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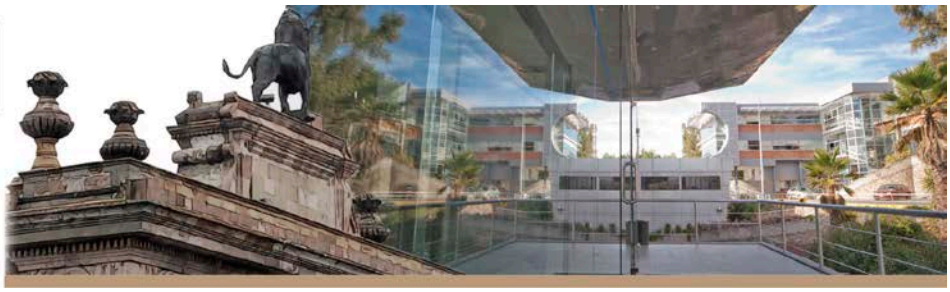

Polarization Holography and its Application to Optical Mass-Storage

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ABSTRACT:

Holographic data storage is one of the most promising techniques in future mass-storage systems after Blu-ray Disc, since it has excellent features, such as storage capacity, access speed, energy consumption, cost and so on. An optical storage system with 3 Gbyte/disc of storage capacity and 3 Gbit/sec of access speed is developing. Angular and shift multiplexing techniques are developed to increase storage capacity. In this paper, an alternative approach to increasing storage capacity is proposed, in which polarization information in vector wave of light is employed.

Recently, retardagraphy that is an optical recording technique with a single beam was proposed as an application to optical storage by the authors. In the retardagraphy, a retardance pattern of a birefringent object can be recorded on a polarization-sensitive medium as a recording medium. In other words, a pattern of the phase difference between two orthogonal polarization components of a vector wave can be recorded. In the conventional holography, a recording laser beam must be split into a signal beam and a tilted reference beams. In contrast, the retardagraphy employs the in-line recording setup so that the optical system for recoding and reading is very simple and robust for environmental turbulence.

Off-axis holography is also discussed for optical mass storage systems. In this architecture, angular-multiplexing and shift-multiplexing techniques in volume holographic recording are employed to increase data capacity. Since two orthogonally polarized beams are superimposed on a polarization sensitive medium with different incident angles, polarization states inside medium is described not with the Jones vector theory but also a tensor theory. A general theory of volume-type polarization holography is discussed. A dual-channel holography is also presented.

Binary and multi-level phase patterns displayed by a parallel-aligned liquid crystal spatial light modulator (PAL-SLM) were recorded on the polarization-sensitive medium, such as azo-benzene polymers, PQ-PMMA and AK1. An imaging polarimetry system measured retardation between two orthogonal polarization components of reconstructed images. In experiments, orthogonal polarization-, 400-time-angular- and 100 micron shift-multiplexing were combined and successfully performed in vector-wave recording.

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