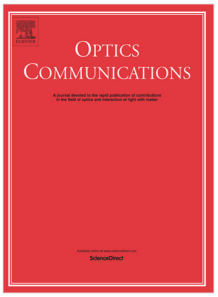
Accepted Manuscript



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PII: S0030-4018(18)30828-9
DOI: https://doi.org/10.1016/j.optcom.2018.09.047
Reference: OPTICS 23486

To appear in: *Optics Communications*

Received date : 20 June 2018
Revised date : 9 September 2018
Accepted date : 19 September 2018

Please cite this article as: L. Zhao, et al., Real-time rendering of computer-generated hologram with the view volume transformation based layered method, *Optics Communications* (2018), https://doi.org/10.1016/j.optcom.2018.09.047

Real-time rendering of computer-generated hologram with the view volume transformation based layered method

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Abstract:
A layered rendering method for generating computer-generated hologram (CGH) of 3D objects based on view volume transformation is presented. The shape distortion and the size deviation of the 3D reconstructed image existing in conventional layer-based methods are avoided, and the reconstructed 3D image can preserve the real size of the original model with high quality. Real-time interaction with the digitally reconstructed holographic image with clear depth cues is experimentally demonstrated.

Key Words: computer-generated hologram; layer-based methods; layer rendering technology.

1.Introduction

Since holograms can record all the information of the 3D object, holographic display shows unique advantages and great flexibility in 3D display which can provide complete optical wave fields of 3D objects as well as clearly depth cues [1]. Traditional optical holographic recording requires a strict recording environment and a complex process. Computer-generated hologram (CGH) only requires the mathematical description of the light wave coded in the computer. CGH can not only fully record the amplitude and phase of the actual light wave, but also can synthesize the wave front of objects that do not exist in the world.

Main methods for generating CGHs are classified as point-based, polygon-based, image-based and layer-based methods. The point-based method is the traditional methods, which takes the 3D object as the combination of a large number of points. Each point emits a separate spherical wave. These spherical waves are superimposed on the holographic plane to calculate the CGH of the 3D object at a specific distance. Due to the large number of points, the calculation process is time-consuming. Some improved methods were proposed to improve calculation speed, such as look-up-table (LUT) and wavefront recording method [2-5]. Polygon methods use the polygon as the unit, and the holographic information for each polygon is calculated and then placed into the corresponding position. Due to the reduction of units, the load of computation also decreases [6-8]. The Image-based method renders projected images of the 3D object from different views. Holograms are loaded on the display system to form 3D effect [9,10]. As the calculation process can be accelerated by the Fourier algorithm, the calculation speed is fast.

The layer-based method divides the projection images of 3D object into multiple layers according to the depth cue. Therefore, all layers are the same size. Since fast Fourier Transform can be used in the calculation of holograms [11,12], the computation speed can be accelerated. However, the sampling pitch in the Fresnel diffraction calculation is proportional to the