Light | Advanced Manufacturing

Outstanding Papers in 2022

Resolution enhancement of digital holographic microscopy via synthetic aperture: a review

Peng Gao, Caojin Yuan

Light: Advanced Manufacturing, 2022, **3**(1) : 105-120. doi: 10.37188/lam.2022.006

Resolution enhancement of digital holographic microscopy: a review

Digital holographic microscopy (DHM) is a wide-field, minimally invasive quantitative phase microscopy approach for measuring the 3D shape or the inner structure of transparent and translucent samples. However, limited by diffraction, the spatial resolution of conventional DHM is relatively low, and therefore, tinny structures of samples can be not seen under conventional DHM. During the past decades, many efforts have been made to enhance the spatial resolution of DHM while preserving a large field of view (FOV). Peng Gao from Xidian University and Cao-jin Yuan from Nanjing Normal University present a comprehensive review of resolution enhancement approaches for DHM, which encompass illumination engineering, hologram extrapolation or synthesis, pixel super-resolution, and artificial intelligence (AI) approaches. They also discussed and summarized the advantages and disadvantages of these resolution enhancement approaches.

Holographic techniques for augmented reality and virtual reality near-eye displays

Jae-Hyeung Park, Byoungho Lee

Light: Advanced Manufacturing, 2022, **3**(1) : 137-150. doi: 10.37188/lam.2022.009

AR and VR: Near-eye displays are advancing with holographic techniques

Near-eye displays are glass-type wearable display devices that enable immersive presentation of virtual images in AR and VR applications. Compact form-factor, light weight, large field of view, wide eyebox, and natural 3D image presentation with proper focus cues are crucial requirements of the near-eye displays for a comfortable viewing experience and natural user interaction. In recent years, holographic techniques have been actively applied to implement these requirements, overcoming the limitation of the conventional bulk optics and 2D display panels. Jae-Hyeung Park from Inha University and Byoungho Lee from Seoul National University review the recent progress in the application of the holographic techniques. By covering various applications such as static holographic optical components and dynamic holographic display devices, they provide a comprehensive overview of holographic techniques that are applied to AR and VR near-eye displays.

The state-of-the-art in computer generated holography for 3D display

David Blinder, Tobias Birnbaum, Tomoyoshi Ito, Tomoyoshi Shimobaba

Light: Advanced Manufacturing, 2022, **3**(3) : 572-600. doi: 10.37188/lam.2022.035

The state-of-the-art in computer generated holography for 3D display

Holographic displays have the promise to be the ultimate 3D display technology, able to account for all visual cues. Recent advances in photonics and electronics gave rise to high-resolution holographic display prototypes. There is a major computational challenge in driving those display: computer generated holography (CGH) consists of numerically simulating diffraction, which is very computationally intensive. David Blinder from Belgium's Vrije Universiteit Brussel and IMEC, Tomoyoshi Shimobaba from Japan's Chiba University and colleagues give a broad overview of the state-of-the-art in CGH. This includes a classification of modern CGH algorithms, describing different algorithmic CGH acceleration techniques, covering the latest dedicated hardware solutions and how to evaluate the perceptual quality of CGH. The remaining challenges, projections on the future of CGH and its potential for photorealistic 3D display are discussed.

Design and realization of 3D printed fiber-tip microcantilever probes applied to hydrogen sensing

Changrui Liao, Cong Xiong, Jinlai Zhao, Mengqiang Zou, Yuanyuan Zhao, Bozhe Li, Peng Ji, Zhihao Cai, Zongsong Gan, Ying Wang, Yiping Wang

Light: Advanced Manufacturing. 2022, **3**(1) : 3-13. doi: 10.37188/lam.2022.005

Optical-MEMS: 3D printed fiber-tip microcantilever probes

Microcantilevers have the advantages of non-labeling, real-time characterization, positioning, and specific detection, which is an excellent method for ultra-trace measurements. In particular, the microcantilever beam probe based on optical fiber can simplify the system of microcantilever sensor, and has the merits of high signal-to-noise ratio, and portability. Yi-Ping Wang from China's Shenzhen University and colleagues now report a class of polymer microcantilever beam probes that can be freely designed and printed in one-step molding on the end of optical fiber. The microcantilever beam utilizes the low stiffness and supreme resilience of the polymer, which enables it to deform under small stress differences. The exceptional recoverability greatly improves its resolution and range. After modifying the probe with palladium, the team demonstrated the highly sensitive and fast-responding hydrogen sensing applications of this new microcantilever probe.

Deep holography

Guohai Situ

Light: Advanced Manufacturing. 2022, **3**(2) : 278-300. doi: 10.37188/lam.2022.013

Deep holography: AI boots holography and vice versa

With the explosive growth of mathematical optimization and computing hardware, deep neural networks (DNN) have become tremendously powerful tools to solve many challenging problems in holography. Guohai Situ from Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, now presents a comprehensive review on the prosperous interactions between DNN and holography. After a brief overview of the basic theory and architectures of DNN, he shows how DNN can solve otherwise challenging problems with respect to digital holography and computer-generated holography. Then he moves forwards and discuss that holography can be an enabling tool for the optical implementation of DNN owing to the capability of interconnection and light speed processing in parallel. The present unified exposition is helpful to stimulate further development in this promising and exciting field of research.