3D image reveals a novel perceptual phenomenon

Kazutake Uehira

Apparent fusion of two 3D images into one when displayed on a pair of stereoscopic screens is governed by binocular disparity and image intensity.

Creating 3D images for future media and technologies has long been a subject of active study. Understanding how the human visual system copes with 3D problems is an important part of this research. We previously reported a depth-fused 3D (DFD) display based on the discovery of a new perceptual phenomenon induced by human binocular vision. The DFD system comprises two 2D displays arranged at different depths. The images on the screens differ only in their luminance (intensity). When they are viewed as completely overlapping, the images are seen as a single image located between the two displays. The perceived depth of the fused image depends on the luminance ratio of the two images. In other words, an apparent 3D image can be produced anywhere in the space between the front and back displays by changing the luminance ratio at each pixel.

Here we describe a new type of DFD display based on stereoscopic rather than 2D screens (see Figure 1). We wished to find out whether two 3D stereoscopic images shown at different depths would elicit the same perception as a conventional DFD display. We also wanted to understand what factors influence the perceptual process.

Subjective tests of this display revealed that two similarly shaped 3D images on stereoscopic displays did indeed blend when they overlapped. Figure 2 shows the perceived depth of the fused image obtained in the test. The impression turns out to depend on both the luminance ratio of the images and the different vantage points of the viewer’s two eyes (binocular disparity).

These factors are decoupled in the 3D display, whereas in a standard DFD system they are not. This decoupling separates disparity-related depth from focus-related depth, since the focal cue continues to determine the actual distance to the screen. We concluded that DFD perception is dominated by the effects of...
binocular disparity and image intensity, that is, the influence of the depth of focus is much weaker. As a next step, we intend to clarify what the human visual system actually focuses on when looking at a fused 3D image.

Author Information

Kazutake Uehira
Kanagawa Institute of Technology
Atsugi, Japan

Kazutake Uehira received his BS and MS in electronics in 1979 and 1981, respectively, and his PhD in 1994, all from the University of Osaka Prefecture, Japan. He joined NTT Electrical Communication Laboratories in Tokyo in 1981. Since then he has been engaged in research and development on image acquisition technologies, and display and high-reality video communication systems. He joined Kanagawa Institute of Technology as a professor in 2001 and is currently engaged in research on 3D displays and 3D video communications.

References