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Focus issue introduction: 3D image acquisition and display: technology, perception and applications

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Abstract: This Feature Issue of *Optics Express* is organized in conjunction with the 2021 Optica (OSA) conference on 3D Image Acquisition and Display: Technology, Perception and Applications which was held virtually from 19 to 23, July 2021 as part of the Imaging and Sensing Congress 2021. This Feature Issue presents 29 articles which cover the topics and scope of the 2021 3D conference. This Introduction provides a summary of these articles.

The Optica (OSA) conference on "3D Image Acquisition and Display: Technology, Perception and Applications" was part of the Optica (OSA) Imaging and Applied Optics Congress, which was held virtually during 19-23, July 2021. This Optics Express feature issue on "3D Image Acquisition and Display: Technology, Perception and Applications" is organized in conjunction with this Optica 3D conference. The scope and topics of this feature issue and the 2021 3D conference cover research areas related to the acquisition, processing, display, and applications of 3D information as well as the perception, human factors, and visual comfort of 3D information displays. While the conference participants were encouraged to submit their work, this feature issue was open to all original contributions in related areas. The goal of this feature issue is to bring together outstanding contributions by leading researchers from a broad range of interdisciplinary fields to present their work in the science, technology, and applications of 3D image collection, processing, and display technologies.

Research related to scientific understanding of 3D information, 3D displays and perception, technological innovations in 3D image acquisition or display methods, 3D sensing and visualization, and task-specific design and applications of 3D acquisition or display technology are particular interests of this feature issue. The 3D conference and the feature issue cover hardware, algorithms, devices, and systems for 3D imaging, 3D visualization, augmented reality displays, 3D displays, and biomedical applications in these domains. We hope that the readers will enjoy this feature issue containing 29 articles that cover the state of the art in the 3D field [1–29]. We are thankful to all of the authors and reviewers for their fine contributions and efforts. Also, we thank Ms. Carmelita Washington from the Optics Express Manuscript Office for her assistance and support during the manuscript review process. We thank the Editor in Chief James Leger and Senior Deputy Editor Chris Dainty for the opportunity to organize this feature issue.

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In the following, we present a summary of 29 articles that appear in the feature issue [1–29]. The presentation follows the appearance of these manuscripts on the Optics Express Virtual Feature WEB site (https://www.osapublishing.org/oe/virtual_issue.cfm?vid=474).

Zilan Pan, Yin Xiao, Lina Zhou, Yonggui Cao, Mo Yang, and Wen Chen report a non-line-of-sight optical information transmission through turbid water [1]. Xingpeng Yan, Chenqing Wang, Yunpeng Liu, Xi Wang, Xinlei Liu, Tao Jing, Song Chen, Pei Li, and Xiaoyu Jiang propose implementation of the real–virtual 3D scene-fused full-parallax holographic stereogram [2]. Youngrok Kim, Sungwoong Park, Hogil Baek, and Sung-wook Min describe voxel characteristic estimation of integral imaging display system using self-interference incoherent digital holography [3].

Kashif Usmani, Timothy O'Connor, and Bahram Javidi present a three-dimensional polarimetric image restoration in low light with deep residual learning and integral imaging [4]. Gokul Krishnan, Yinuo Huang, Rakesh Joshi, Timothy O'Connor, and Bahram Javidi investigate a spatio-temporal continuous gesture recognition under degraded environments including performance comparison between 3D integral imaging (InIm) and RGB-D sensors [5]. P. Kopycki, A. Tolosa, M. J. Luque, M. C. Garcia-Domene, M. Diez-Ajenjo, G. Saavedra, and M. Martinez-Corral examine the utility of pinhole-type screens for lightfield display [6]. Xuan Wang and Hong Hua present the design of a digitally switchable multifocal microlens array for integral imaging systems [7].

Pengyinjie Lyu and Hong Hua describe a perceptual-driven approach to statically foveated head-mounted displays, an Editor's Pick paper [8]. Li Liu, Xinzhu Sang, Xunbo Yu, Xin Gao, Yuedi Wang, Xiangyu Pei, Xinhui Xie, Bangshao Fu, Haoxiang Dong, and Binbin Yan describe a 3D light-field display with an increased viewing angle and optimized viewpoint distribution based on a ladder compound lenticular lens unit [9]. Yang Meng, Yan Lyu, Laurence Lujun Chen, Zhongyuan Yu, and Hongen Liao propose motion parallax and lossless resolution autostereoscopic 3D display based on a binocular viewpoint tracking liquid crystal dynamic grating adaptive screen [10].

Gokul Krishnan, Rakesh Joshi, Timothy O'Connor, and Bahram Javidi present optical signal detection in turbid water using multidimensional integral imaging with deep learning [11]. Igor Yanusik, Anastasiia Kalinina, Alexander Morozov, and Jin-Ho Lee describe a pupil replication waveguide system for autostereoscopic imaging with a wide field of view [12]. Rong-Ying Yuan, Xiao-Li Ma, Fan Chu, Guang-Xu Wang, Min-Yang He, Chao Liu, and Qiong-Hua Wang report an optofluidic lenticular lens array for a 2D/3D switchable display [13].

Fan Chu, Yu-Qiang Guo, Yu-Xian Zhang, Wei Duan, Han-Le Zhang, Li-Lan Tian, Lei Li, and Qiong-Hua Wang propose a Four-mode 2D/3D switchable display with a 1D/2D convertible liquid crystal lens array [14]. Wen-Kai Lin, Shao-Kui Zhou, Kouichi Nitta, Osamu Matoba, Bor-Shyh Lin, and Wei-Chia Su describe a binocular dynamic holographic floating image display [15]. Xin Gao, Xunbo Yu, Xinzhu Sang, Li Liu, and Binbin Yan propose improvement of a floating 3D light field display based on a telecentric retroreflector and an optimized 3D image source [16].

Shenyu Zhu, Yong Meng Sua, Patrick Rehain, and Yu-Ping Huang propose present a single photon imaging and sensing of highly obscured objects around the corner [17]. Di Wang, Nan-Nan Li, Yi-Long Li, Yi-Wei Zheng, and Qiong-Hua Wang propose a curved hologram generation method for speckle noise suppression based on the stochastic gradient descent algorithm [18]. Yannanqi Li, Qian Yang, Jianghao Xiong, Kun Yin, and Shin-Tson Wu describe 3D displays in augmented and virtual realities with holographic optical elements in an Invited paper [19].

Vladislav Kravets, Bahram Javidi, and Adrian Stern present a compressive imaging for thwarting adversarial attacks on 3D point cloud classifiers [20]. Yan Zhang, Xiaodan Hu, Kiyoshi Kiyokawa, Naoya Isoyama, Hideaki Uchiyama, and Hong Hua describe realizing mutual

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occlusion in a wide field-of-view for optical see-through augmented reality displays based on a paired-ellipsoidal-mirror structure [21].

Long Pan, Yiqun Wang, Chenjin Deng, Wenlin Gong, Zunwang Bo, and Shensheng Han propose Micro-Doppler effect based vibrating object imaging of coherent detection GISC lidar [22]. Erik Bélanger, Carine Benadiba, Émile Rioux-Pellerin, Frédéric Becq, Pascal Jourdain, and Pierre Marquet propose an engineered fluidic device to achieve multiplexed monitoring of cell cultures with digital holographic microscopy [23]. Genaro Saavedra, A. Gimeno-Gómez, Manuel Martínez-Corral, Jorge Sola, and Emilio Sánchez-Ortiga present a three-dimensional imaging through patterned type-1 microscopy [24].

Pranav Wani, Kashif Usmani, Gokul Krishnan, Timothy O'Connor, and Bahram Javidi investigate a lowlight object recognition by deep learning with passive three-dimensional integral imaging in visible and long wave infrared wavelengths [25]. Timothy O'Connor, Sabato Santaniello, and Bahram Javidi propose COVID-19 detection from red blood cells using highly comparative time-series analysis (HCTSA) in digital holographic microscopy [26]. Jostein Thorstensen, Jens T. Thielemann, Petter Risholm, Jo Gjessing, Runar Dahl-Hansen, and Jon Tschudi present a high-quality dense 3D point clouds with active stereo and a miniaturizable interferometric pattern projector [27].

Ozan Cakmakci, Yi Qin, Peter Bosel, and Gordon Wetzstein present a holographic pancake optics for thin and lightweight optical see-through augmented reality, an Editor's Pick paper [28]. Offer Bar Lev, Adrian Stern, and Isaac August describe object localization and tracking in three dimensions by space-to-time encoding [29].

Disclosures. Hong Hua has a disclosed financial interest in Magic Leap Inc. The terms of this arrangement have been properly disclosed to The University of Arizona and reviewed by the Institutional Review Committee in accordance with its conflict of interest policies. The rest of the authors declare no conflicts of interest.

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