ABSTRACT

After the discovery of laser and holography, the problem of interferometry in diffused light gained the attention of many workers all-over the world. This resulted in an enormous number of publications on various aspects of the problem. One of the important aspects of the problem is the study of the interference phenomenon in storing and retrieval the images.

The use of film as a linear storage medium is a relatively new application in the history of photographic emulsion. The overlapping exposures are stored linearly by controlled photographic processing which determine the storage capability of the film. Spatial filtering techniques are then applied to separate the image spectra and to retrieve the individual images.

The image of a laser illuminated surface has a random fine structure called a speckle pattern. This structure is due to the coherent addition of the diffraction patterns generated in the image plane by each point of the object. It can be said briefly that the random properties of the image depend on the nature of the object, on its shape and inclination of the incident laser beam. The mean properties of the image depend only on the imaging lens. Particularly, the mean size of speckle is given by the diameter of the Fraunhofer diffraction pattern of the imaging lens and the spectrum of image irradiance is modulated by the transfer function of the imaging lens. Consequently, the Fourier spectrum of an intensity speckle pattern is spread out.

In the first chapter of this work,the characteristics of the different types of holographic plates are discussed. Holographic

plates as an optical device for image storage, their noise and signal to noise ratio are also studied. To increase the efficiency of the hologram, the amplitude hologram must be converted to phase hologram by bleaching processes. Different types of bleach baths are investigated.

In the methods of information processing described here (chapters II and III) the low-frequency optical signals are modulated by a random intensity distribution to spread out information in the Fourier plane. In chapter II, the double-exposure technique is studied theoretically and experimentally for image storage and retrieval of amplitude objects. Two Amplitude objects, Eiffel tower and the Soviet Palace, in the form of positive slides are stored and retrieved optically. The technique is based on the fact that two laterally translated and identical intensity speckle patterns display a system of Young's fringes in their Fourier plane. The contrast of fringes is maximum and their spacing is inversely proportional to the lateral shift.

If the laterally displaced speckle patterns are not identical, the contrast of the corresponding Young's fringes is no longer maximum. Consequently, the contrast of Young's fringes displayed in the Fourier plane by two laterally displaced speckle patterns represents their correlation degree.

Moreover, not only single images are stored and retrieved but also two overlapping images are stored and individually retrieved.

In chapter III, an improvement of the technique of storage and retrieval images and to increase the capacity of storage are brought about as a result of multiple exposures. Coherent light source has been employed in the storage as well as in the retrieval of the images. Two signals i.e. Eiffel tower and Soviet Palace are recorded on a single frame with an equal lateral displacements for each signal. The noise of the retrieved image can be suppressed by taking the exposure time in the form of binomial coefficient ratio. Up to five exposures are studied in this work. The factors affecting the contrast of the individual retrieved image are also studied. The maximum number of signals that can be multiplexed is discussed.