Practical 3D+2D Displays

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Problem

Most commercially available 3D displays show stereoscopic images to viewers wearing special glasses, while showing incomprehensible ghosted images to viewers without glasses. It is not always desirable to require that all viewers wear stereo glasses. They may cause flickering, interfere with other activities and be prohibitively expensive.

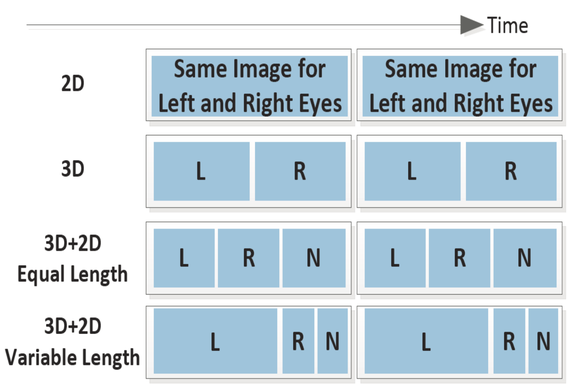
Simultaneous 3D+2D Display

Our method enables stereoscopic 3D displays to be watched by 3D and 2D viewers simultaneously. Ghosted images that observed on traditional 3D displays can be eliminated for viewers without stereoscopic glasses while 3D perception is preserved for viewers with glasses.

Left eye image Right eye image Negative Right image

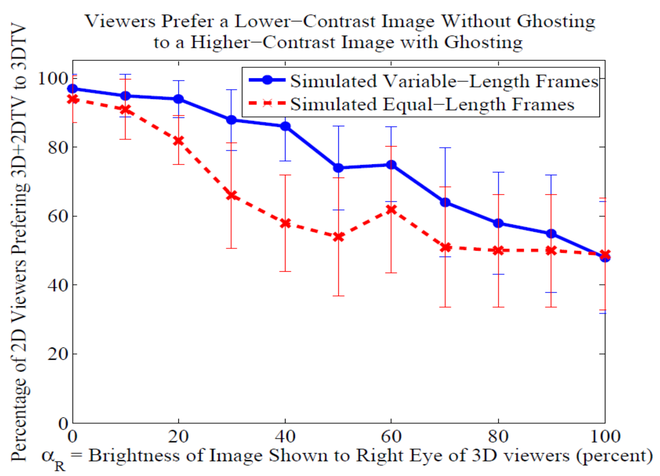
Standard 3D Display Our 3D+2D Display

Our 3D+2D display adds a third image (N) to each frame, shown to neither eye of the viewer with glasses, but seen by both eyes of a viewer without glasses. This third image is used to display the negative of the Right image, leaving them a low-contrast version of the Left image.



2D Viewer Preference

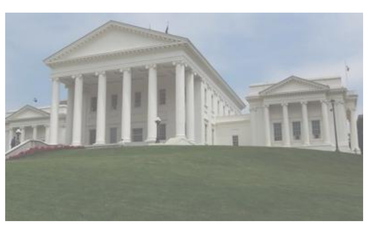
Contrast Ratio Reducing brightness of right eye image (α_R) can help improve contrast ratio for 2D viewers. But if α_R is decreased too much, the 3D experience of viewers with glasses will deteriorate.



Ghosting-control weight Even though viewers prefer contrast loss over fully ghosted image, the contrast loss is also undesirable. Thus we investigated the optimal trade-off between contrast loss and ghosting for 2D viewers. The image that 2D viewers see can be represented as:

$$[Left] + \alpha_R \cdot [Right] + w \cdot [Neither]$$

Fully Ghosted

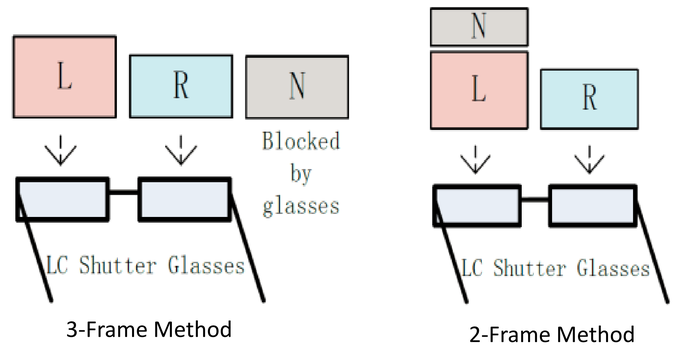


Low Contrast

With Ghosting-control weight

Two Frame Approximation

The three frame method is ideal, but can not be implemented without hardware modification. The following figure shows an approximation for standard 2-frame displays. The image (N) is simply added to the [Left] image slot.



This introduces negative crosstalk into the [Left] image. However, our display, like many existing stereo displays, has noticeable positive crosstalk due to hardware limitations. Since the negative and positive crosstalk cancel, this results in total crosstalk to the left eye only a little greater than the standard level. Test users have found the 3D image quality acceptable.

Look through Left Lens with 3-Frame Method

Look through Left Lens with 2-Frame Method

Reference

SCHER, S., LIU, J., VAISH, R., GUNAWARDANE, P., AND DAVIS, J. 2013. 3D+2D TV: 3D DisplaysWith No Ghosting for Viewers Without Glasses. ACM Trans. on Graphics (@ SIGGRAPH13).