NEWS RELEASE

NTT

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NTT Discovers a New 3-D Perception Mechanism for Displaying 3-D Images

NTT has discovered a new perception mechanism in the displaying of 3-D images. As illustrated in Fig. 1, it was discovered that a depth is perceived when multiple copies of the same image with varying luminances are superimposed on top of one another.

Figure 2 shows a prototype of 3-D display constructed by NTT to verify the new mechanism. Some of the advantages of this 3-D display are that it does not require any special 3-D glasses, it provides a more naturalistic perception of depth and thus does not cause viewer fatigue, and it can be built from existing components that are readily available. A 3-D display based on the new perception mechanism would clearly have enormous potential for supporting image communications that convey a more realistic sense of presence. This capability could be applied to 3-D television and games, all sorts of simulators, electronic museums and exhibits, and many more potential applications.

I . Research background

Present-day 3-D image display technology researchers are focusing on the development of display systems that provide a high reality image. The most wide-spread approach uses the physiological depth cue of binocular parallax (see Defining terms below), such as represented by 3-D display systems requiring that the viewer ware special shutter glasses. In this approach, data is presented in two fields, one containing the data for the image to be seen by the left eye and the other containing data for the image to be seen by the right eye. The LC shutter glasses provide vision alternately to each eye, thus giving the viewer a sense of visual depth and three-dimensional movement. The main problem with this approach is that, even though the viewer's eyes remain focused on the screen, the position of the image is displaced. This creates a certain amount of physiological unnaturalness and inevitably causes viewing fatigue.

Recently this has led 3-D display researchers around the globe to turn their attention to the development of display systems exploiting accommodation as a physiological depth cue in addition to binocular parallax.

NTT has identified naturalistic 3-D image display technology as critically important for the development of video communications that convey a more realistic sense of presence, and the development of 3-D video display capability that is indistinguishable from the real thing is the goal of an intensive R&D effort. As part of the company's on-going investigation of how the human visual system interprets depth, NTT researchers discovered the new mechanism of 3-D image display described in this news release.

Following up on this promising approach, NTT constructed the prototype 3-D display illustrated in Fig. 3, that exploits the physiological depth cue accommodation in addition to binocular parallax.

II . Characteristics of the new perception mechanism

There are two salient aspects of the newly discovered perception mechanism:

(1)First, when two same images are superimposed with a space between them in the depth direction, they are perceived not as two separate images to the viewer but rather as a single depth-fused image.

(2)Second, by varying the luminance ratio of the two images, the perceived depth of the depth-fused image can be changed at will.

In applying this novel perception mechanism to two-way video communications, it only requires about 1.3 times the data volume of present video streams to support regular TV picture quality, and thus it could be readily delivered over public networks.

III . Future developments

Using the prototype 3-D display system, NTT will continue to seek a better theoretical understanding of the new physiological depth cue, while investigating ways to achieve sharper resolution, larger screen sizes, and ways to exploit monocular movement parallax and other depth cues.

- Defining terms

Figure 4 illustrates how the four physiological depth cues-binocular parallax, accommodation, convergence, and movement parallax-work, that enable the human visual system to interpret depth in sensed images.

- Binocular parallax: As our eyes view an object from slightly different locations, the images sensed by the eyes are slightly different. This differences in the sensed images is called binocular parallax.

- Accommodation: Accommodation refers to the tension of the muscle that changes the focal length of the lens of eye. It thus brings objects into focus at different distances.

- Convergence: When watching an object close to us, our eyes point slightly inward; this difference in the direction of the eyes is called convergence.

- Monocular movement parallax: If the viewer moves his head, he can perceive depth because the human visual system can extract depth information in two similar images sensed after each other in the same way it can combine two images from different eyes.

The practical 3-D displays that have been developed so far only exploit binocular

parallax and convergence. Since people use all available internal and external cues in their perception of depth and three-dimensionality, we should be able to build a 3-D display that provides a more naturalistic sense of visual depth and three-dimensional movement by incorporating all four physiological depth cues.

- Figure 1 The new perception mechanism for 3-D display
- Figure 2 Basic configuration of prototype
- Figure 3 Comparison with existing technologies
- Figure 4 Physiological depth cues
- Milestones in 3-D display technology

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