HoloTV Images Jump off the Screen, into Tomorrow's Homes (w/Video)

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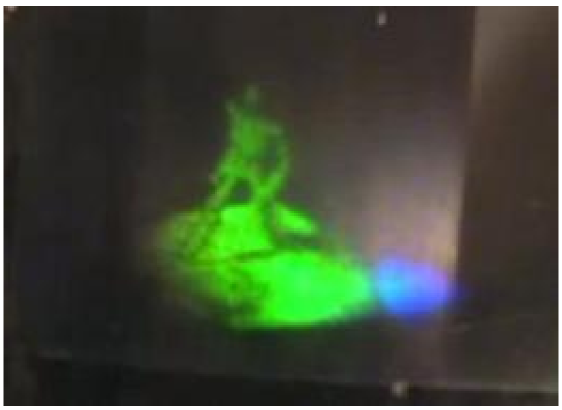

A holoTV image of a man walking appears in front of a transparent screen. Excerpt from video below. Credit: José J. Lunazzi, et al.

(PhysOrg.com) -- Unlike today's biggest and most realistic LCD and plasma TVs, 3D TV screens can project images that seem to float in mid-air beyond the screen. That means, for instance, that viewers could watch basketball players dribble in front of, next to, or behind the TV screen as they go for a lay-up.

In a recent study, a team of researchers has developed a type of 3D TV system called "holoTV," which works a bit differently than a standard holographic TV system. The holoTV system projects a video scene or animation onto a white-light screen, creating an image that appears to float in front of the screen. Viewers don't need to wear special goggles to view the floating images, which have the appearance of volumetric images, although the system is not volumetric. The scientists, from the University of Campinas in Sao Paulo, Brazil, and the High Polytechnic Institute José Antonio Echeverría in Havana, Cuba, have published their study in a recent issue of *Optics Letters*.

"3D TV is a general term, which can be applied to all systems where depth is perceived, but usually requires goggles," lead author José Lunazzi, a professor at the University of Campinas, explained to *PhysOrg.com*. "Only holoTV and holography have continuous parallax, which means that when the observer moves his head, he can see different views without discontinuities."

As Lunazzi explained, holography is academically defined as an object's light wave interfering with a reference wave. One proposed technique for holographic TV involves using a laser to render the images, as in conventional holography, but registering electronically. However, this scheme requires the detection to have 10 times more resolution than is currently available, even to produce very small images, making holographic TV impractical for now.

In contrast, Lunazzi and his colleagues refer to their technique as holoTV, a term they adopted in 1990. Unlike holographic TV, holoTV doesn't involve a reference wave. Instead, as in the researchers' current holoTV system, holographic images are created from projection in a diffractive screen made by the splitting and subsequent interference of a light beam on a holographic film.

"3D images are impressive when they appear in front of a support, like ghosts which your hand goes through," Lunazzi said. "These images are often named 'floating images,' which don't require goggles. The support may be so transparent that it is not perceived. Other systems show images on transparent screens which are 2D, and to be more impressive they say 'holographic images' when they are actually 'ghost images.' These can be of large size, as seen in shows, but viewers who are close can notice the lack of depth."

In the researchers' set-up to make the screen, a laser emits a beam that is divided in two by a beam splitter. One of the beams is reflected by a mirror and then reaches a spatial filter, which causes the beam to diverge. The second beam travels through a cylindrical lens that causes that beam to diverge in only one direction, and then passes through a diffuser.

Then the two wide beams intersect at a 45° angle, and their interference is recorded on a holographic film, which becomes the 60cm x 30cm screen. When projecting on the screen, each wavelength of the white-light beam converges at a different position beyond the screen, so that a viewer's left and right eyes receive light at different wavelengths (different colors), each composed of many beams converging toward the eyes. The projection makes each eye receive a different view to compose the scene as a natural one.

Using a diffraction grating, the researchers demonstrated how to project the image in front, behind, or next to the screen. The diffraction causes a blur on the screen, and the wider the blur, the greater the distance between the image and the diffraction grating - and the greater the depth of the image. One example the researchers demonstrated is an image of a man walking, which is projected 27cm in front of the screen. When sitting 140cm from the screen, a viewer would have a narrow field of view of 24cm (or 11°), enough to accommodate small head movements.

"Two or three persons can watch, in fact, if seated along a line," Lunazzi said. "To achieve a larger angle, greater diffractive power is needed and could be obtained by larger interference angles on the recording of the screen. New materials should in fact be used to obtain higher diffraction efficiency to reduce the effect of the ambient light." The researchers have already constructed improved screens, and plan to publish the results in upcoming papers.

Many other recent studies have been investigating 3D TV technology, which is already commercially available in Japan, although viewers must wear goggles. There is still limited viewing content, since only specially recorded shows can be viewed on 3D TVs: a scene must be filmed from many sides and then incorporated into a single image to be projected in 3D. Ideally, a holoTV would produce floating images that can be viewed at any angle, be updated quick enough to allow for smooth TV viewing, and be affordable. Whether hung flat on a wall or set like a checkerboard on a coffee table, holographic and holoTV displays could bring TV action into the living room.

Besides TV, other applications could include 3D advertisements in department store windows, as well as medical uses. For example, surgeons currently need to take multiple 2D scans to view organs from different angles, but 3D imaging could give them a fuller, more realistic view.

More information: José J. Lunazzi; Daniel S. F. Magalhães; Noemí I. R. Rivera; and Rolando L. Serra. "Holo-television system with a single plane." February 15, 2009 / Vol. 34, No. 4 / *Optics Letters*.