An Interactive Multi-User Holographic Environment

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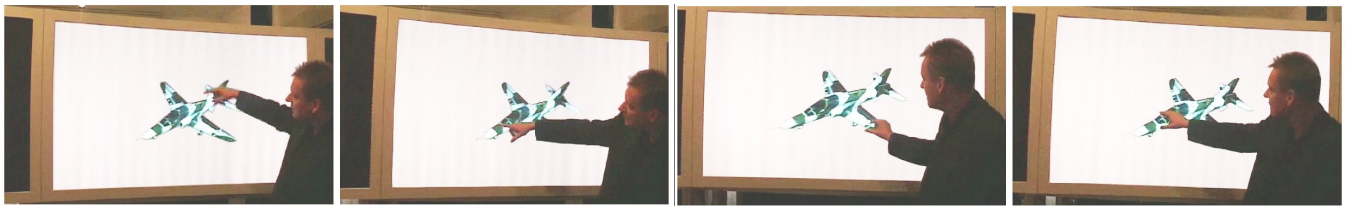

Abstract

We present an interactive multi-user holographic environment that allows freely moving naked eye participants to share a large 3D scene with fully continuous, observer independent, parallax.

CR Categories: B.4.2 [Input/Output and Data Communications]: Input/Output Devices—Image Display

Keywords: Interactive displays, Imaging technology, VR

1 Installation description

Introduction. Our installation is a demonstration of the capabilities of a unique large scale holographic system designed for multi-user interactive applications. Our custom 50Mpixel display (1600x900mm screen) is capable of recreating the illusion of seeing virtual objects floating at fixed physical locations. The display is truly multi-user and does not require wearing any kind of device. Each viewer sees the scene from its point of view and enjoys full horizontal parallax. The number of simultaneous viewers is only limited by available space. One user at a time is able to manipulate displayed objects through a 3D deviceless interface. Timing constraints when manipulating large scale detailed objects are met by employing advanced multiresolution techniques.

The technology behind the show. Our holographic environment is a unique combination of optimized optical design, commodity hardware technology, and parallel multiresolution graphic technology. The display's overall 50M pixels originate from the 64 XGA (1024x768) projectors densely arranged behind a holographic screen. All of them project their specific image onto the screen to reconstructs the light field of 3D scenes. The screen is a holographically recorded, randomized surface relief structure that enables high transmission efficiency and controlled angular distribution profile. These fully randomized (nonperiodic) structures are non-wavelength dependent and eliminate moiré, without chromatic effects. The result is a homogeneous light distribution and continuous 3D view with no visible crosstalk within the field of depth determined by the angular resolution. Further technical details on the display are available elsewhere [Balogh et al. 2006]. Providing each projector of the holographic display with the continuous flow of images needed to reconstruct a moving 3D scene is a computationally relevant task. In the 50 Mpixel system, this is accomplished by a dedicated cluster in which each PC generates multiple XGA images using double head NVIDIA boards. The application used for demonstrating the display allows an unlimited number of users to see complex objects and offers a natural direct 3D manipulation interface to move and scale them. Timing constraints when manipulating large-scale objects (e.g., detailed laser scans) are met by employing advanced multiresolution visualization techniques [Cignoni et al. 2004]. The application is driven by a markerless, vision-based hand tracking system. The use of intuitive one- and two-handed gestures for interacting with models enables users to exploit powerful natural 3D interaction metaphors from everyday life (such as grabbing objects to move them).

Conclusions and future work. This emerging technology demonstration clearly shows that it is now possible to build large-scale 3D interactive displays providing consistent, shared, three-dimensional dynamic information to a group of users. This is clearly a significant step forward in display technology and it paves the way to novel applicative approaches to complex cooperative tasks, such as, for example, the design of intricate manufactured objects or the understanding of complex simulation results. It goes without saying that we expect that this technology will also have interesting applications in many other domains, including entertainment, art, and cultural heritage (e.g., museum exhibits). It should also be mentioned that, according to "Star Trek, the Next Generation", HoloDeck technology, which will combine transporter, replicator, and holographic systems will be common by the 2360s. In the next three centuries or so, we'll have some time to focus our work on the transporter and replicator components.

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