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Commentary on High-Performance Computing and Human Vision I: Perception of visual space

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The presentation by Kersten (1997) demonstrated that changes in the shadow cast by an object are sufficient to produce perception of that object moving in depth. Cutting (1997) characterized many of the pictorial depth cues first described by Leonardo da Vinci. In generating effective virtual reality, we need to understand these perceptual cues.

The presentations by Cutting (1997) and Kersten (1997) deal with the study of visual space perception. They both focus on the sensitivity that we have to static monocular or pictorial cues for depth and spatial layout. Cutting characterizes and demonstrates the effectiveness of many of the pictorial depth cues first described by Leonardo da Vinci in the early 14th century.

In his oral presentation, Cutting ingeniously demonstrated the effectiveness of these cues by presenting slides of paintings that all included a view of the Eiffel Tower. His primary point was that different cues specify layout at different distances. A few cues, such as the T-shaped intersection of contours, may be a clue for the interposition of surfaces at any distance. In contrast, other depth cues, such as binocular disparity, are primarily useful in the near space that we can contact by reaching. This taxonomy of cues seems less a consequence of psychological processes than the result of physical optics.

One connection between this work and high-performance computing rests in the expanding technology of "virtual reality." It can be argued that those who wish to create effective virtual reality displays must understand the sensitivity of our visual systems to the various sources of information for layout. While binocular disparity is essential in creating the impression that one is viewing an object a meter away, one can safely present both eyes with the identical image when a distant vista is being presented. This approach would be required if the virtual reality display was painted by hand. Increasingly, the technology of computer graphics is being used to automatically calculate the correct binocular disparity, relative size, and shading. Programs such as POVray and Wavefront use a description of a physical layout, a lighting environment, and a viewer's location to generate a highly veridical image that requires no knowledge of the psychology of perception on the part of the user. At present, limitations in computational speed force users to select some cues and omit others on the basis of knowledge of how important a cue is for a particular scene.

Kersten's presentation demonstrates the power and effectiveness of computer graphics programs for the study of visual perception. His displays were used to demonstrate that the changing position of a cast shadow can generate the perception of an object's rising and falling in space. The animated shadow changes were calculated by a computer graphics program and are highly realistic. As a tool, computer graphics gives us the ability to generate, for example, very realistic cast shadows, but also to see just how unrealistic the shadow can be and still function to anchor an object to a part of a surface other than that which it covers. Kersten's work argues persuasively that the visual systems accept a wide range of "objects" as anchors. As a tool for exploring visual perception, computer graphics programs that reflect the laws of optics will clearly become increasingly important in the future.

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