

Editorial

Editorial on Special Issue “Holography, 3-D Imaging and 3-D Display”

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1. Introduction

Modern holographic techniques have been successfully applied in many important areas, such as 3D inspection, 3D microscopy, metrology and profilometry, augmented reality, and industrial informatics. This Special Issue covers selected pieces of cutting-edge research works, ranging from low-level acquisition, to the high-level analysis, processing, and manipulation of holographic information. The Special Issue also serves as a comprehensive review on the existing state-of-the-art techniques in 3D imaging and 3D display, as well as a broad insight into the future development of these disciplines. The Special Issue contains 25 papers in the field of holography, 3-D imaging and 3-D display. All the papers underwent substantial peer review under the guidelines of *Applied Sciences*. The twenty-five papers are divided into three groups: holography, 3-D imaging, and 3-D display.

2. Holography

There are 12 papers under the category of holography and these papers are divided into four topics: digital holography (DH), computer-generated holography (CGH), holographic printing and holographic optical elements (HOEs). Under DH, there are four papers. Tsang et al. report a low complexity method for reconstructing a focused image from an optical scanned hologram that is representing a 3-D object scene. While the proposed method has been applied to holograms obtained from optical scanning holography (OSH), the method also can be applied to any complex holograms such as those obtained from standard phase-shifting holography [1,2]. Rosen et al. review the prime architectures of optical hologram recorders in the family of coded aperture correlation holography (COACH) systems. They also discuss some of the key applications of these recorders in the field of imaging in general [3]. Tahara et al. investigate the quality of reconstructed images in relation to the bit depth of holograms formed by wavelength-selective phase-shifting digital holography. Their results indicate that two-bit resolution per wavelength is required to conduct color 3D imaging [4]. Finally, the fourth and the last paper under DH, Xu et al. propose novel generalized three-step phase-shifting interferometry with a slight-tilt reference. The proposed slight-tilt reference allows the full and efficient use of the space-bandwidth product of the limited resolution of digital recording devices as compared to the situation in standard off-axis holography [5].

Under CGH, Zhang et al. present a technique for generating 3D computer-generated holograms with scalable samplings, by using layer-based diffraction calculations. They have demonstrated

experimentally that the proposed method can reconstruct quality 3D images at different scale factors [6]. Yang et al. investigate a fast computer-generated holographic method for VR and AR near-eye 3-D display. The display system is compact and flexible enough to produce speckle-noise-free high-quality VR and AR 3D images with efficient focus and defocus capabilities [7]. Jiao et al. employ a deep convolutional neural network to reduce the artifacts in a JPEG compressed hologram. Simulation and experimental results reveal that the proposed “JPEG + deep learning” hologram compression scheme can achieve satisfactory reconstruction results for a computer-generated phase-only hologram after compression [8]. In the fourth and the last paper under CGH, Yamaguchi et al. develop a fringe printer for CGHs. The printer can give a plane-type hologram with a 0.35- μm resolution [9].

There are four papers for holographic printing and holographic optical elements (HOEs). Su et al. report the progress in the synthetic holographic stereogram printing technique [10] and Fan et al. propose a stereogram printing based on holographic element-based effective perspective image segmentation and mosaicking [11]. Along the line of HOEs, Zhang et al. employ a multiplexed lens-array holographic optical element (MHOE) for a dual-view integral imaging 3-D display [12], and Ferrara et al. review volume holographic-based solar concentrators recorded on different holographic materials [13].

3. 3-D Imaging

There are six papers under the category of 3-D Imaging. Zhuang et al. report an early study on imaging 3-D objects hidden behind highly scattered media. Experimental results show that the complex amplitude of the object can be recovered from the distorted optical field [14]. Kim et al. suggest an efficient neural network model for shape from focus along with a weight passing method. The proposed network reduces the computational complexity with accuracy comparable with the conventional model [15]. Yang et al. propose absolute phase retrieval using only one coded pattern together with geometric constraints in a fringe projection system. The proposed method is suitable for real-time measurement [16]. Jang et al. investigate sampling based on a Kalman filter for shape from focus in the presence of noise. Experimental results demonstrate more accurate and faster performance than other existing filters [17]. Zhang et al. provide a review on tomographic diffractive microscopy (TDM) and suggest that TDM will play a key role in the exploration of biological cells as well as for the investigation of nano-structure devices [18]. Finally, Wang et al. characterize the phase response of spatial light modulators for coherent imaging [19].

4. 3-D Display

There are seven papers under the category of 3-D display. Pettingill et al. investigate static structures in leaky mode waveguides for transparent, monolithic, holographic, near-eye display. [20]. Kim et al. provide their initial results on an electronic tabletop holographic display and hope the work will give guidance for the future development of commercially acceptable holographic display systems [21]. Tsai et al. investigate an optical design for a novel glasses-type 3-D wearable ophthalmoscope and conclude that a wearable ophthalmoscope can be designed optically and mechanically with 3-D technology [22]. Gao et al. investigate a holographic 3-D virtual reality (VR) and augmented reality (AR) display based on 4K-spatial light modulators and show that holographic 3-D VR and AR displays can be good candidates for true 3-D near-eye display as compared to stereoscopic display [23]. Choi et al. propose a new type of the dual-view 3-D display system based on direct-projection integral imaging using a convex-mirror-array and confirm the feasibility of the proposed system in practical applications [24]. Geyer et al. review high-resolution episcopic microscopy (HREM) and provide an overview of scientific publications that have been published in the last 13 years involving HREM imaging [25]. Finally, Falldorf et al. present a novel concept and first experimental results of a new type of 3D display, which is based on the synthesis of spherical waves [26].

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