Holographic Optical Elements Technology for Glasses-Free 3D Cinema

Ryo Sato, Koki Nakamura, Kai Sou, Yue Bao

***Abstract*— In autostereoscopic, it is still a major problem to provide parallax images for observation positions at different distances, as in 3D movie theaters. To solve this problem, "Cinema3D" has been proposed, but this system has the problem that the equipment is very complex and large. In this paper, we propose a method of creating a screen with holographic optical elements (HOEs) as pixels to reproduce light rays focused on the observation positions at different distances with a smaller and simpler device. Our experiment involved creating a diminutive prototype screen using HOEs as pixels, validating the effectiveness of the proposed method.**

Keywords: Autostereoscopic, Holography, Holographic Optical Element

I. Introduction

Stereoscopic display technology is widely used, especially in 3D movie theaters. In 3D movie theaters, 3D glasses are needed to provide parallax images to observers at different distances. For this reason, autostereoscopic technology is being researched. Currently, methods using observer tracking [1] and other methods have been proposed, but providing parallax images to observation positions at different distances, such as 3D movie theaters, is a major problem. To solve this problem, a system has been proposed in which an optical element such as a concave mirror is placed in front of the screen to focus light rays from each pixel to observation positions at different distances [2]. However, this method's equipment is very complicated and large. In this paper, we propose a method of creating a screen with Holographic Optical Elements (HOEs) as pixels to reproduce light rays that are focused on the observation position at different distances with a smaller and simpler device.

II. Proposed Method

HOEs can give functions such as splitting and focusing to the incoming light. In this paper, HOEs having a splitting function are used as pixels on the screen to reproduce light rays that are focused to enter both eyes of observers at different distances. By using multiple HOEs, parallax images can be provided for observation positions at different distances. An overview of the proposed system is shown in Figure 1.

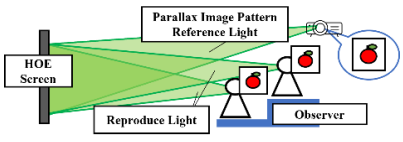

Figure 1. Observation in the proposed system

III. Experiment

we created a small prototype screen with HOEs arranged in a 2 x 2. Only a green laser is used to create the HOEs, and no lenses or other optical elements are used in its creation, so chromatic aberration problems do not occur. The reference light was irradiated to the created screen, and the reproduced results were taken from the focusing position. The shooting method and results are shown in Figure 2.

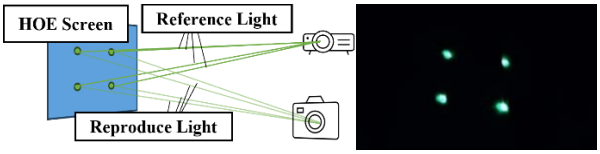

Figure 2. Shooting method and result

The rays from each of the four HOEs are focused on a single point and can be observed from that point.

IV. Conclusion

Current Autostereoscopic has the problem that it is difficult to provide parallax images for observation positions at different distances. Therefore, it is not available in movie theaters, where stereoscopic display technology is widely used. The method proposed to solve this problem, in which multiple optical elements are placed in front of the screen, has the problem of large and complex equipment. In this paper, we proposed a method of creating a screen with HOEs as pixels to reproduce light rays focused on the observation positions at different distances. Therefore, it was possible to provide parallax images to observation positions at different distances with the simple and compact display system consisting only of a screen and a projector. In the experiment, a small screen was prototyped, and it was confirmed that it could reproduce the light rays focused on the observation position. The results confirmed the principle of the proposed method. In the future, we will increase the number of HOEs and light focusing positions to enable the provision of parallax images and observation positions at different distances.

References

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Ryo Sato is specializing in Computer Science at the Graduate School of Tokyo City University, Japan (e-mail: g2281431@tcu.ac.jp).

Koki Nakamura is specializing in Computer Science at the Graduate School of Tokyo City University, Japan (e-mail: g2281448@tcu.ac.jp).

Kai Sou is specializing in Computer Science at the Graduate School of Tokyo City University, Japan. (e-mail: g2281435@tcu.ac.jp).

Yue Bao received a Ph.D. degree in systems innovation from Kanazawa University in 1996. He is currently working as a professor at the Graduate School of Integrative Science and Engineering, Tokyo City University, Japan. His research interests include three-dimensional display, computer graphics, and image processing. (email: bao@tcu.ac.jp).