Real-time holographic display with color multiplexing

Chao Ping Chen, Xiao Li, and Yikai Su*

National Engineering Lab of TFT-LCD Materials and Technologies, Department of Electronic Engineering, Shanghai Jiao Tong University, Shanghai 200240, China

*yikaisu@sjtu.edu.cn

Abstract: Three-dimensional (3D) technology has ignited a new wave of display industry growth as it is now widely adopted in the consumer electronics. Among various 3D technologies, holography is considered as an ultimate 3D technique for its ability to reconstitute both the intensity and phase information of a scene, thus allowing the observer to perceive the light as it would have been scattered by the real object itself. In this talk, we will introduce a real-time holographic display, which is based on the optical holography and capable of playing a dynamic motion picture. The refreshing process consisting of recording and erasing is realized by a dye-doped liquid crystal (DDLC) without any applied voltage. Compared to other photorefractive materials, DDLC is noted for its large optical nonlinearity and easy scalability to fabricate. It has been found out that the response time can be affected by a number of factors, such as the intensity of recording beams, polarizations of the writing beams, grating period, and the temperature etc. By optimizing the above parameters, the total response time, recording plus erasing, can be shortened less than 10 ms. This has been experimentally validated via a demonstration of 25-Hz monochromatic video, output by a spatial light modulator and reconstructed by a DDLC plate. To further render a full-color holographic display, we resort to angular multiplexing of three holograms illuminated by R/G/B lasers, respectively. The performance of multiplexing can be judged in terms of diffraction efficiency and overlapping. In experiments, the diffraction efficiencies of three different gratings have been measured. Besides, both the diffraction angles of the reading beams and source image sizes are well adjusted to guarantee the perfect superposition of different holograms. Finally, we have managed to obtain a static color image. In conclusion, our results indicate a possibility of realizing dynamic, color holographic 3D display. We will continue to carry out more in-depth researches concerning the relative problems.

Keywords: holographic display, 3D display, holographic multiplexing, dye-doped liquid crystal, real-time, fast response

Biography: Chao Ping Chen received the B.S. degree in 2004 from Shanghai University and the M.S. and Ph.D. degrees in 2006 and 2009, respectively, from Pusan National University, South Korea. He worked at Infovision Optoelectronics and Shanghai Tianma for 3 odd years before he joined the faculty of Shanghai Jiao Tong University as an assistant professor in 2012. His research interests include holography, liquid crystal display, 3D display, and solid state lighting.