soulez[1], Corinne Fournier[2]; [1]*Université de Lyon, Université Lyon1, ENS de Lyon, CNRS, Centre de Recherche Astrophysique de Lyon, UMR 5574, France;* [2]*Université Jean Monnet Saint-Etienne, CNRS, Institut d Optique Graduate School, Laboratoire Hubert Curien UMR 5516, France.* We propose an approach to automate stained micro-biological samples imaging using multispectral in-line holography. The approach is based on a self-calibrated regularized inverse problems reconstruction.

M3B.3 • 14:45
Compact Quantitative Phase Imaging Based on a Polarization-Dependent Varifocal Metalens, Qixuan Min[1,2], Jingying Guo[1], Guohai Situ[1,2]; [1]*Wangzhijiang Innovation Center for Laser, Shanghai Inst. of Optics and Fine Mechanics, China;* [2]*Hangzhou Inst. for Advanced Study, Univ. of Chinese Academy of Sciences, China.* The transport-of-intensity equation is a non-interferometric method for quantitative phase imaging. We propose a compact TIE method based on a polarization-dependent varifocal metalens. Experimental results indicate precise phase reconstruction of objects by our method.

M3B.4 • 15:00
Label-Free Cell Imaging and Biochemical Analysis Using Multimodal Holographic Tomography, Chung-Hsuan Huang[1], Han-Yen Tu[2], Chau-Jern Cheng[1]; *[1]National Taiwan Normal Univ., Taiwan; [2]Chinese Culture Univ., Taiwan.* We present a label-free multimodal holographic tomography combining three-dimensional refractive index imaging with Raman spectroscopy. Experimental results show cellular tomograms and specific Raman signals of human retinal cells are detected for cellular analysis and diagnosis.

M3B.5 • 15:15 (Invited)
Fluorescence Self-Interference Digital Holography Enables High-Fidelity, Multi-Dimensional Scanning-Free Volumetric Imaging, Yuhong Wan[1], Tianlong Man[1], Wenxue Zhang[1], Minghua Zhang[1], Hongqiang Zhou[1]; *[1]Beijing Univ. of Technology, China.* We demonstrated improvements on performances of self-interference digital holography (SIDH) using high-fidelity 3D deep learning network. Meanwhile, by exploring its multi-dimensional data encoding and decoding ability, the SIDH was pushed toward scanning-free 3D polarization microscopy.

16:30 -- 18:30
Room: Tuffatore B
M4A • Unconventional Holographic and QPI Techniques and Applications
Presider: Björn Kemper; Westfälische Wilhelms Univ Münster, Germany

M4A.1 • 16:30 (Invited)
Digital Holography With Structured Light and Single-Pixel Detection, Lluis Martínez[1], Jesús Lancis[1], Enrique Tajahuerce[1]; *[1]Universitat Jaume I, Spain.* We review digital holography and wavefront sensing techniques based on structured illumination and single-pixel detection. We focus on methods employing a digital micromirror device (DMD) and a single photodiode or a position sensing detector.

M4A.2 • 17:00
In-Vivo Sound Localization of Anurans Made Possible by Digital Holography, Kieber Rémi[1], Stephane Letourneur[1], Morgane Sowinski[2,1], Nicolas Joly[1], Fabienne Aujard[2], Emmanuel Brun[3], Renaud Boistel[2], Pascal Picart[1]; *[1]Le Mans Universite, France; [2]MECADEV, CNRS 7179, National Museum of Natural History of Paris, France; [3]INSERM UA7 Strobe, Université Grenoble Alpes, France.* This paper presents a methodology and related experimental results as a first attempt to answer the question of anuran audition and their ability to localize sound at acoustic frequencies they should not.

M4A.3 • 17:15
Out-of-Focus Noise Elimination by Tunable Focusing in Optical Scanning Holography, Yongwei Yao[1], Yaping Zhang[1], Ting-Chung Poon[2]; *[1]Kunming Univ of Sci and Tech, China; [2]Virginia Tech, USA.* We propose an out-of-focus noise elimination method in optical scanning holography by tunable focusing. Numerical simulation results are presented to demonstrate the visibility of the proposed method.

M4A.4 • 17:30
Advances in Computational Label-Free Three-Dimensional Quantitative Phase Imaging Extend Microscopy Beyond Fluorescence, Pietro Ferraro[1]; [1]*Inst. of Intelligent Systems ISASI, Italy.* Despite advances in QPI-microscopes, their acceptance is hindered by limited specificity compared to fluorescence-microscopy. Efforts worldwide aim to overcome this by developing computational methods for label-free single-cell imaging, bridging QPI and FM for practical use.

M4A.5 • 17:45
Young's Interference Hologram Generated With a Spatial Light Modulator for Nanophotonic Sensor, Lotfi Berguiga[2,1], Théo Girerd[3,1], Fabien Mandorlo[3,1], Cécile Jamois[2,1], Taha Benyattou[2,1], Lydie Ferrier[3,1]; [1]*Instituts des Nanotechnologies de Lyon, France;* [2]*CNRS, France;* [3]*INSA Lyon, France.* A new method of phase interrogation of photonic sensors is proposed. The method relies on the Young's interference experiment generated by holography with a DMD. Phase variations have been measured for photonic crystal temperature sensor.

M4A.6 • 18:00 (Invited)
Quantitative Phase Imaging With Maximized Sensitivity and Resolution, Pierre Bon[1]; [1]*Centre National de la Recherche Scientifique (CNRS), France.* I will present our recent developments to increase robustness, signal-to-noise ratio and resolution in label-free holographic methods to detect, identify and characterize ultra-small objects (e.g. viruses), using quadriwave lateral shearing interferometry (QLSI).

16:30 -- 18:30
Room: Sala Convegni
M4B • Surfaces and Materials Analysis
Presider: Pasquale Memmolo; Inst. of Intelligent Systems ISASI, Italy

M4B.1 • 16:30 (Invited)
Digital Holographic Imaging of Thermal Signatures: Detection of Surface/sub-Surface Inhomogeneities, Subhash Utadiya[2], Vismay Trivedi[3], Rahul Nandoriya[1], Ragni Trivedi[4], Gyanendra Sheoran[3], Atul Srivastava[5], Humberto Cabrera[6], Bahram Javidi[7], Arun Anand[1]; [1]*Sardar Patel Univ., India;* [2]*The Maharaja Sayajirao Univ. of Baroda, India;* [3]*National Inst. of Technology Delhi, India;* [4]*National Inst. of Technology Surat, India;* [5]*Indian Inst. of Technology Bombay, India;* [6]*International Center for Theoretical Physics, Italy;* [7]*Univ. of Connecticut, USA.* Thermal loading induces a spatiotemporal temperature distribution in a test sample. We present our work on detection of surface/subsurface inhomogeneities in occluded transparent dielectrics and opaque objects by coupling digital holographic interferometry and thermal stressing.

M4B.2 • 17:00
Quantitative Analysis of Drying Processes of Viscous Liquids Using Simultaneously Recorded Speckle and Phase Information, Gyanendra Sheoran[4], Gaurav Dwivedi[4], Vineeta Kumari[1], Neelam Barak[2], Arun Anand[3], Ajay Sharma[5], Vismay Trivedi[4], Shivam Sharma[4]; [1]*Department of Science and Technology, Technology Bhawan, India;* [2]*Department of Electronics & Communication, Maharaja Surajmal Inst. of Technology, India;* [3]*Department of Physics, Sardar Patel Univ., India;* [4]*Advanced Research in Optical and Microwave Applications (AROMA) Lab, Department of Applied Sciences, National Inst. of Technology Delhi, India;* [5]*Department of Computer Science & Engineering, National Inst. of Technology Delhi, India.* This study explores

drying dynamics of viscous liquids via digital speckle and holography techniques. The experimental investigation delves into understanding drying processes, offering insights into intricate fluid behavior for industrial applications and scientific advancements.

M4B.3 • 17:15
Anomaly Defect Detection in Composite Materials by Using Machine Learning and Deep Learning Methods, Cosimo Patruno[1], Adriano Liso[1], Veronica Vespini[2], Sara Coppola[2], Vito Reno[1], Pietro Ferraro[2], Ettore Stella[1]; [1]*Inst. of Intelligent Industrial Technologies and Systems for Advanced Manufacturing (STIIMA) - CNR, Italy;* [2]*Inst. of Applied Science and Intelligent Systems (ISASI) – CNR, Italy.* Composite materials are extensively used in sectors such as automotive and aeronautical fields, where their quality is monitored by nondestructive testing. The role of shearography and laser ultrasonic in the detection of simulated defects in Carbon fiber reinforced polymer (CFRP) is investigated by using machine learning and deep learning models.

M4B.4 • 17:30
Rapid and Quantitative Formation of a Free-Standing Liquid Film Based on Digital Holographic Monitoring, Vincenzo Ferraro[3], Zhe Wang[1,2], Sara Coppola[2], Ernesto Di Maio[1], Pier Luca Maffettone[1]; [1]*Univ degli Studi di Napoli Federico II, Italy;* [2]*ISASI-CNR, Italy;* [3]*Department of Engineering and Architecture, Univ. of Parma, Italy.* The inherent properties of digital holography allow to preform real-time quantitative thickness mapping of thin liquid films. A rapid thin film formation strategy based on stretching the liquid film and holographic monitoring is proposed.

M4B.5 • 17:45
Reconstructing the Surface Curvature of a Spatial Light Modulator Using Speckle Illumination, Kira A. Maathuis[1], A.P. Mosk[1]; [1]*Universiteit Utrecht, Netherlands.* We present a method to reconstruct the surface curvature of a spatial light modulator, based on speckle illumination and an automatic differentiation based reconstruction.

M4B.6 • 18:00 (Invited)
Information Security Using the Properties of Optical Vortex Lattice, Naveen K. Nishchal[1]; [1]*Indian Inst. of Technology Patna, India.* In recent past, optical vortex array has generated lots of interests in the optics community due to its inherent characters. In this study, our focus is its application in image/data security.

Tuesday, 4 June

08:30 -- 10:30
Room: Tuffatore B
Tu1A • Inverse Problems, Phase Retrieval, Beam Shaping
Presider: Tatiana Latychevskaia; Physics Inst., Univ. of Zurich, Switzerland

Tu1A.1 • 08:30 (Invited)
Hyperspectral Phase Retrieval, Igor A. Shevkunov[1], Vladimir Katkovnik[1], Karen Egiazarian[1]; *[1]Tampere Univ., Finland.* Hyperspectral phase retrieval (HSPR) is a solution for the phase problem that reconstructs a spectral response for each pixel of the object's complex amplitude. With more than ten spectral channels, HSPR reveals hidden or obscured objects by exploiting spectral signatures, even if they are indistinguishable in conventional images.

Tu1A.2 • 09:00
Optimization Algorithm of Computer-Generated Hologram Considering Leakage of Active Beam Deflector, Myeong-ho Choi[1], Kanghee Won[2], Jae-Hyeung Park[3]; *[1]Department of Electrical and Computer Engineering, Inha Univ., Korea (the Republic of); [2]Department of Information Display, Kyunghee Univ., Korea (the Republic of); [3]Department of Electrical and Computer Engineering, Seoul National Univ., Korea (the Republic of).* This paper introduces an optimization algorithm for computer-generated hologram (CGH), focusing on mitigating the leakage from an active beam deflector. Simulation results successfully confirm that the optimized CGH can reconstruct leakage noise-suppressed holographic image.

Tu1A.3 • 09:15
Overcoming Deterministic Perturbations in Physics-Informed Holographic Reconstruction Through Joint Optimization, Yunping zhang[1], Edmund Y. Lam[1]; *[1]The Univ. of Hong Kong, Hong Kong.* We propose a novel holographic imaging method that jointly optimizes complex-valued magnitude and mismatched physical parameters to address degraded and erroneous reconstructions caused by physical perturbations.

Tu1A.4 • 09:30
Deep Imaging Inside Scattering Media Through Virtual Spatiotemporal Wavefront Shaping, Yiwen Zhang[1], Minh Q. Dinh[1], Zeyu Wang[1], Tianhao Zhang[1,2], Tianhang Chen[1], Chia Wei Hsu[1]; *[1]Univ. of Southern California, Viet Nam; [2]Zhejiang Univ., China.* Using a multispectral scattering matrix and digital reconstruction and optimizations, we correct for strong sample-induced spatiotemporal wavefront distortions to enable 3D diffraction-limited-resolution images deep inside highly scattering media.

Tu1A.5 • 09:45
Beam Shaping With 3D Printed Refractive, Holographic and Diffractive Optics on Fiber, Zihao Zhang[1], Leander Siegle[1], Pavel Ruchka[1], Daniel Flamm[1], Harald Giessen[1]; *[1]Univ. of Stuttgart, Germany.* We design, 3d print, and measure a 3D freeform hologram onto the tip of a single mode fiber, yielding a 3D focus shape. Particularly, we generate a spiral distribution of several separate foci in 3-dimensions.

Tu1A.6 • 10:00 (Invited)
Digital Holographic Microscopy: Accurate Reconstructions Using IP Approaches, Corinne Fournier[1], Dylan Brault[1], Thomas Olivier[1], Sachin Joshi[1]; [1]*Institut d Optique Graduate School, Laboratoire Hubert Curien, Universite Jean Monnet Saint-Etienne, CNRS, France.* Reconstruction algorithms remain a major challenge for quantitative measurements with digital holography. Inverse problems approaches exploit accurate image formation models to solve some reconstruction issues. We present them using results obtained with our open-access application.

08:30 -- 10:30
Room: Sala Convegni
Tu1B • Three-dimensional Display Technologies I
Presider: Enrique Tajahuerce; Universitat Jaume I, Spain

Tu1B.1 • 08:30 (Invited)
Natural-Light Digital Holographic Cameras, Tatsuki Tahara[1], Tomoyoshi Shimobaba[2], Mahiro Baba[2], Yuichi Kozawa[3], Mohamad Ammar Alsherfawi Aljazaerly[4], Tomoya Nakamura[4]; [1]*National Inst. of Information & Comm Tech, Japan;* [2]*Chiba Univ., Japan;* [3]*Tohoku Univ., Japan;* [4]*Osaka Univ., Japan.* We introduce digital holographic cameras that can capture an incoherent hologram with natural light. Our cameras are portable, able to be set on a tripod stand, and suitable for motion-picture recording of incoherent holograms.

Tu1B.2 • 09:00
Holographic Maxwellian Near-eye Display With Continuous Eyebox Replication, Zhang Shijie[1], Juan Liu[1]; [1]*Beijing Inst. of Technology, China.* we propose a holographic Maxwellian near-eye display system with an adjustable and continuous replication eyebox based on pupil detection. The detector is required to measure the pupil size.

Tu1B.3 • 09:15
Accelerating Computation of CCGH Using Convolutional Symmetric Compressed LUT Method in 360° Dynamic Color 3D Holographic Display, Jiahao Wei[1], Juan Liu[1]; [1]*Beijing Inst. of Technology, China.* We propose a convolutional symmetric compressed look-up-table method to accelerate CCGH computation and further optimize it for GPU parallel framework. Experimental results show that our proposed method can achieve real-time (>24fps) color holographic display corresponding to three perspectives of a 3D scene.

Tu1B.4 • 09:30
Holographic Near-eye Display With Phase-Space Synthesis, Jiasheng Xiao[1], Runze Zhu[1], Hao Zhang[1]; [1]*Tsinghua Univ., China.* A holographic near-eye display based on the phase-space synthesis technique is proposed. An optimization-free algorithm for hologram generation is developed. Realistic 3D display accompanied by natural defocus blur are verified.

Tu1B.5 • 09:45
Efficient Fabrication of High Bit-Level Pancharatnam-Berry Diffractive Optical Elements (PB-DOE) by Using LCoS for Photoalignment, Weijie Wu[1], Mike Pivnenko[1], Daping Chu[1]; [1]*Univ. of Cambridge, UK.* PB-DOE for linear 2π 8-bit phase modulation with tunable diffraction

efficiency was fabricated by using phase-only liquid crystal on silicon (LCoS) device for photoalignment of liquid crystals (LCs). Wide viewing angle holographic images were displayed.

Tu1B.6 • 10:00
Enhancement of the Image Quality of Pinhole-Based Lightfield Near eye Display Using a Polarized Temporal Multiplexing, Hyeontaek Lee[1], Hee-Jin Choi[1]; [1]*Sejong Univ., Korea (the Republic of).* In this paper, we propose a method to enhance the image quality of a pinhole-based lightfield near eye display using a polarized temporal multiplexing.

Tu1B.7 • 10:15
Simple Method for Hologram Multiplexing Using Vertical Interlacing, Maria L. Cruz[1], Tomasz Kozacki[2]; [1]*Engineering Faculty, Universidad Panamericana, Mexico;* [2]*Faculty of Mechatronics, Inst. of Micromechanics and Photonics, Warsaw Univ. of Technology, Poland.* We propose a simple method for multiplexing computer generated hologram using random vertical interlacing and lineal phases. Three different images are multiplexed in a hologram increasing the system view angle.

11:00 -- 13:00
Room: Tuffatore B
Tu2A • Holography for High-throughput Analysis of Dynamic Precesses
Presider: George Nehmetallah; Catholic Univ. of America, USA

Tu2A.1 • 11:00 (Keynote)
Ultrafast Holographic Widefield Microscopy, Giulio Cerullo[1]; [1]*Dipartimento di Fisica, Politecnico di Milano, Italy.* Using multiplexed off-axis holography, we introduce a widefield all-optical lock-in camera, which decouples modulation frequency from frame rate, enabling shot-noise-limited widefield transient absorption imaging. We demonstrate applications to imaging ensembles of nanostructures and charge/spin diffusion.

Tu2A.2 • 11:45
Application of Digital Holographic Microscopy for Assessment of Hydrodynamic Focusing in a Microfluidic Chip, Jian Kim[1], Álvaro Barroso[1], José Á. Picazo-Bueno[2,1], Steffi Ketelhut[1], Jürgen Schnekenburger[1], Björn Kemper[1]; [1]*Westfälische Wilhelms Univ Münster, Germany;* [2]*Univ. of Valencia, Spain.* We evaluated the hydrodynamic focusing capability of a microfluidic chip utilizing quantitative phase imaging (QPI) with digital holographic microscopy (DHM).

Tu2A.3 • 12:00
Numerical Simulations of Hydrodynamic Interactions Among Cells for Microfluidic Holographic Cyto-Tomography, Angela Vitolo[1], Massimiliano M. Villone[1], Pier Luca Maffettone[1]; [1]*Univ. of Naples Federico II, Italy.* We simulate the dynamics of cell suspensions flowing in microfluidic channels with the aim of clarifying the influence of hydrodynamic interactions on cell rotation, which is crucial for designing devices for holographic in-flow tomography.

Tu2A.4 • 12:15
Adaptive Space-Time Digital Holography for Imaging Flow Cytometry and Tissue Slide Analysis, Vittorio Bianco[1], Zhe Wang[1,2], Valentina Brancato[3], Luigi Coppola[3], Giovanni Smaldone[3], Massimiliano d'Aiuto[4], Gennaro Mossetti[5], Pier Luca Maffettone[2], Marco Salvatore[3], Pietro Ferraro[1]; *[1]Consiglio Nazionale delle Ricerche-ISASI, Italy; [2]Università degli Studi di Napoli Federico II, Italy; [3]IRCCS SYNLAB SDN, Italy; [4]Clinica Villa Fiorita, Italy; [5]Pathological Anatomy Service, Casa di Cura Maria Rosaria, Italy.* Space-Time Digital Holography exploits the sample motion to obtain phase-contrast imaging in closed form using linear sensor arrays. We show its application to flow-cytometry and the digitalization of tissue slides for use in digital pathology.

Tu2A.5 • 12:30 (Invited)
High-Speed Imaging of Dynamic Transparent Object by Parallel Phase-Shifting Digital Holography, Yasuhiro Awatsuji[1], Shun Notte[1], Sudheesh K. Rajput[1], Tomoyoshi Inoue[1], Kenzo Nishio[1], Peng Xia[2], Osamu Matoba[3]; *[1]Kyoto Inst. of Technology, Japan; [2]National Inst. of Advanced Industrial Science and Technology, Japan; [3]Kobe Univ., Japan.* The authors review recent progress in parallel phase-shifting digital holography for high-speed imaging of dynamic and transparent object. A movie of acoustic field and selective images of sound wave propagations at different frequencies were demonstrated.

11:00 -- 13:00
Room: Sala Convegni
Tu2B • Lensless Holographic Microscopy
Presider: Aydogan Ozcan; Univ. of California Los Angeles, USA

Tu2B.1 • 11:00 (Invited)
Can Digital Lensless Holographic Microscopy (DLHM) do Quantitative Phase Imaging (QPI)?, Jorge Garcia-Sucerquia[1]; *[1]Universidad Nacional de Colombia Sede Medellin, Colombia.* Abstract not available.

Tu2B.2 • 11:30
Twin Image Removal Using Multicolour Illumination in Lensless Reflective Holographic Microscopy, Matei Rosca[1], Paul Wright[1], Christopher F. Blanford[2,3], Bruce Grieve[1]; *[1]Department of Electrical & Electronic Engineering, The Univ. of Manchester, UK; [2]Department of Materials, The Univ. of Manchester, UK; [3]Manchester Inst. of Biotechnology, The Univ. of Manchester, UK.* A challenge for in-line holography is removing the twin image. In this study, two holograms recorded with different wavelengths are used to not only suppress the twin image but also obtain additional colour information.

Tu2B.3 • 11:45
Simulating Digital Lensless Holographic Microscopy Holograms Through a Realistic Model, Maria J. Lopera Acosta[1,2], Jorge Garcia-Sucerquia[3], Yunfeng Nie[2], Heidi Ottevaere[2], Carlos Trujillo[1]; *[1]Universidad EAFIT, Colombia; [2]Vrije Universiteit Brussel, Belgium; [3]Universidad Nacional de Colombia, Colombia.* This work introduces a realistic modeling approach for Digital Lensless Holographic Microscopy (DLHM) by decomposing the complex light propagation with several straightforward steps. Experimental results show that this realistic model outperforms other methods with higher reconstruction accuracy and low computational cost.

Tu2B.4 • 12:00
Experimental Method to Remove Occlusions in Digital Lensless Holographic Microscopy, Carlos A. Buitrago[1], Samuel Zapata-Valencia[1,2], Jorge Garcia-Sucerquia[1]; [1]*Universidad Nacional de Colombia, Colombia;* [2]*Inst. of New Imaging Technologies (INIT), Universitat Jaume I, Spain.* An experimental method to remove occlusions in digital lensless holographic microscopy is presented. The coordinated addition of a set of in-line holograms produces a composite hologram, whose reconstruction retrieves the sample information without any occlusions.

Tu2B.5 • 12:15
Object Thickness Recovery With Single-Shot Phase Contrast Technique Using a Polychromatic X-ray Laboratory Source, Diego Rosich[2], Margarita Chevalier[1], Adrian Bellara[1], Tatiana Alieva[1]; [1]*Universidad Complutense de Madrid, Spain;* [2]*Instituto de Física de Cantabria (CSIC-UC), Spain.* We explore three methods to extend the single-shot phase contrast technique for polychromatic partially coherent X-ray beams. The accuracy of estimating nylon fibre thickness, considering the method and the sample-detector distance, is analyzed.

Tu2B.6 • 12:30 (Invited)
Lensless Digital Holographic Microscopy for Label-Free Multi-Contrast High-Throughput Coherent bio-Imaging, Maciej Trusiak[1]; [1]*Warsaw Univ. of Technology, Poland.* I will discuss several methodologies based on lensless digital holographic microscopy for label-free multi-contrast high-throughput coherent bio-imaging of live and fixed cells, and unimpaired tissue slices.

14:00 -- 15:00
Room: Tuffatore B
Tu3A • Plenary Session I
Presider: Pietro Ferraro; Inst. of Intelligent Systems ISASI, Italy

Tu3A.1 • 14:00 (Plenary)
Diffractive Information Processing and Computational Imaging, Aydogan Ozcan[1]; [1]*Univ. of California Los Angeles, USA.* I will discuss diffractive optical networks designed by deep learning to all-optically implement various complex functions as the input light diffracts through spatially-engineered passive surfaces.

15:00 -- 16:00
Room: Tuffatore B
Tu4A • Tutorial Session
Presider: Hiroshi Yoshikawa; Nihon Univ., Japan

Tu4A.1 • 15:00 (Tutorial)
Iterative Methods in Digital Holography, Tatiana Latychevskaia[1,2]; [1]*Physics Inst. UZH, Physics Inst., Univ. of Zurich, Switzerland;* [2]*Paul Scherrer Inst., Switzerland.* This tutorial demonstrates how to simulate and reconstruct holograms, and how to create an iterative routine from a single-run reconstruction routine. Cases of amplitude and phase-shifting objects, 3D objects, and resolution enhancement will be discussed.

16:30 -- 18:30
Room: Tuffatore B
Tu5A • Advanced Interferometric Technologies
Presider: Pascal Picart; Le Mans Universite, France

Tu5A.1 • 16:30 (Invited)
Recent Advances in Interferometric Quantitative Phase Microscopy, Renjie Zhou[1]; [1]*Chinese Univ. of Hong Kong, Hong Kong.* Abstract not available.

Tu5A.2 • 17:00
Compact Self-Interference Digital Holographic Microscope Based on a Budget Fresnel Bi-Mirror, Carlos A. Buitrago[1], Jorge Garcia-Sucerquia[1]; [1]*Universidad Nacional de Colombia, Colombia.* A compact off-axis self-interference digital holographic microscope (DHM) is presented. Using a bi-mirror as the shearing element, this architecture enables single-shot spherical-aberration-free quantitative imaging for a fraction of the cost of similar DHM systems.

Tu5A.3 • 17:15
Advancing Bio-Threat Detection With Digital Holographic Microscopy: the HoloZcan Project, Alessandro Molani[1], János Pálhalmi[2], Béla Mihalik[3], Paul Claassen[4], Edwin Langerak[4], Sajjad Mohammadian[4], Bas van der Linden[4], Thijs Withaar[4], Anna Mezo[2], Mariana Ferrari[5], Praveen Rahi[5], Györgyi Bela[3], Francesca Pennati[1], Andrea Aliverti[1]; [1]*Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Italy;* [2]*DataSenseLabs Ltd., Hungary;* [3]*IDEAS Science Ltd., Hungary;* [4]*Sioux Technologies B.V, Netherlands;* [5]*Institut Pasteur, Université Paris Cité, Biological Resource Center of Institut Pasteur – Collection de l'Institut Pasteur, France.* The HoloZcan project integrates digital holographic microscopy (DHM) and artificial intelligence (AI) to enhance bio-surveillance, offering portable, cost-effective, real-time bio-aerosol analysis. Advancements in DHM hold promise for strengthening bio-detection capabilities and mitigating emerging health risks.

Tu5A.4 • 17:30
Lateral Shear Interferometry for Shape Accuracy Measurements of 3D-Printed Micro-Optics, Yanqiu Zhao[1], Lunwei Wang[1], Leander Siegle[1], Harald Giessen[1]; [1]*4th Physics Inst. - Univ. of Stuttgart, Germany.* Lateral shear interferometry is utilized to assess the shape accuracy of 3D-printed micro-optics. Different 3rd order aberrations are added deliberately to the lens design. The printing accuracy is evaluated, demonstrating lambda/100 RMS wavefront error for lenses with d = 140 µm and f = 570 µm.

Tu5A.5 • 17:45
Bi-Directional Digital Holographic Imaging for the Quantification of the Scattering Phase Function of Natural Snow, Mikael Sjodahl[1], Joel Wahl[1]; [1]*Lulea Tekniska Universitet, Sweden.* A bi-directional digital holographic imaging system is presented that is designed to acquire sufficient information to be able to estimate the scattering phase function for different type of snowfall.

Tu5A.6 • 18:00 (Invited)
Portable Holographic Modules: New Opportunities for in-Vitro Fertilization, Natan T. Shaked[1]; [1]*Tel Aviv Univ., Israel.* I will present new wide-field multiplexed off-axis holography sensors, which can work in clinical conditions, without an optical table, to dynamically image the cell refractive index and select sperm cells for in vitro fertilization.

16:30 -- 18:15
Room: Sala Convegni
Tu5B • Holographic Imaging for Industrial Applications I
Presider: Tomasz Kozacki; Politechnika Warszawska, Poland

Tu5B.1 • 16:30 (Invited)
Development of the Fastest and Most Accurate 3D-Sensor for Scrap Reduction in Micro-Chip Production, Markus Fratz[1], Tobias Seyler[1], Annelie Schiller[1], Gennadii Laskin[1], Marc J. Aslan[1], Alexander Bertz[1], Daniel Carl[1]; [1]*Fraunhofer Inst. for Physical Measurement Techniques IPM, Germany.* Total inline inspection of micro-chip production can reduce waste and energy consumption but has strong demands on measurement speed, accuracy, and field of view. This talk shows the development of a production ready measurement system.

Tu5B.2 • 17:00
EREMITE: a MarinE InfRastructurE to MonItor the STate of the SEas, Cosimo Distante[1], Pierluigi Carcagni[1,2], Andouglas Gonçalves da Silva Júnior[2], Luiz M. Garcia Gonçalves[3]; [1]*ISASI, CNR, Italy;* [2]*Federal Inst. of Rio Grande do Norte, Brazil;* [3]*Computer and Automation Department, Federal Univ. of Rio Grande do Norte, Brazil.* EREMITE a low-cost and open multi-sensory system that monitors and digitises our marine ecosystems to understand their state, ecological health and functioning, with the concept of any sensor, anytime, anywhere.

Tu5B.3 • 17:15
Holographic Vibrometry in Rough Environments, Florian Dötzer[1], Johannes May[1], Stefan Sinzinger[1]; [1]*Fachgebiet Technische Optik, Technische Universität Ilmenau, Germany.* Measuring vibrations in the (sub-)nanometer range using holographic vibrometry typically requires vibration-damped conditions. Introducing an artificial reference vibration produces stable beat frequencies even in the presence of parasitic vibrations, enabling sensitive lock-in evaluation techniques.

Tu5B.4 • 17:30
Damage Detection and Formation Mechanism Analysis of Mural Microcracks, Wenjing Zhou[1], Huiling Zhang[1], Anqi Li[1]; [1]*Shanghai Univ., China.* We established a digital holographic imaging platform for detecting mural defects and created a geometric defect model using phase information from reconstruction. By combining with molecular dynamics, we characterized mural microcracks and analyzed expansion mechanism, offering a theoretical basis for mural damage research and repair methods.

Tu5B.5 • 17:45 (Invited)
Shinephi: a Phase Imaging Platform for Industrial Applications, Valerio Pruneri[1], Rubaiya Hussain[1], Sebastian Haegele[1], Iris Cusini[1], Roland A. Terborg[1]; [1]*ICFO -Institut de Ciencies Fotoniques, Spain.* We present an interferometric imaging platform integrated with the post-processing software for applications in the field of material science and biology. Examples of application include surface topography, live-cell and quantum imaging.

Wednesday, 5 June

08:30 -- 10:30
Room: Tuffatore B
W1A • QPI for Single-cell Analysis
Presider: Pasquale Memmolo; Inst. of Intelligent Systems ISASI, Italy

W1A.1 • 08:30 (Invited)
Quantitative Phase Imaging and Fluorescence for Analyzing Biomechanical Properties of Live Cells, Adam Wax[1]; [1]*Duke Univ., USA.* QPI can provide nanoscale information on cellular dynamics but lacks molecular sensitivity. By including fluorescence reporters, the response of cells to mechanical stimuli can be linked to molecular signaling even in 3D culture environments.

W1A.2 • 09:00
Optimizing Label Free Circulating Tumor Cell Detection for Liquid Biopsy in Ovarian Cancer, Beatrice Cavina[1], Giusy Giugliano[2], Michela Schiavo[2], Daniele Pirone[2], Lisa Miccio[2], Pasquale Memmolo[2], Anna Maria Porcelli[3], Anna Myriam Perrone[1,4], Giuseppe Gasparre[1], Pietro Ferraro[2], Ivana Kurelac[1]; [1]*DIMEC, Department of Medical and Surgical Sciences, Centro di Studio e Ricerca sulle Neoplasie (CSR) Ginecologiche, Alma Mater Studiorum-Univ. of Bologna, Italy;* [2]*ISASI, CNR, Italy;* [3]*FABIT, Department of Pharmacy and Biotechnology, Alma Mater Studiorum-Univ. of Bologna, Italy;* [4]*Division of Oncologic Gynecology, IRCCS Azienda Ospedaliero-Universitaria di Bologna, Italy.* Liquid biopsy could be groundbreaking in ovarian cancer (OC), where most patients are still diagnosed at advanced stages. We demonstrate a proof of concept for holographic label free distinction of OC cells from monocytes.

W1A.3 • 09:15
Digital Holographic Flow Cytometry for Early Screening of Urothelial Carcinoma, feng pan[1], Lu Xin[1], Wen Xiao[1], Hao Wang[2], Ran Peng[2], Xi Xiao[2]; [1]*Beihang Univ., China;* [2]*Department of Radiation Oncology, Peking Univ. Third Hospital, China.* In this work, we use digital holographic (DH) microscope coupled to a label-free and high-throughput flow cytometer for early screening of urothelial carcinoma (UC) cells reinforced by deep learning.

W1A.4 • 09:30
Living Cells Behave as Micro-Lenses: Label-Free Biomarkers for Diagnosis and Biocompatible Optical Components, Lisa Miccio[1], Daniele Pirone[1], Jaromir Behal[1], Giusy Giugliano[1], Michela Schiavo[1], Marika Valentino[1], Vittorio Bianco[1], Pasquale Memmolo[1], Pietro Ferraro[1]; [1]*Inst. of Intelligent Systems ISASI, Italy.* Biological cells are presented as bio-lenses and their projections on next future biomedical applications are discussed. Static or in-flow conditions combined with Digital Holography figure out the interaction between bio-lensing properties and cell morphology.

W1A.5 • 09:45
Observing Morphology Changes of Bladder Cancer Cells After Radiation Using Holographic Microscopy, Ran Peng[1], Feng Pan[2], Xi Xiao[1], Xuemin Li[1], Ruiping Guo[1], Luqi Wang[1], Hao Wang[1,3]; [1]*Department of Radiation Oncology, Peking Univ. Third Hospital, China;* [2]*Key Laboratory of Precision Opto-Mechatronics Technology of Ministry of Education, School of Instrumentation Science & Optoelectronics Engineering, Beihang Univ., China;* [3]*Cancer Center, Peking Univ. Third Hospital, China.* The morphological changes of irradiated urothelial bladder

carcinoma cells has been revealed by digital holographic microscopy. Different doses of 6-MV X-rays were used to irradiate the cells for studying their refractive index changes.

W1A.6 • 10:00 (Invited)
Neuronal Microscopy for Cell Behavioral Examination and Manipulation, Chiara Paviolo[1]; [1]*CEA-Leti, France.* Building on the recent advances of computational microscopy, biology and artificial intelligence, neuronal microscopy is a novel imaging technique able to perceive, interpret, conjecture, infer, anticipate and act in 2D holographic- and 3D live-cell imaging.

08:30 -- 10:30
Room: Sala Convegni
W1B • Optical Metrology and Fringe Analysis
Presider: Ting-Chung Poon; Virginia Tech, USA

W1B.1 • 08:30
Triple Correlated Wavelength Selective Hybrid Meta-Holography, Hongqiang Zhou[1], Chongli Zhao[1], Tianlong Man[1], Yuhong Wan[1]; [1]*Beijing Univ. of Technology, China.* We present a hybrid amplitude and phase holographic scheme with a correlated algorithm based on the wavelength-selective dielectric filters. We demonstrate three types of silicon nanofins: rectangular and square shapes for dynamic holographic display.

W1B.2 • 08:45
Speckle Noise Reduction in Amplitude Holograms, Using a Limited-Bandwidth Random Phase Generated by a Chaotic map, Maria L. Cruz[1], Hector Gilardi-Velázquez[2]; [1]*Facultad de Ingeniería, Universidad Panamericana, Mexico;* [2]*Facultad de Ingeniería, Universidad Panamericana, Mexico.* We propose a new method for generating a limited-bandwidth random phase using a chaotic function. The random phase is applied in the generation of amplitude holograms, reducing the speckle noise in the reconstructed image.

W1B.3 • 09:00
Circular Grating Talbot Interferometer for the Measurement of the Effect of Uniform and Non-Uniform Magnetic Field on Flame Temperature, Shilpi Agarwal[1], Chandra Shakher[2]; [1]*Jawaharlal Nehru Univ., India;* [2]*IIT Delhi, India.* The temperature inside the ethanol flame is measured in uniform and non-uniform magnetic field using circular gratings Talbot interferometer. Experimental results reveal that the flame temperature is affected in the presence of non-uniform magnetic field.

W1B.4 • 09:15
Phase Stabilized Digital Holographic Imaging of Vibrating Objects, Matthew Goodman[1], Krishna Rupavatharam[1], Wm. R. Babbitt[1]; [1]*Montana State Univ. Spectrum Lab, USA.* Range selective Digital Holographic imaging is performed on a vibrating object, where feedback from a lidar subassembly provides real-time phase compensation, which stabilizes the holographic recording of an object moving many wavelengths during sensor integration.

W1B.5 • 09:30
Parallel Phase-Shifting Digital Holography and Angular-Multiplexing Recording for Single-Shot Temperature Tomography, Sudheesh K. Rajput[1], Konishi Nana[1], Sun Notte[1], Ryuki

Yamaguchi[1], Tomoyoshi Inoue[1], Kenzo Nishio[1], Peng Xia[2], Manoj Kumar[3], Osamu Matoba[3], Yasuhiro Awatsuji[1]; *[1]Kyoto Inst. of Technology, Japan; [2]National Inst. of Advanced Industrial Science and Technology, Japan; [3]Center of Optical Scattering Image Science, KOBE Univ., Japan.* We propose imaging of axially asymmetric and dynamic 3D temperature distribution of air around a heat source. Method is based on simultaneous reconstruction of phase information from various viewpoints using angular-multiplexing in parallel-phase-shifting digital holography.

W1B.6 • 09:45
Holography-Based Full-Field Characterization for SOlid Polymer MEmbranes and Films, Zhe Wang[1], Anna Palma[3], Vincenzo Ferraro[1,2], Concetta Di Natale[1], Veronica Vespini[3], Fabiana Graziano[3], Francesca Ferranti[4], Silvia Mari[4], Simonetta Grilli[3,1], Pier Luca Maffettone[1], Sara Coppola[3,1]; *[1]DICMaPI, Univ degli Studi di Napoli Federico II, Italy; [2]Univ. of Parma, Italy; [3]ISASI-CNR, Italy; [4]Italian Space Agency, Italy.* Space-time digital holography allows expanded fields of view, enhanced contrast, and improved resolution during phase imaging. Here we propose a specialized strategy for achieving characterization and analysis of solid functionalized membrane under spatiotemporal modulation.

W1B.7 • 10:00 (Invited)
Photopolymers for Astronomy: the Case of Volume Phase Holographic Gratings, Andrea Bianco[1], Michele Frangiamore[1], Andrea Vanella[1], Luca Oggioni[1], Giorgio Pariani[1], Paola Moretti[2], Chiara Bertarelli[2]; *[1]INAF -Osservatorio Astronomico di Brera, Italy; [2]Chimica, Materiali ed Ingegneria Chimica, Politecnico di Milano, Italy.* Modern astronomical spectrographs required high performance dispersing elements such as Volume Phase Holographic Gratings (VPHGs). We develop holographic photopolymers for the manufacturing of large size VPHGs from the UV to the NIR. More than 10 telescopes around the world use our devices and the requests are increasing.

11:00 -- 13:00
Room: Tuffatore B
W2A • AI-powered Holographic Imaging II
Presider: Guohai Situ; Shanghai Inst. Opt. Fine Mech., China

W2A.1 • 11:00 (Keynote)
Single-Shot 3D Imaging Exploiting Holography and Physics-Informed Neural Network Reconstruction, Juergen Czarske[1]; *[1]TUD | Dresden Univ. of Technology, Germany.* Minimally invasive fiber endoscopy is indispensable for various applications in biomedical imaging. Using a diffuser, the 3D information is holographically encoded, which is decoded by a neural network. Fluorescence imaging with keyhole access is enabled.

W2A.2 • 11:45
Incoherent Holographic Single-Shot 3D Imaging via Physics-Enhanced Neural Networks With Spatial Regularization, Liyun Zhong[1], Yuheng Wang[2], Huiyang Wang[2], Xiaoxu Lu[2]; *[1]Guangdong Univ. of Technology, China; [2]South China Normal Univ., China.* We propose a self-calibrating reconstruction approach based on physics-enhanced neural networks with spatial regularization priors for incoherent holography. The contradiction between SNR and temporal resolution is alleviated, and the interlayer crosstalk artifacts are greatly suppressed.

W2A.3 • 12:00
Label-Free Phenotyping of Neuroblastoma Cells by Combining Holographic Flow Cytometry and Machine Learning, Daniele Pirone[1], Pasquale Memmolo[1]; *[1]CNR-ISASI, Italy.* Non-invasive detection and phenotyping of neuroblastoma cells in blood samples is highly demanded for liquid biopsy applications. Here we show that an effective solution can be provided by machine learning combined to holographic flow cytometry.

W2A.4 • 12:15
Segmentation for Focus Prediction in Time-Lapse Digital Holographic Microscopy Using Deep Convolutional Neural Networks, Melat Tecle[1], Saara Koivusalo[2], Tomi Pitkäaho[3], Aki Manninen[2], Thomas J. Naughton[1]; *[1]Maynooth Univ., Ireland; [2]Univ. of Oulu, Finland; [3]Centria Univ. of Applied Sciences, Finland.* Human prostate cell clusters in digital holographic microscopy time-lapse images are automatically segmented using a hologram-domain phase-based approach and passed to a convolutional neural network to determine the in-focus reconstruction depth.

W2A.5 • 12:30 (Invited)
Unlocking Disease-Specific Cell Phenotypes: Digital Holographic Microscopy and AI in Concert, Pierre M. Marquet[1]; *[1]Université Laval, Canada.* In this talk, we will show how technical developments involving AI in the field of digital holographic microscopy can make this quantitative phase-imaging technique powerful for identifying disease-specific cell phenotypes in cultured human neurons.

11:00 -- 13:00
Room: Sala Convegni
W2B • Three-dimensional Display Technologies II
Presider: Tatiana Alieva; Universidad Complutense de Madrid, Spain

W2B.1 • 11:00 (Invited)
Wide Angle Hologram, a Tour From Generation to Display, Tomasz Kozacki[1], Rafal Kukolowicz[1], Maksymilian Chlipala[1], Moncy Sajeev Idicula[1], Izabela Gerej[1], Juan Martinez-Carranza[1]; *[1]Warsaw Univ. of Technology, Poland.* 3D AR\VR technology is the future for handling information for entertainment and work. This work shows that wide-angle holograms are up to the task. We discuss end-to-end holographic solution including generation, processing, and display.

W2B.2 • 11:30
Occlusion Processing for Computer-Generated Holograms Using Light-Field Modulation of Zone Plates, Yasuhiro Takaki[1], Takayuki Koyama[1]; *[1]Tokyo Univ of Agriculture and Technology, Japan.* The modulation of zone plates by light field information can generate holograms which provide naturally shaded and sharp reconstructed images. This study proposes the modification of the modulation scheme to enable the occlusion processing.

W2B.3 • 11:45
3D Rendering Pipeline for a High-Speed Line-Field Optical Coherence Tomography System, Xingyu Yang[1], Zijian Zhang[1], Samuel Lawman[1], Xinjie Zhu[1], Yalin Zheng[1], Yaochun Shen[1]; *[1]Univ. of Liverpool, UK.* We provide a full solution for creating 3D models using a 100k Hz

A-line rate line-field OCT system. The generated models have a 50-fold reduction of data size and can be exported for AR/VR and 3D printing.

W2B.4 • 12:00
Super-Resolution Self-Interference Incoherent Digital Holography Using Sparse Synthetic Aperture, Youngrok Kim[1], Dong-woo Seo[1], Chihyun In[1], Sung-Wook Min[1]; *[1]Kyung Hee Univ., Korea (the Republic of).* We proposed the resolution enhancement of self-interference incoherent digital holography using sparse acquisition. Stochastic gradient descent-based optimization is exploited to find and refine the absent holographic signals.

W2B.5 • 12:15
Immersive Exploration of Tomographic Datasets: Virtual Reality Revolutionizing Microscopic Analysis, Nicola Mosca[1], Maria di Summa[1], Moh Rafik[1], Vittorio Bianco[2], Daniele Pirone[2], Ettore Stella[1]; *[1]CNR STIIMA, Italy; [2]CNR-ISASI, Italy.* Traditional microscopy has limitations. On the contrary, tomographic methods provide non-destructive 3D visualization. This paper proposes immersive exploration via virtual reality, revolutionizing scientific analysis by bridging traditional techniques with advanced methodologies for enhanced research insights.

W2B.6 • 12:30
Phase-Only Digital Holography for Illumination Using a Single Computer-Generated Hologram (CGH), Xin P. Gao[1], Yuanbo Deng[1], Daping Chu[1]; *[1]Univ. of Cambridge, UK.* Computer-generated hologram (CGH) is optimised for using a single phase-only hologram achieving white light illumination, reducing colour dispersion and improving image quality. It explores coherence, speckles, and the impact of LCoS sizes on illumination performance.

W2B.7 • 12:45
Compact Near-eye Display for Mixed Reality Using Micro Lens Array and Point Light Source Array, Minseong Kim[1], Jae-Hyeung Park[2]; *[1]Electrical and Computer Engineering, Inha Univ., Korea (the Republic of); [2]Electrical and Computer Engineering, Seoul National Univ., Korea (the Republic of).* We propose a compact Maxwellian near-eye display using a micro lens array (MLA) and point light source array (PLSA). In the proposed method, the gap between the display panel and the optical system is reduced by utilizing the MLA, and the Maxwellian view is achieved by using the PLSA.

14:00 -- 15:00
Room: Tuffatore B
W3A • Plenary Session II
Presider: Pietro Ferraro; Inst. of Intelligent Systems ISASI, Italy

W3A.1 • 14:00 (Plenary)
How Vision Comfort Requirements and 3D Cues are Defining Next Generation Display Architectures for All-day-use Smart Glasses, Bernard Kress[1]; *[1]Google LLC, USA.* Wide adoption of smart glasses has notably missed the consumer market over the past decade, even though enterprise, industry and defense markets resonated strongly with such early hardware offerings (Google Glass, HoloLens, Magic Leap, IVAS, etc.…). This major miss was mainly due to the lack of strong smart glasses use cases having strong differentiation from the ones developed for smart phones or watches. Today, with the advent of LLM and generative AI, smart

glasses linked to high resolution cameras and gaze trackers might be able to provide unprecedented resonance with the consumer and thus for the first time propulse smart glasses as a potential commodity in the consumer electronics realm. But such a potential market pull is also contingent on the availability of generic platforms over which such apps may be running, as with Vision OS, Android XR and Horizon OS. The availability of a strong hardware ecosystem (display, imaging, sensing) is the last requirement and needs to address all three AR comfort pillars: wearable comfort, visual comfort and social comfort. In this talk, we will focus specifically on visual comfort and how 3D information may be provided to the smart glass wearer in a visually comfortable way without impacting either wearable or social comfort.

15:00 -- 16:30
Room: Tuffatore C
W4A • Poster Session

W4A.1
Heuristic Optimal Design of Diffractive Waveguide Optical Combiner for AR Display, Shinwoong Park[1], Youngsub Kim[1], Hwi Kim[1]; [1]*Korea Univ., Korea (the Republic of).* This study presents an idea for a waveguide structure that can implement holographic augmented reality (AR) and a method for optimizing output uniformity with diffractive optical elements (DOE).

W4A.2
Large BackGround Produced Using Circular Convolution in Full-Parallax High-Definition Computer Holography, Takeshi Imai[1], Hirohito Nishi[1], Kyoji Matsushima[1]; [1]*Kansai Univ., Japan.* A novel technique is proposed to expand the background in 3D scenes of full-parallax high-definition computer-generated holograms without increasing the calculation time. In this technique, the periodic backdrop's wavefield is calculated using the circular convolution.

W4A.3
Optimization Method of Overlapped CGHs for Expanded eye-box in Automotive Holographic Head-up Display, Jin Su Lee[1], Keehoon Hong[1], Minsik Park[1]; [1]*ETRI, Korea (the Republic of).* This study integrates holographic display into automotive HUDs to tackle ghost image issues. Despite SLM limitations, using SGD optimization with a 2D beam splitter and windshield expands the eye-box, eliminating ghost images. Results achieve PSNR levels of 23-26dB, demonstrating holographic HUD potential in cars without treated windshields.

W4A.4
Holographic Head-Mounted Display Capable of Displaying AR in Accordance With User's Attitude Angle, Taichi Sakakihara[1], Yuji Sakamoto[1]; [1]*Graduate School of Information Science and Technology, Hokkaido Univ., Japan.* We developed a holographic head-mounted display (Holo-HMD) that can display AR in accordance with the user's attitude angle. It performs phase compensation as a calculation algorithm for CGH, thereby enabling fast calculations.

W4A.5
Unsupervised Deep Learning Algorithm Based on Hybrid Phase for Generating Phase-Only Holograms, Kangsheng Sun[1], Chao Han[1]; [1]*AnHui Polytechnic Univ., China.* An unsupervised deep learning algorithm based on hybrid phase is proposed for highspeed generation of high-quality phase-only holograms (POHs). The hybrid phase is superimposed with the target

amplitude and then fast Fourier transformed to generate complex amplitude holograms, which are then converted to POHs by a complex-valued neural network.

W4A.6
Multi-Pixel Parallel Search Algorithm for Binary Hologram Generation, Yongan Zhang[1,2], Yunhao Zhang[1,2], Fei Ye[1,2], Qinghe Song[1,2], Yaping Zhang[1,2]; *[1]Faculty of Science, Kunming Univ. of Science and Technology, China; [2]Yunnan Provincial Key Laboratory of Modern Information Optics, Kunming Univ. of Science and Technology, China.* This paper introduces a novel Multi-pixel Parallel Search (MPS) algorithm for the generation of binary holograms. Compared to the Direct Binary Search (DBS) algorithm, this algorithm produces binary holograms with superior imaging quality.

W4A.7
Pruning-Sparse MAML Based Computational Hologram Generative Networks for Fast Adaptation to new Scenes, Chaoqun Ma[1], Jing Liu[1], Wenyu Xu[4], Xiaoming Chen[2], Shizhou Shi[3], Xiaoyu Jiang[2]; *[1]Xi'an Jiaotong Univ., China; [2]Army Academy of Armored Forces, China; [3]School of Electronic Engineering, Beijing Univ. of Posts and Telecommunications, China; [4]Independent Consultant, China.* Pruning-Sparse Model-Agnostic Meta Learning algorithm enhances hologram generated networks training, allowing quick scene adaptation and extending to diverse holography networks beyond supervised models.

W4A.8
Phase Correlation Spectroscopy: Microparticles Diffusion Coefficient Determination, Sunil Bhatt[1], Himanshu Joshi[1], Ankit Butola[2], Krishna Agarwal[2], Dalip Singh Mehta[1]; *[1]Indian Inst. of Technology Delhi, India; [2]UiT The Arctic Univ. of Norway, Norway, Norway.* We propose the idea of phase correlation spectroscopy to investigate the dynamics of diffusion of microparticles in the vicinity of large detection volume utilizing the time-resolved measurements of fluctuations in the phase of the particle.

W4A.9
Withdrawn.

W4A.10
Self-Assembling of Polymeric Microstructures, Sara Coppola[1,2], Giuseppe Fontanarosa[2], Lisa Miccio[1], Veronica Vespini[1], Simonetta Grilli[1,2], Nicolo incardona[3], Gaetano D'avino[2], Pier Luca Maffettone[2], Pietro Ferraro[1]; *[1]ISASI CNR, Italy; [2]Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università degli Studi di Napoli "Federico II", Italy; [3]3D Imaging and Display Laboratory, Department of Optics, Universitat de València, Spain.* The fabrication of polymeric microstructures has gained a lot of interest because of high flexibility in terms of geometry, dimension and reduced costs. Here we propose the study of self-assembling process for the formation of polymeric bumps integrated with a multiphysics analysis.

W4A.11
Measurement of Temperature and Heat Transfer Coefficient Around Textile Conductive Yarn Using Digital Holography, Pramod Sankar Pillai[2], Shilpi Agarwal[1], Bipin Kumar Kumar[2], R Alagirusamy[2], Apurba Das[2], Chandra Shakher[2]; *[1]Jawaharlal Nehru Univ., India; [2]IIT Delhi, India.* In this paper, the application of digital holographic interferometry (DHI) to measure temperature

and heat transfer coefficient of stainless steel coated yarn is investigated. The study may find application to design heating fabric and compression bandages.

W4A.12
Chirp-Encoded Finge-Adjusted Joint Transform Correlator for 3D Object Recognition Using Fresnel Holography, Jyoti B. Mohapatra[1], Ram Kumar[1], Jyothish M[2], Naveen K. Nishchal[1]; [1]*Indian Inst. of Technology Patna, India;* [2]*Isro Inertial System Unit, India.* Three-dimensional object recognition has been explored using hologram matching. Chirp-encoded fringe-adjusted JTC is used to correlate the Fresnel holograms which extract meaningful information from the correlation output, yielding enhanced accuracy and efficiency in object recognition.

W4A.13
Improved Reconstruction for Digital in-Line Holography Based on EFEMD, Mingguang Shan[1], Haotian Li[1], Zhi Zhong[1], Bin Liu[1], Lei Yu[1], Lei Liu[1]; [1]*Harbin Engineering Univ., China.* The background is eliminated by enhanced fast empirical mode decomposition (EFEMD) for digital in-line holograms, which can enhance the reconstruction quality. The experiment of particles was conducted to demonstrate the validity of the proposed approach.

W4A.14
Lens-Less Digital Holographic Microscopy for Thickness Profiling of Transparent Samples, Vismay Trivedi[1], Subhash Utadiya[2], Kevin Bhanderi[3], Mugdha Joglekar[2], Chaitanya Limberkar[3], Kireet Patel[3], Gyanendra Sheoran[1], Humberto Cabrera[4], Bahram Javidi[5], Arun Anand[3]; [1]*National Inst. of Technology, Delhi, India;* [2]*Applied Physics Department, The Maharaja Sayajirao Univ. of Baroda, India;* [3]*Department of Physics, Sardar Patel Univ., India;* [4]*The Abdus Salam International Centre for Theoretical Physics, Italy;* [5]*Univ. of Connecticut, USA.* The manuscript describes the development of a Mach Zehnder interferometer based, lens-less digital holographic microscope for thickness profiling of transparent/semi-transparent samples (thin films).

W4A.15
Label-Free Identification of T-Lymphocytes in Holographic Microscopy Empowered by Machine Learning, Daniele Pirone[1]; [1]*CNR-ISASI, Italy.* The precise count of T-lymphocytes is a challenging topic since whose number is demonstrated to correlate to disease severity. Here we report a method for label-free identification of T-lymphocytes through holographic microscopy and machine learning.

W4A.16
Measurement of Internal Defects in Quartz Glass Using in-Line Digital Holographic Microscopy, Mingguang Shan[1], Jianchao Guo[1], Zhi Zhong[1], Bin Liu[1], Lei Yu[1], Lei Liu[1]; [1]*Harbin Engineering Univ., China.* A method for detecting internal defects in quartz glass using digital holography technology is proposed and verified by experiment.

W4A.17
Digital Holographic Particle Field Imaging Based on Infrared Illumination, Su Ping[1]; [1]*Tsinghua Univ., China.* Increasing the illumination wavelength can mitigate the interlayer interference of defocused images. This presentation proposes employing an infrared coherent light source to illuminate the particle field, thereby achieving enhanced axial positioning accuracy.

W4A.18
Known-Plaintext Attack on Optical Scanning Cryptography, Yihan Wang[1], Aimin Yan[1]; *[1]Shanghai Normal Univ., China.* Optical scanning cryptography (OSC) is an optical image encryption technique by optical heterodyne scanning. We find that the security bug of OSC originates from its linearity and the OSC system is vulnerable to known-plaintext attack.

W4A.19
3D Visualization of Phytoplankton via in-Flow Digital Dolographic Tomography, Francesca Borrelli[1], Giusy Giugliano[1,4], Daniele Pirone[1], Jaromir Behal[1], Valerio Zupo[2], Mariano Amoroso[3], Maria Costantini[3], Angela Sardo[3], Lisa Miccio[1], Pasquale Memmolo[1], Vittorio Bianco[1], Pietro Ferraro[1]; *[1]Inst. of Applied Sciences and Intelligent Systems "E. Caianiello", Italy; [2]Dipartimento di Biotecnologie Marine Ecosostenibili, Stazione Zoologica Anton Dohrn, Italy; [3]Dipartimento di Biotecnologie Marine Ecosostenibili, Stazione Zoologica Anton Dohrn, Italy; [4]Department of Mathematics and Physics, Univ. of Campania, Italy.* We use in-flow digital holographic tomography to perform the 3D visualization of phytoplankton as a label free, quantitative, high throughput investigation technique of these samples known to be natural bio-sensors for water quality assays.

W4A.20
Cost-Effective, DIY, and Open-Source Digital Lensless Holographic Microscope With Distortion Correction, Carlos A. Buitrago[1], Heberley Tobón-Maya[1,2], Jorge Garcia-Sucerquia[1]; *[1]Universidad Nacional de Colombia, Colombia; [2]Inst. of New Imaging Technologies (INIT), Universitat Jaume I, Spain.* A cost-effective, DIY, and open-source certifiable digital lensless holographic microscope (DLHM) is presented. The proposed microscope reduces the flaws regularly found when budget laser diodes and aspherical lenses are utilized in compact setups.

W4A.21
Integrating Digital Holographic Microscopy With Data Analysis for Monitoring Lymphocyte Activation in Cellular Immunotherapy, Martyna Mazur[1], Maria Baczewska[1], Paulina Laskowska[2], Michal T. Gontarz[1], Michal Ziemczonok[1]; *[1]Inst. of Micromechanics and Photonics, Warsaw Univ. of Technology, Poland; [2]Department of Experimental Hematology, Inst. of Hematology and Transfusion Medicine, Poland.* The approach utilizing digital holographic microscopy (DHM) for analysing the status of T cells activation, the important part of CAR T cells immunotherapy, is presented. The preliminary research reveals usability of DHM in this field.

W4A.22
Amnis Image Stream-Analysis of Tumor Cells, Martina Mugnano[1], Zhe Wang[1], Vincenza Cerbone[2], Giulia Scalia[2], Annalaura Montella[2], Mario Capasso[2], Silvia Mari[3], Francesca Ferranti[3], Daniele Pirone[4], Marika Valentino[1,4], Lisa Miccio[1,4], Pier Luca Maffettone[1]; *[1]DICMaPI, Department of Chemical, Materials and Production Engineering, Univ. of Naples "Federico II", Italy; [2]Ceinge Advanced Biotechnologies, Italy; [3]Italian Space Agency, Italy; [4]Inst. of Applied Sciences and Intelligent systems "E. Caianiello" National Research Council, Italy.* Imaging flow cytometry is a cutting-edge technology for analyzing cell features. Here we show the advantage of using this system to study cell nucleus of tumor cells, using ovarian cancer A2780 cell line as model. Amnis Image stream it has been used as a standard comparison tool respect to quantitative phase imaging to study cell features.

W4A.23
Phase Imaging From X-ray Intensity Images Using Transport of Intensity Equation, Ram Kumar[1], Naveen K. Nishchal[1]; *[1]Indian Inst. of Technology Patna, India.* X-ray imaging lacks phase information necessary for better medical diagnosis. We bridge the gap between X-ray imaging and comprehensive 3D visualization by using transport of intensity equation to recover the phase information.

W4A.24
Multimodal Optical Microscopy for Oral Cancer Screening, Pramila Thapa[1], Sunil Bhatt[1], Himanshu Joshi[1], Ankit Butola[3], Varun Surya[2], Deepika Mishra[2], Dalip Singh Mehta[1]; *[1]Indian Inst. of Technology Delhi, India; [2]All India Inst. of Medical Sciences (AIIMS), India; [3]UiT, The Arctic Univ. of Norway, Norway.* A multi-modality system can reduce the fatality rate of oral cancer and increase diagnostic-accuracy. In this paper, autofluorescence and quantitative-phase microscopy were used simultaneously to use a multi-modal optical approach for oral cancer screening.

W4A.25
Single Shot Off-Axis Digital Holographic Imaging Based on Kramers-Kronig Relations, Lei Yu[1], Wenbo dong[1], Zhi Zhong[1], Lei Liu[1], Shan Mingguang[1]; *[1]Harbin Engineering Univ., China.* We propose a method based on the Kramers-Kronig relations, which only measures the sample hologram without additionally measuring the reference beam. The experiment is performed to verify the feasibility and validity of the proposed method.

W4A.26
A Strategy for Hereditary Anemia Taxonomy Through Hierarchical Intelligent Classification Scheme in Digital Holography, Marika Valentino[1,2], Daniele Pirone[1], Michela Schiavo[1], Zhe Wang[1,3], Pasquale Memmolo[1], Vittorio Bianco[1], Lisa Miccio[1], Pietro Ferraro[1]; *[1]Inst. of Intelligent Systems ISASI, Italy; [2]Department of Electric and Information Technologies Engineering, Univ. of Naples Federico II, Italy; [3]Department of Chemical, Materials and Production Engineering, Univ. of Naples Federico II, Italy.* The phenotyping of hereditary anemias remains a challenge in clinical diagnostics. Digital Holography allows exploiting a bunch of descriptive information of red blood cells that, in tandem with Machine Learning, accurately classify anemia's type.

W4A.27
Interferometric Methods as a Novel Approach for Bacterial Biofilm Degradation Research, Maria Baczewska[1], Arkadiusz Kus[1], Katarzyna Galczynska[2,3], Michal Arabski[2,3], Martyna Mazur[1], Malgorzata Kujawinska[1]; *[1]Politechnika Warszawska, Poland; [2]Jan Kochanowski Univ., Poland; [3]Central Office of Measures, Poland.* An interferometric approach for quantifying bacterial biofilm after usage of antibacterial agent. The effect tested by DHM and LI and compared with biological tests. We present that multimodal measurement provides better determination of biofilm degradation.

W4A.28
Imaging Through Mouse Skull by Using Single-Pixel Microscopy, Naru Yoneda[1,2], Yuuki Tatsumi[1], Luis Ordóñez[3], Erick Ipus[3], Mitsuhiro Morita[1], Manoj Kumar[1,2], Enrique Tajahuerce[3], Osamu Matoba[1,2]; *[1]Kobe Univ., Japan; [2]OaSIS, Kobe Univ., Japan; [3]Universitat Jaume I, Spain.* In this paper, we propose imaging through the mouse skull by using single-pixel imaging (SPI). The experimental results indicate the proposed method can see through the intact skull of the mouse.

W4A.29
Artificial Intelligence for Label-Free Cells Classification in Holographic Microscopy, Pierpaolo Fiore[1], Daniele Pirone[2], Francesco Bardozzo[1], Lu Xin[3], Wen Xiao[3], Xiaoping Li[4], Gioele Ciaparrone[1], Vittorio Bianco[2], Lisa Miccio[2], Feng Pan[3], Pasquale Memmolo[2], Pietro Ferraro[2], Roberto Tagliaferri[1]; *[1]Univ. of Salerno, Italy; [2]ISASI CNR, Italy; [3]Key Laboratory of Precision Opto-Mechatronics Technology of Ministry of Education, China; [4]Peking Univ. People's Hospital, China.* Digital holography in microscopy is one of the emerging technologies to deal with biological specimen imaging without using exogenous agents. Artificial Intelligence approaches are presented here to classify label-free cells also in presence of bias.

W4A.30
Quantitative Matrix Imaging of Biological Tissues Through Solving the Inverse Scattering Problem in Reflection Microscopy, Thomas Wasik[1,2], Victor Barolle[1], Alexandre Aubry[1], Josselin Garnier[2], Mathias Fink[1]; *[1]Institut Langevin - CNRS, France; [2]Ecole polytechnique, France.* The extension of optical diffraction tomography (ODT) to reflection microscopy offers significant potential for non-invasive imaging. However, inherent physical constraints pose challenges, requiring changes in methods to achieve relevant refractive index reconstruction.

W4A.31
Fast Phase Reconstruction Using Digital Translation Complex Amplitude Division, Zhi Zhong[1], Yan Sun[1], Bin Liu[1], Lei Yu[1], Mingguang Shan[1], Lei Liu[1]; *[1]Harbin Engineering Univ., China.* A phase reconstruction method of structured light is proposed using digital translation complex amplitude division to enhance the reconstructed efficiency and verified by experiment.

W4A.32
Global Estimation of Underwater Polarization Imaging Using Image Correlation, Mingguang Shan[1], Bei Hu[1,2], Zhi Zhong[1], Lei Liu[1], Yongqiang Xie[2], Zhongbo Li[2]; *[1]Harbin Engineering Univ., China; [2]Inst. of Systems Engineering, AMS, PLA, China.* A method for global estimation of underwater polarization imaging using image correlation is proposed and some experiments are carried out to verify the feasibility and effectiveness of this approach.

W4A.33
Dual-Wavelength, Near-Infrared Holographic Tomography, Arkadiusz Kus[1]; *[1]Inst. of Micromechanics and Photonics, Warsaw Univ. of Technology, Poland.* In this work two measurements at different wavelengths obtained with a swept-source allow to decrease the values of phase of the scattered wave for the synthetic wavelength and thus apply Born approximation in tomographic reconstruction for any object.

W4A.34
Lensless Digital Holographic Reconstruction Based on the Deep Unfolding Iterative Shrinkage Thresholding Network, Duofang Chen[1]; *[1]Xidian Univ., China.* To eliminate the twin images in the lensless digital holography reconstruction, a deep unfolding iterative shrinkage thresholding network is proposed. The experiments show that the method outperforms the traditional ASM and the exist HRNet.

W4A.35
Multiple Image Encryption Using Radial Modes of Light Beam, Allarakha Shikder[1], Naveen K. Nishchal[1]; *[1]Indian Inst. of Technology Patna, India.* Structured light beam-based information

encryption techniques offer several benefits. Exploiting some of the features, this work demonstrates a method to encrypt multiple images using an array of light beams with different radial modes.

W4A.36
Optical Asymmetric Color Image Encryption Using Vector Light Field Encoding, Naveen K. Nishchal[1]; [1]*Indian Inst. of Technology Patna, India.* Vector beam is a type of beam that has inhomogeneous polarization distribution across the transverse plane. In this study, an arbitrary vector light beam is used for asymmetric color image encryption achieving high level of security.

W4A.37
Scheme of Computer-Generated Hologram Compression with Convolutional Neural Networks Optimized by Genetic Algorithm Improved, Yuxuan Yao[1], Guanglin Yang[1]; [1]*Peking Univ., China.* Scheme of computer-generated hologram compression with convolutional neural networks optimized is proposed. Its improvement involves the incorporation of additional genetic mechanisms tailored for weight adjustments within CNNs. Experimental results show that the scheme is feasible.

W4A.38
Method of Computer-Generated Hologram Compression Using Quantum-Weighted AutoEncoder, Chengcheng Hu[1], Guanglin Yang[1]; [1]*School of Electronics, Peking Univ., China.* We propose a quantum-weighted autoencoder network for the compression of computer-generated holograms. Experimental results show that the image quality of computer-generated holograms reconstructed by this quantum network is generally better than that of traditional autoencoders.

W4A.39
The Implementation of a Full-Color Holographic System Utilizing Voice Interaction and the Taylor Rayleigh–Sommerfeld Combined Point Cloud Gridding, Yu Zhao[1], Zhong Xu[1], Bing Han[1], Meng Xie[1], ZiJie Huang[1], Xiaoyan Qin[2]; [1]*Yangzhou Univ., China;* [2]*School of Mathematics and Statistics, Zaozhuang Univ., China.* In recent holographic research, systems using depth cameras capture real object data, modulated by spatial light modulators to reconstruct 3D scenes. We enhance this process with U^2-RAS for better data and ChatGLM for voice interaction, and introduce a faster hologram generation method.

W4A.39
Cell and Cell Culture Phantoms for Benchmarking Quantitative Phase Microscopes, Michal Ziemczonok[1], Sylvia Desissaire[2], Tigrane Cantat-Moltrecht[2], Malgorzata Kujawinska[1]; [1]*Warsaw Univ. of Technology, Poland;* [2]*CEA, Leti, Univ. Grenoble Alpes, France.* We demonstrate how to design and fabricate artificial cells and cell cultures based on phase images of real specimens. Such cell phantoms enable benchmarking and validation of most quantitative phase imaging instruments in real-world applications.

16:30 -- 18:30
Room: Tuffatore B
W5A • Unconventional Holographic Imaging Systems
Presider: Yuhong Wan; Beijing Univ. of Technology, China

W5A.1 • 16:30 (Keynotel)
Historical Development of Coded Aperture Correlation Holography, Vijayakumar Anand[1]; [1]*Tartu Ülikooli, Estonia.* Coded aperture correlation holography (COACH) was developed in 2016 by connecting two research areas: coded aperture imaging and incoherent digital holography. Here, we review the history and recent developments of COACH beyond the state of the art.

W5A.2 • 17:15
Full-Color Complex Hologram Quality Enhancement Method Captured With Incoherent Holographic Camera, KiHong Choi[1], Keehoon Hong[1]; [1]*Electronics and Telecom Research Inst, Korea (the Republic of).* This study enhances incoherent digital holography image quality using a U-Net-based network, addressing low dynamic range and noise issues. The result demonstrates significant improvement in image quality compared to the original data.

W5A.3 • 17:30
Matched Illumination Condition in non-Interferometric Quantitative Phase Imaging, Chao Zuo[1], Shun Zhou[1], Zhuo S. Li[1], Qian Chen[1]; [1]*Nanjing Univ of Science and Technology, China.* Non-interferometric quantitative phase imaging based on intensity-only measurement is often plagued by low-frequency missing problems due to the difficulty of meeting matched illumination condition. Here, we analyze the reasons from the transfer function perspective and present several methods to address this challenging issue.

W5A.4 • 17:45
Parallel Phase-Shifting Digital Holography With a DMD Using the Fractional Talbot Effect, Erick Ipus[1], Lluis Martínez[1], Jesús Lancis[1], Enrique Tajahuerce[1]; [1]*Universitat Jaume I, Spain.* We propose a parallel phase-shifting digital holography method using the fractional Talbot effect generated by periodic patterns encoded in a DMD. The method improves the efficiency of other phase-shifting holographic techniques based on DMDs.

W5A.5 • 18:00
3D Topographic Imaging of Columnar-Thin-Film-Coated Fingermarks Using Transport of Intensity, Austin Scott[1], Partha P. Banerjee[1], Muhammad Faryad[2], Akhlesh Lakhtakia[2]; [1]*Univ. of Dayton, USA;* [2]*Pennsylvania State Univ., USA.* The transport of intensity technique is used to recover 3D topograms of columnar-thin-film-coated fingermarks on various substrates. The technique is found to be especially useful for highly scattering samples, where holographic methods perform poorly.

W5A.6 • 18:15
Astigmatic Dual-Beam Interferometric Particle Imaging for Volumetric Metal Droplet Field Characterization, Yingchun Wu[1], Zhenghui Yang[1], Hang Zhang[1], Yu Wang[1], Yang Zhang[1], Zhu Zhuo[1,2], Xuecheng Wu[1]; [1]*Zhejiang Univ., China;* [2]*Hangzhou Dianzi Univ., China.* The measurement principle and data processing algorithm of astigmatic dual-beam interferometric particle imaging (ADIPI), with proof-of-concept experiments on simultaneous measurement of the three-dimensional (3D) position, size and velocity of metal droplet field, are presented.

16:30 -- 18:15
Room: Sala Convegni
W5B • Holographic Imaging for Industrial Applications II
Presider: Pasquale Memmolo; Inst. of Intelligent Systems ISASI, Italy

W5B.1 • 16:30 (Invited)
In Situ 3D Imaging in Volumetric Additive Manufacturing, Christophe Moser[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* Tomographic Volumetric 3D printing reaches printing time in the order of few tens of seconds. We will show methods to visualize and measure the three dimensional object while it is manufactured.

W5B.2 • 17:00
Two-View Tomographic off-Axis Holography for Burning Aluminum Droplet Field Measurement, Yu Wang[2], Letian Zhang[2], Yingchun Wu[2], Yue Zhao[2], Weiqiang Xiong[1], Shixi Wu[1], Xuecheng Wu[2]; [1]*Science and Technology on Aerospace Chemical Power Laboratory, China;* [2]*State Key Laboratory of Clean Energy Utilization, China.* A 50 kHz high-speed two-view tomographic digital off-axis holography with pulsed illumination is developed, and applied to measure the 3D positions of burning aluminum droplets in solid propellant combustion with high accuracy.

W5B.3 • 17:15
Comparison of Monge-Ampère Equation and Poisson's Equation for Holographic Lighting, Dominik Metzner[1]; [1]*Hella GmbH & Co. KGaA, Germany.* In cases where the light source is a non-coherent LED, the accuracy reduces if we consider a holographic phase image created with the Gerchberg-Saxton algorithm started using a randomized initial phase. To improve the reconstruction using LEDs, we introduce two mathematical problems that could build the base for holographic lighting.

W5B.4 • 17:30
Volumetric Micro Clouds Drawn With Femtosecond Laser Pulses, Keisuke Numazawa[1], Kota Kumagai[1], Yoshio Hayasaki[1]; [1]*Utsunomiya Univ., Japan.* Volumetric display with a micro cloud is developed. The micro cloud is generated with a focused laser pulse. The image is visualized by light scattering form the cloud voxels.

W5B.5 • 17:45 (Invited)
HoloTile for Volumetric Additive Manufacturing, Jesper Glückstad[1]; [1]*SDU Centre for Photonics Engineering, Univ. of Southern Denmark, Denmark.* HoloTile [1, 2, 3, 4] is a novel digital holographic light sculpting modality with properties well suited to volumetric additive manufacturing (VAM). This paper discusses the consequences of moving from an imaging-based to a holographic-based VAM configuration, and how HoloTile may be used to improve volumetric printing further.

Thursday, 6 June

08:30 -- 10:30
Room: Sala Convegni
Th1A • Advanced Processing Techniques in Digital Holography
Presider: Partha Banerjee; Univ. of Dayton, USA

Th1A.1 • 08:30 (Keynote)
Image or Far? Quantifying Complex Processes From Speckle in Space and Time, George Barbastathis[1]; [1]*Massachusetts Inst. of Technology, USA.* Numerous processes, from pharmaceutical manufacturing to blood perfusion in the retina, may be described as complex multi-phase flows. We discuss various strategies for using laser speckle to quantify them non-invasively and at high speed.

Th1A.2 • 09:15
Phase Gradient and Speckle Motion as a Digital Refocus Approach for Holographic Interferometry, Mikael Sjodahl[2], Pascal Picart[1]; [1]*Le Mans Universite, France;* [2]*Lulea Univ. of Technology, Sweden.* We propose to consider the speckle motions from induced phase gradients to provide a criterion for accurate image refocusing in digital holographic interferometry. Experiments confirm the theory.

Th1A.3 • 09:30
Phase de-Noising in Digital Holography Using KSVD Approaches, Mathis Collard[1], Silvio Montresor[1], Marie Tahon[1], Pascal Picart[1]; [1]*Le Mans Universite, France.* We present a study of Kernel Singular Value Decomposition Based (KSVD) based algorithm to de-noise wrapped phase maps in digital holography interferometry. We focus on the adaptation of this approach to reduce decorrelation speckle noise.

Th1A.4 • 09:45
Phase Retrieval of 3D Printed Freeform Microoptical Wavefronts, Lunwei Wang[1], Yanqiu Zhao[1], Florian Mangold[1], Julian Schwab[1], Leander Siegle[1], Harald Giessen[1]; [1]*Univ. of Stuttgart, Germany.* 3D printed freeform microoptics have revolutionized imaging on the submillimeter scale. Aspherical singlets, doublets, multiplets, but also 3D printed diffractive optical elements and lenses can be printed with unprecedented accuracy and shape freedom.

Th1A.5 • 10:00
Enhancement of Large Area Micro-Printing Phase Quality via Aberration Analysis and Correction, Emilia Wdowiak[1], Michal Józwik[1], Piotr Zdankowski[1], Maciej Trusiak[1]; [1]*Warsaw Univ. of Technology, Poland.* Large area two-photon polymerization (TPP) holds promise for diverse applications but raises concerns regarding fabrication precision across the entire printing area. Here, we scrutinize phase quality within a commercial TPP setup, employing Zernike polynomial analysis to study aberrations and suggest correction methodology.

Th1A.6 • 10:15
Tomographic Flow Cytometry Based on Automatic Angle Recovery for Three-Dimensional Imaging of Carbon Nanoparticles in Bladder Cancer Cells, Yijing Li[1], Leiping Che[1], Wen Xiao[1], Hao Wang[2], Ran Peng[2], Xi Xiao[2], Feng Pan[1]; [1]*School of Instrumentation and Optoelectronic Engineering, Beihang Univ., China;* [2]*Third Hospital, Peking Univ., China.* Method enables

automatic angle recovery of tomographic flow cytometry by establishing relationship between cell rotation angle and motion distance is proposed and applied to observe the 3D distribution of carbon nanoparticles in bladder cancer cells.

11:00 -- 13:00
Room: Sala Convegni
Th2A • Digital Holographic Microscopy for Clinical Applications
Presider: Pietro Ferraro; Inst. of Intelligent Systems ISASI, Italy

Th2A.1 • 11:00 (Invited)
Digital Holography for Personalized Cancer Therapy Selection, David D. Nolte[1]; [1]*Physics and Astronomy, Purdue Univ., USA.* The phase sensitivity of low-coherence digital holography, applied ex vivo to living tissue biopsies exposed to therapeutic drugs, measures changes in dynamic speckle that are useful for predicting cancer patient outcomes in clinical trials.

Th2A.2 • 11:30 (Invited)
Digital Holographic CLinical MEdical STudies: INsights Into Cancer Cell MOrphology and Behavior, Xi Xiao[1], Ran Peng[1], Feng Pan[3], Sara Coppola[4], Pietro Ferraro[4], Hao Wang[1,2]; [1]*Department of Radiation Oncology, Peking Univ. Third Hospital, China;* [2]*Cancer Center, Peking Univ. Third Hospital, China;* [3]*School of Instrumentation Science and Optoelectronics Engineering, Beihang Univ., China;* [4]*Inst. of Applied Sciences and Intelligent Systems "E. Caianiello", Italian National Research Council (ISASI-CNR), Italy.* Quantitative morphology and refractive index distribution of cancer cells could be pieces of evidence for clinical detection. We show how holographic tomography improve our treatment strategies by providing deeper insights into cancer cell.

Th2A.3 • 12:00
Advances in Digital Holography: Compact System Integration for Monitoring and Diagnosis of Astronaut Health in Space Applications, Giusy Giugliano[1,2], Lisa Miccio[1], Vittorio Bianco[1], Pasquale Memmolo[1], Daniele Pirone[1], Pietro Ferraro[1]; [1]*Inst. of Intelligent Systems ISASI, Italy;* [2]*Department of Mathematics and Physics Univ. of Campania, Italy.* Extreme conditions' impact on astronaut health necessitates robust diagnostics. Here, we propose to integrate telemedicine, compact devices, and Quantitative Phase Imaging with Artificial Intelligence as a diagnosis tool promising revolutionary advancements in space healthcare applications.

Th2A.4 • 12:15
Retinal Blood Flow Estimation by Digital Holography: Mitigating the Effect of Illumination Power Variations, Yann Fischer[1], Olivier Martinache[1], Zofia Bratasz[1], Marius Dubosc[1], Michael Atlan[1]; [1]*ESPCI, France.* High-speed digital holography unveils local blood flow contrasts in the eye fundus using a forward scattering model of dynamically diffused light, enabling estimation of absolute blood flow. Intra-individual reproducibility is improved by renormalizing based on the assessment of illumination power from the modulation depth of interferograms.

Th2A.5 • 12:30
Label-Free Assessment of Intestinal Inflammation in Patients With Ulcerative Colitis Using Digital Holographic Microscopy, Arne Bokemeyer[2], Joost Buskermolen[1], Steffi Ketelhut[1], Phil-

Robin Tepasse[1], Richard Vollenberg[1], Jonel Trebicka[1], Hartmut H. Schmidt[2], Michael Vieth[3], Dominik Bettenworth[1,4], Björn Kemper[1]; *[1]Westfälische Wilhelms Univ Münster, Germany; [2]Department of Gastroenterology, Univ. Duisburg-Essen, Germany; [3]Institut für Pathologie, Friedrich-Alexander-Univ. Erlangen-Nürnberg, Germany; [4]CED Schwerpunktpraxis Münster, Germany.* We evaluated the application of quantitative phase imaging (QPI) with digital holographic microscopy (DHM) for the assessment of histopathological inflammation in patients with ulcerative colitis (UC).

Th2A.6 • 12:45

Investigation on Lysosomal Accumulation by a Quantitative Analysis of 2D Phase-Maps in Digital Holography Microscopy, Michela Schiavo[1], Giusy Giugliano[1], Daniele Pirone[1], Jaromir Behal[1], Vittorio Bianco[1], Sandro Montefusco[2], Pasquale Memmolo[1], Lisa Miccio[1], Pietro Ferraro[1], Diego Medina[2]; *[1]ISASI-CNR, Italy; [2]Tigem, Italy.* Quantitative Phase Imaging through Digital Holography (QPI-DH) represents a quantitative and label-free method to detect lysosomal dysfunction in cells. Testing in the cellular model of Mucopolysaccharidosis type III-A, a lysosomal storage disease, demonstrate its potential.