Enhancement of Reconstructed Image Quality and Faster Calculation Speed Using Limited Multiple Wavefont Recording Plane Method

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For faster generation of the computer generated hologram (CGH) a virtual plane called wavefront recording plane (WRP) was introduced between the hologram plane and the object. Firstly, the complex amplitude from each object point is recorded on the WRP. Secondly wavefront from the WRP is propagated to the CGH plane by a Fast Fourier transform (FFT). FFT of each object point to the WRP is computationally costly. Thus multiple WRP (MWRP) was introduced which reduced the computational time farther [1-2] but using too many WRPs might take more time than the minimum computational time [2].

In this paper, we focus on reconstructed image quality enhancement for complex objects, long objects which have lots of curves and edges, using limited number of MWRPs (LMWRP). We visualize the object in layers with respect to object point's depth. In LMWRP method first WRP is created for the farthest depth layer, z_1 and number of points in this layer, $N(z_1)$ is remembered. Onwards from the second depth layer, if number of points in the current layer is greater than the previous layer a new WRP is created, $N(z_i) > N(z_{i+1})$, as shown in figure 1(a). Since our method does not require to calculate WRP position at every depth it reduces memory usage and also creating new WRP for new curves or edges cause lesser super imposition of inferences - creating clearer reconstructed image showing finer edges or curves.

(a) (b) (c) (d)

Fig. 1. Reconstructed images of bear with (a) proposed method (b) MWRP method, (c) full color Bear object, (d) outline of the position of WRPS

A horse, a bunny, a full color bear with 48.5k, 36k, 669k object points respectably are chosen to verify the idea. Peak signal-to-noise ratio (PSNR) of the reconstructed images with LMWRP method is 24.2, 15.8, and 14.85 whereas with MWRP PSNR is 23.3, 14.9, 13.78. Moreover the computational cost of LMWRP are 433, 318 and 25152 seconds while for MWRP cost are 436, 323, and 23504 seconds. Due to huge uniformity of points between layers computational cost for bear in MRWP is lower than proposed method. The reconstructed images of proposed method, MWRP method and the original image are shown in Fig. 1(b), (c), (d) respectively. These results clearly verify that higher PSNR and also lower calculation time can be achieved with LMWRP method.

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