Holo-HMD and Remaining Issue

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1. Introduction

Recently, display devices of electro-holography that displays stereoscopic holographic video using digital technology have been prototyped. Especially, holographic head-mounted displays (Holo-HMDs) with light weight and small size have been developed. This paper explains Holo-HMDs, and discusses remining issues for the practical use.

2. Holo-HMD

A spatial light modulator (SLM) such as a liquid crystal display and a digital mirror device is used for a device displaying hologram data. There is the problem that the viewing zone and visual field became narrow, because the resolutions are not enough for hologram data. However, in holo-HMD use, it is possible to expand the visual field using a Fourier transform optical system.

Fig.1 shows our holo-HMD, which is a monocular system[1]. The size is 90mmx130mmx30mm, and the weight is 120g, the visual field is 8 degrees. The optical system is small and short, because it consists only a laser diode, a lens, an LCD, and mirrors. This is closed to practical use for augmented reality (AR).

Conventionally, complex optical system is used for an HMD due to eliminate optical aberrations, so it becomes large and heavy. Our system is used a single non-aspheric lens, because the aberration are corrected by the algorithm of hologram data calculation.

3. Remaining Issue

Speckle noise and calculation time are remaining issues for holo-HMDs to realize practical system.

Reconstructed images displayed by the holo-HMD show that speckle noise, which is a characteristic noise in holography, degrades the image quality. There are some methods to suppress the noise, such as using a special SLM or non-coherent lights, however these methods have some problems. We need a novel method to suppress the noise by improvement of the calculation algorithm of the hologram data.

Another problem is the large amount of calculation time of hologram data. With the development of GPUs, real-time is possible when an image consists several hundreds of points, it is possible to calculate in real-time. However, a realistic, complex scene takes a couple of second, not in real time.

References

[1] E. Murakami, Y. Oguro, Y. Sakamoto, "Study on Compact Holographic Head-Mounted Display for Augmented Reality," The 23rd International Display Workshops in conjunction with Asia Display 2016, 3Dp1/3DSAp1-10, Dec. 2016