A proposed holographic memory system would be capable of storing data at unprecedentedly high density, and its data-transfer performance in both reading and writing would be characterized by exceptionally high bandwidth. The capabilities of the proposed system would greatly exceed even those of a state-of-the-art memory system, based on binary holograms (in which each pixel value represents 0 or 1), that can hold ≈1 terabyte of data and can support a reading or writing rate as high as 1 Gb/s.

The storage capacity of the state-of-the-art system cannot be increased without also increasing the volume and mass of the system. However, in principle, the storage capacity could be increased greatly, without significantly increasing the volume and mass, if multilevel holograms were used instead of binary holograms. For example, a 3-bit (8-level) hologram could store 8 terabytes, or an 8-bit (256-level) hologram could store 256 terabytes, in a system having little or no more size and mass than does the state-of-the-art 1-terabyte binary holographic memory.

The proposed system would utilize multilevel holograms. The system (see figure) would include lasers, imaging lenses and other beam-forming optics, a block photorefractive crystal wherein the holograms would be formed, and two multilevel spatial light modulators. The proposed system would greatly exceed all state-of-the-art holographic memory systems, both in storage density and in data-transfer performance in both reading and writing, by orders of magnitude.
in high-speed input conversion of data up to 12 bits. For readout, the system would also include two arrays of complementary metal oxide/semiconductor (CMOS) photodetectors matching the spatial light modulators. The system would further include a reference-beam-steering device (equivalent of a scanning mirror), containing no sliding parts, that could be either a liquid-crystal phased-array device or a microscopic mirror actuated by a high-speed microelectromechanical system. Time-multiplexing and the multilevel nature of the DMDSLM would be exploited to enable writing and reading of multilevel holograms. The DMDSLM would also enable transfer of data at a rate of 7.6 Gb/s or perhaps somewhat higher.

This work was done by Tien-Hsin Chao of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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