Enhancement of reconstructed image quality and calculation speed for multiple wavefront recording 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 still computationally costly. Thus multiple WRP (MWRP) was introduced which farther reduced the computational time for long depth objects [1] but in conventional MWRP method using optimum number WRP is required [2].

In our proposed method, we focus on reconstructed image quality enhancement for complex objects, long objects which have lots of curves and edges with non-uniform distribution of points. We visualize the object in layers with respect to object point's depth. Firstly WRP is created for the farthest depth layer, d_1 and number of points in this layer, N (z_1) is remembered. 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 Fig 1(a). Since the proposed method creates WRP based on the number of object points in depth layer, it avoids creating new WRP for depth layer with very fewer number of object points. Thus lesser number of WRP is created which has lower memory usage and also have lower calculation time.

Our proposed method is compared with conventional MWRP, using three objects of 35,263 points. Computation time, PSNR, and number of WRP in conventional MWRP method and proposed method is 287 sec., 18.33 dB, 8 and 249 sec., 18.45 dB, 122 respectively. Original image, the reconstructed images using conventional MWRP and proposed method are shown in Fig. 1(b), (c), (d) respectively. This clearly verifies that higher PSNR and also lower calculation time can be achieved for complex, long depth objects which have non-uniform object point distribution.

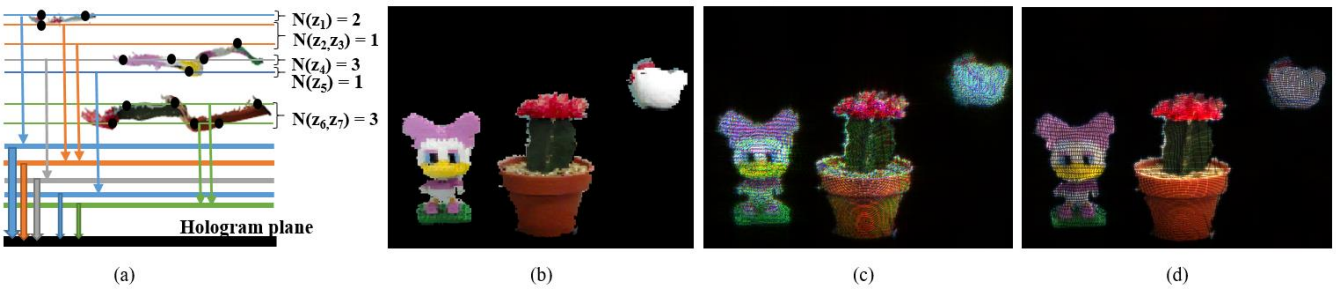

Fig. 1. (a) Schematic diagram of proposed method, (b) original image of three objects, reconstruction image of three objects using (c) conventional multiple WRP method, (d) proposed method

Acknowledgment

This research was supported by the Korea government, under the ITRC (Information Technology Research Center) support program (IITP-2017-2015-0-00448) supervised by the IITP (Institute for Information & communications Technology Promotion). This work was also supported by Institute for Information & communications Technology Promotion (IITP) grant funded by the Korea government (No.2017-0-00417, Openholo library technology development for digital holographic contents and simulation).

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