Full-color high-definition CGH employing RGB color filters

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1. Introduction

For last several years, we have presented very large-scaled computer-generated holograms (CGHs) called high-definition CGHs (HD-CGHs), which reconstruct full-parallax high-quality 3D images[1-3]. However, these HD-CGHs could reconstruct only monochromatic images. Recently, we proposed the technique for their full-color reconstruction using RGB color filters and simulation to design appropriate filter properties[4,5]. The techniques make it possible to create high-quality full-color HD-CGHs[6].

2. Principle and techniques

Our HD-CGHs work well as reflection hologram because their fringe pattern made of Cr thin films. RGB color filters are attached to each RGB fringe block, as shown in Fig.1. Here, gaps of the fringe, called guard gap, are made for increasing position tolerances of the filters as in Fig.2. One of key techniques is to use a multi-chip type white LED for the illumination light source. Fairly narrow spectra are obtained from combination of the light source and filters, as shown in Fig.3 (b). We adopt a vertical stripe pattern for the RGB color filters in order to avoid overlapping light diffracted by the filters with the reconstructed object image, because the light source is usually placed below the object for gaining higher diffraction efficiency.

3. Optical reconstruction and conclusion

The RGB color filters used are fabricated by the same technique as that of LCD panels. The filter properties are shown in Fig.3 (a). These properties are designed through the simulation technique[4,5]. An example of optical reconstruction and parameters of the full-color HD-CGH is shown in Fig.4 and Table 1, respectively. The HD-CGH is composed of 16 G pix, the fringe pattern is generated by using the polygon-based method[7] and the silhouette method with the switch-back technique[3].

Table 1 Parameters of the fabricated HD-CGH

No. of fringe pixels	131,072 × 131,072
Pixels pitches	0.8 μm × 0.8 μm
Size	10.5 × 10.5 cm^2
Fringe type	Binary amplitude

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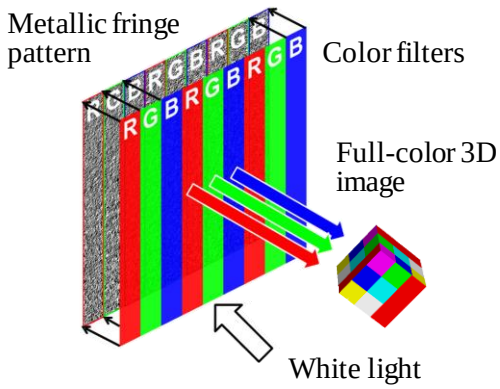

Fig.1 The principle of full-color CGH using RGB filters.

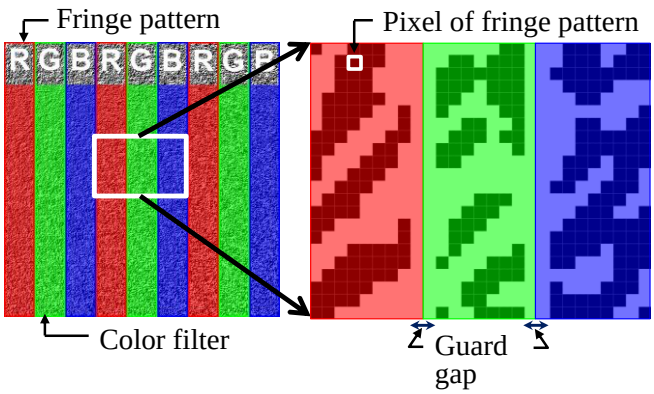

Fig.2 Color filters attached to the fringe pattern with guard gaps.

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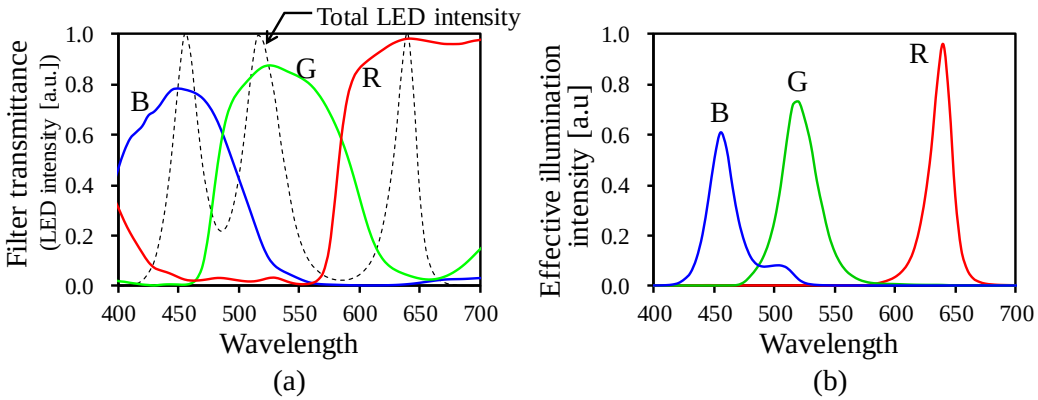

Fig.3 Spectra of (a) transmission of the fabricated RGB filter and (b) effective illumination estimated by the white LED spectrum used for the light source.

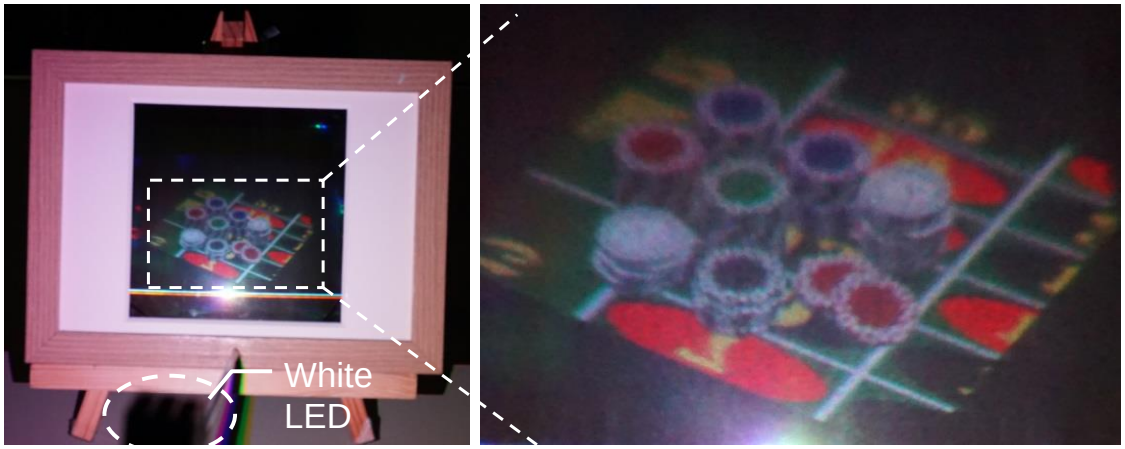

Fig.4 Optical reconstruction of a HD-CGH named 'Casino Chips'.