

Multi-layered aerial images formed by AIRR and a light-field display

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1. Introduction

Aerial imaging is no longer technology seen in the movies, but are beginning to be used in various areas of real life, such as advertisements, entertainment and operating devices. One of methods to form such aerial images is aerial imaging by retro-reflection (AIRR) [1]. In this paper, we proposed the device that enable us to see the multi-layered aerial image which pops up from the display, by using AIRR with a slit-shaped retro-reflector and a light-field display.

2. Principle

Fig. 1 showed the principle of our proposed device. Conventional AIRR was composed of three elements: light source, retro-reflector and beam splitter. In our method, these elements were replaced with a light-field display, retro-reflector which has slit-shaped holes and is covered with a quarter-wave retarder, and reflective polarizer [2]. A light-field display enables us to see the three-dimensional object without dedicated glasses. By forming the image of light-field display with AIRR, we can make the floating aerial image which seems to have the depth. Moreover, to increase the visibility of aerial images, we made the display invisible from the front by disposing the polarizer and the reflective polarizer in a cross Nicol arrangement.

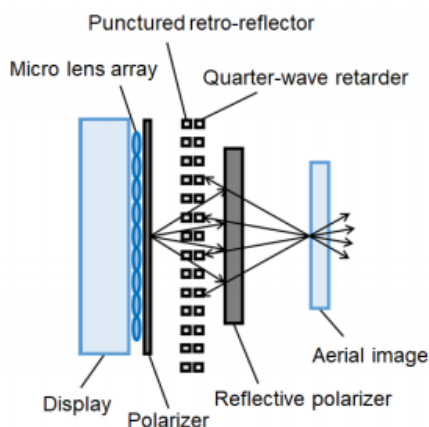


Fig. 1 Aerial imaging system using AIRR and light-field display.

3. Result

Using this system, we succeeded to form two aerial images which pop up from the display but have the different distance from the display (Fig. 2). However, the problem that moiré fringes occur when we change observation

distance also became clear. The light-field display has hexagonal lenses arranged in a honeycomb structure. There is a non-light emitting area at the edge of each lens, which makes dark lines. The interference between these lines and the regular pattern of slit-shaped holes of retro-reflector results in visual stripes. Moiré does not occur in the sweet spot where these periods are perfectly matched, but it is very difficult to maintain this state in the situation that the user's viewpoint can change laterally. Further study is necessary to remove moiré fringes, by changing the hole shape of retro-reflector.

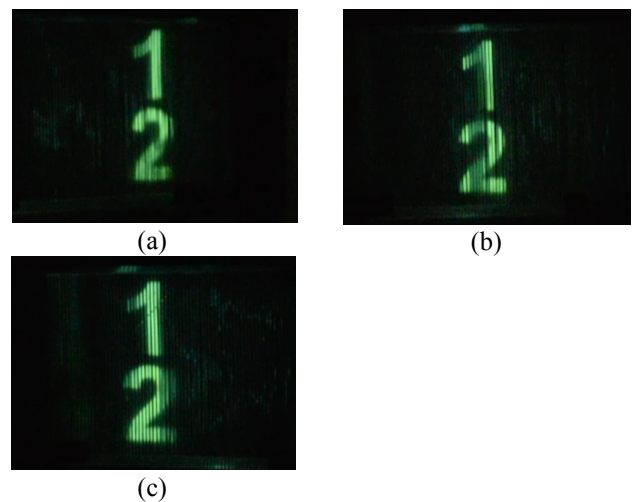


Fig. 2 Aerial images seen from (a) the left, (b) the front and (c) the right.

4. Conclusion

By integrating the light-field display and AIRR, we succeeded to form multi-layered aerial images which pop up from the display. Removing moiré fringes remains as a problem to be solved.

References

- [1] H. Yamamoto, et al., Opt. Exp. 22, 26919 (2014).
- [2] M. Nakajima, et al., Proc. IDW '15, FMC5-3 (2015).