Parallax Barrier 3D Display Full Panel Simulator based on Wave Optics

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1. Introduction

Recently, research on three-dimensional (3D) displays is underway using lenticular lenses or parallax barrier [1]. In general, design and simulation studies for 3D displays have been conducted based on geometric optics, which have fast calculation speed and intuitive visibility. However, diffraction occurs as pixel pitches of display panels become smaller and simulation tools based on current geometric optics are facing limitations. This paper introduces a simulation tool based on wave optics including diffraction that overcomes the limitations of usual 3D display panel analysis tools.

2. Parallax Barrier 3D Display Panel Simulator

There are two configurations of 3D display design panels to be analyzed in this paper, as shown in Fig. 1. Images on the parallax barrier 3D display can be seen separately from the left and right images using a slit. In addition, the parallax barrier 3D display is designed the display so that all images are visible from one point (i.e. human eye).

The difference between the two design configurations is the sequence of panels and barriers as shown in Fig. 1. The focus of this paper is to analyze how diffraction affects the full panel in order.

Because of each angle achieved from by eye and the pixel of structure is different, it is necessary to analyze the pixel – slit combination locally on the panel. Therefore, a radiant profile of local pixel – slit is obtained for panel characteristics and applied to the full panel.

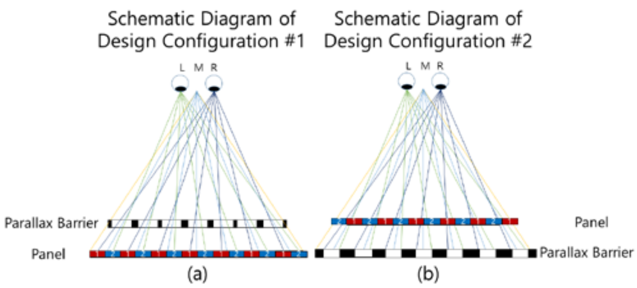

Fig. 1. Schematic diagram of design configuration (a) #1 BLU-Panel–Parallax Barrier, (b) #2 BLU-Parallax Barrier – Panel

Fig.2 shows results of the geometric and wave pixel simulator with a local calculated pixel – slit for configuration #1 and configuration #2. Geometric-based simulators do not contain diffraction, while wave-based simulators have results that reflect diffraction.

For all characteristics in the pixel-slit structure, a radiant profile with diffraction is obtained, and each result is used to expand to full panel simulation.

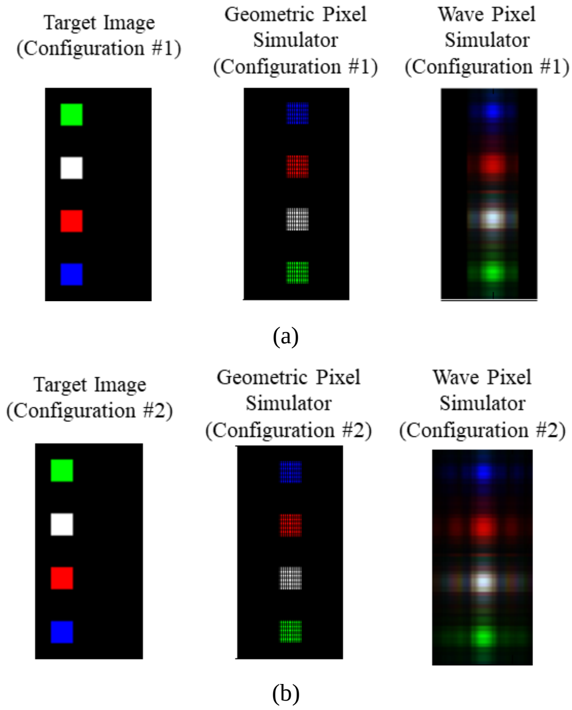

Fig.2 Geometric-wave radiant profile about (a) configuration #1, (b) configuration #2

3. Conclusions

In this paper, the full panel is used as a pixel to analyze how diffraction among pixels affects the results by obtaining a light distribution model in local units and applying the model to the full panel.

For the future work, we will compare the degree of diffraction according to various factors such as pixel pitch of pixels, aperture ratio of slits, and pitch of slits.

Acknowledgements

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References

[1] H. Kim, J. Hahn, and B. Lee, “The use of negative index planoconcave lens array for wide-viewing angle integral imaging,” Optics Express, vol. 16, no. 26, pp. 21865-21880, 2008.