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Dixon Dudderar holds the end of the bundle of optical fibers which transmits holographic data from the circuit board under observation. The end of the fiber optic strand carrying the illumination beam from the laser can be seen at right foreground.

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A technique for transmitting holograms under water, around corners and even through solid obstacles has been demonstrated by AT&T Bell Laboratories scientists. Researchers can use the technique to observe the unfolding of events such as the effect of vibrational stress on remote and otherwise inaccessible objects.

A major advance in holographic interferometry, the technique uses optical fibers to illuminate the hologram subject and to transmit the holographic data.

Holographic interferometry is a special branch of holography—the science of three-dimensional photography. Its uses include measurements requiring millionths-of-a-meter accuracy and detailed studies of very fine structures.

"We've taken essentially off-the-shelf communications systems components and integrated them in a new way to do things we couldn't do before," said Dixon Dudderar of the Metallurgical Engineering Department at Murray Hill.

"Fiber optics were developed for large-scale systems and also are widely used in instrumentation," he said. "We've scaled the application to holographic interferometry, giving us an extremely sensitive tool for probing situations that have been unreachable. And the real-time feature lets us watch strains develop—in a VLSI chip, for example."

The fiber optic links allow the holograms to be made with no constraint on the relative locations of the laser, the subject and the hologram plate. Loops or bends in the fibers do not impede the illumination of the subject or the transmission of the hologram. Reference and illumination beams are carried over single strands of fibers; the hologram data is transmitted from the subject over a bundle of fibers.

The bundle consists of thousands of fibers arranged so that the array of fibers at one end of the bundle is a mirror image of the array at the other end. This is necessary to preserve the left-to-right coherence of the holographic data transmitted from the subject to the hologram plate.

In one use of the new technique, Bell Labs researchers studied the mechanics of thermal deformation that affects solder posts when power is applied to leadless ceramic chip carriers on a printed wiring board. Leadless carriers may be widely used in the microelectronics industry when problems such as thermal deformation are solved.

Image bundles of multimode fibers are regularly used in medical and industrial instruments such as endoscopes, cystoscopes and boroscopes. "Holographic interferometry would benefit from the greater stability of single mode fibers, however," Dudderar said. Multimode or single mode fibers can be used for both reference and illumination beams.

The technique was conceived by Dudderar and John Gilbert, Department of Civil Engineering, University of Wisconsin—Milwaukee. **—M.N.**