



Rewritable holograms, such as these, could allow three-dimensional rendering of battlefields and other military command-and-control applications. Courtesy of Nasser Peyghambarian group, University of Arizona.

### The eye of the beholder

No matter how advanced the sensor technology, what is captured ultimately must go through the eye. Researchers are working on ways to present increasingly complex information without burdening soldiers unduly.

Nasser Peyghambarian, a professor of optics at the University of Arizona in Tucson, published results a few years ago (see "Coming Attractions: Holographic Movies," *Photonics Spectra*, April 2008, p. 94) about holographic technology that allows scenes to be presented in three dimensions, without the need for special glasses. At the time, it took several minutes to record a scene.

That is too slow for an application such as the depiction of a battlefield or other command-and-control applications, Peyghambarian said. "Video rates may not be needed, but it needs to be pretty fast."

He reported that his group had been working on the problem and should have new results out soon. Although he declined to give exact figures, he did say that these would show fast update times, perhaps fast enough to be useful.

Finally, there are microdisplays that use tiny chips near the eye to create a virtual image with the effect of a regular screen some distance away. In this way, a soldier can effectively carry a high-resolution screen in something the size of a postage stamp.

Kopin Corp. of Taunton, Mass., is

developing a  $2048 \times 2048$ -pixel device for the US military, said to be the world's highest-resolution microdisplay. Antonio V. "Tony" Bacarella, director of business development for the company's visual products group, noted that military applications demand higher imaging system performance than commercial ones. They typically require fewer cosmetic defects, higher contrast and more brightness uniformity.

They also must work in extreme cold. For that reason, Kopin uses three methods in its devices to maintain operation at very low temperatures. Two of the techniques, which were developed for commercial digital cameras, are integrated in the display backplane, allowing near-instant-on operation, despite the cold.

As can be seen, the company's military and consumer products do share some technology. Another example is found in the high-resolution microdisplay under development. Its increase in pixel count has been accomplished by a decrease in pixel size, and those smaller pixels are showing up in some commercial products.

Bacarella declined to give specifics about the new technology but did offer a comparison to older products that shows where things are headed. In talking about pixel size, he said, "When you go back a couple of years, the standard was fifteen microns. Now you're looking at pixels that are subnine microns."

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