Optimization of a holographic memory setup using an LCD and a PVA-based photopolymer

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Abstract

Holographic data pages were stored in a polyvinyl alcohol (PVA)/acrylamide (AA) photopolymer. This material is formed of AA photopolymers which are considered interesting materials for recording holographic memories. A liquid crystal device was used to modify the object beam and store the data pages in the material. During the storage process, some parameters like exposure time, beam ratio and reading beam intensity were controlled to obtain high image quality after the reconstruction process. The bit error rate (BER) was calculated fitting the histograms of the images to determine what parameters improve the quality of the images.

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1. Introduction

Two-dimensional memory technologies like CD-ROMs and DVDs have arrived to their limits of capacity, and the world needs new technological systems to keep more information. Thus holographic data storage (three-dimensional technology) is becoming the new optical memory technology. These new technologies allow an important number of bits to be stored in a recording material with more capacity, more density and faster readout rates than two-dimensional technology [1,2]. Some companies such as Aprilis [3] or InPhase [4] have already created the first prototypes of holographic optical storage systems capable of storing from 200 Gbyte to 1.6 Tbyte.

Photopolymers are considered interesting materials for recording holographic memories because they have a high refractive index modulation [5], large dynamic range [1,6,7], good light sensitivity, real-time image development, high optical quality and low cost. In addition to this, their properties like energetic sensitivity or spectral sensitivity can be easily changed by modifying their composition [5,8].

In this study, we focus on the optimization of a holographic memory setup using a liquid crystal display (LCD) and a polyvinyl alcohol (PVA)–acrylamide (AA) photopolymer.

Twisted-nematic liquid crystal displays (TN-LCDs) have been studied for application to spatial light modulators (SLMs) used to modify in real time the amplitude or phase of a light beam [9]. This LCD can be used to design programmable optical elements, such as lenses and data pages or in holographic data storage. In

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mind in order to improve the quality of the stored images as much as possible.

5. Conclusion

In this study, two different data pages with a different pixel size were stored in a PVA-AA. TN-LCDs were used as an SLM to modify the object beam and store the data pages in the material. The data pages were stored using an experimental design in which the variables are beam ratio, exposure time and reading beam intensity. These variables were modified to find the best quality image. The BER of the read images was calculated to quantify the quality of the image and then decide what beam ratio, exposure time and reading beam intensity values yield the best image. From the experiments, we conclude that the quality of the images is improved when the pixel size and the beam ratio are decreased, and when the exposure time and reading beam intensity are increased, but within certain limits so as not to saturate the CCD and deform the holograms.

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