Encrypted holographic storage using double-phase encoding technique

Tien Viet Vu, Nam Kim, Seok-Hui Jeon*

Department of Information and Communication Engineering, Chungbuk National University
*Department of Electronics Engineering, Incheon University

tienvv@osp.chungbuk.ac.kr

Several encryption techniques were successfully applied to secure holographic memory systems.[1,2] In these systems the reference beam, object beam, or both can be encoded optically. Optics provides many degrees of freedom with which the optical beam may be encoded, such as amplitude, phase, wavelength, and polarization.

To increase the data rate in holographic memory systems, some authors proposed and successfully demonstrate a novel dual-channel holographic recording technique,[3] in which the holograms of the two channels can be operated simultaneously in both the recording and the retrieving processes. The simultaneous nature of this scheme provides the ability for the users to interact with the storage medium from an additional channel, and offers a faster data transfer rate. Two orthogonally polarized beams carrying data of two channels are multiplexed as a composite signal beam. Two separated reference beams with orthogonal polarization states are employed to generate two interference patterns with the two signal beams.

In this paper, we proposed a new dual-channel holographic recording technique in which the simultaneous nature is guaranteed and a secure part is employed to prevent users from unauthorized accesses. The setup implementing the technique is show in Fig. 1.Two polarizing beamsplitters PBS1 and PBS2 are used to create three beams, two signal beams and one reference beam. The information of two channels generated by two amplitude-based spatial light modulators SLM1 and SLM2 is imprinted on the two signal beams. Since only one reference beam is required, we employ the reference beam encoding configuration for security purpose to simplify the setup. The encoding technique is realized by use of a random phase mask PM that is placed on the reference beams. Three lenses locating on the three beams produce Fourier-transforms of the information and the mask. The reference beam is normal to the storage medium while the two

signal beams are symmetric with respect to each other by the axis of the reference beam. The intensity of the three beams can be adjusted by use of two halfwave plates WP1 and WP2. The polarization of the reference beam is controlled by the halfwave plate WP3. The role of the two lenses behind the storage medium is to inverse Fourier transforms the information carried in two reconstructed beams. The resulting information is captured by two CCD cameras CCD1 and CCD2.

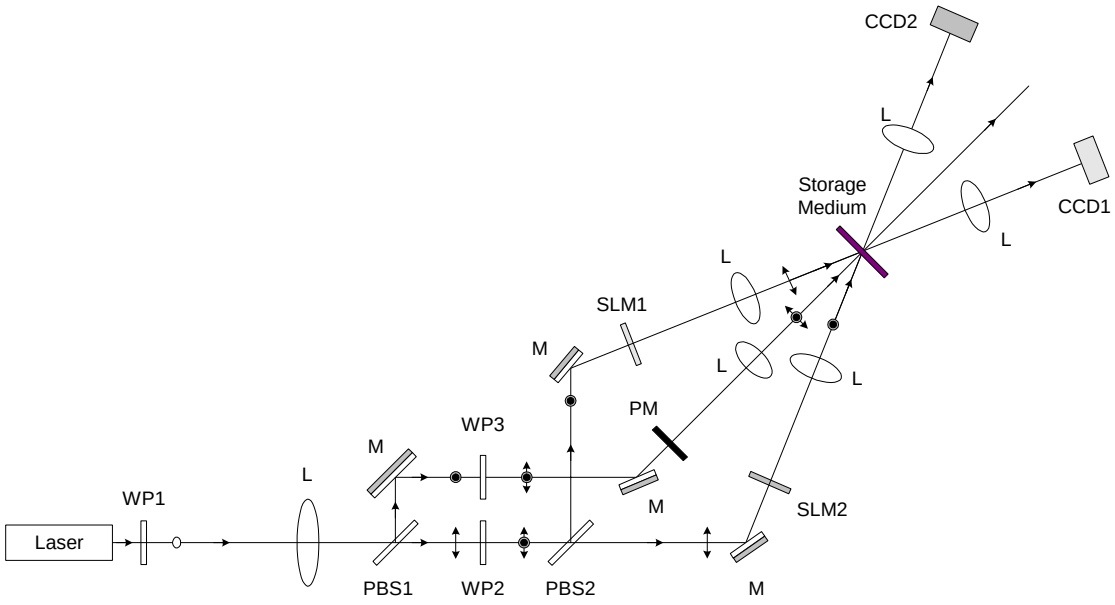

Figure 1. Secure dual-channel holographic memory system.

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References

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