CHAPTER - V

SUMMARY AND CONCLUSIONS

Holography has been applied to many fields of interferometry by virtue of its ability in recording phase information of light waves. Some remarkable works about this holographic interferometry have been already reported; for example, holographic shearing interferometry [1,2], holographic Schlieren method [3,4], diffusely reflecting surface interferometry [5-8], holographic multiple-beam interferometry [9-11].

Similarly, the application of holography to vibration analysis allowed one to undertake an investigation of a number of problems which were previously not solvable. For instance, it is proposed to study oscillations of membranes in microphones and loud speakers as well as surface waves on different substances. This opens the possibility of detection of vibration of objects in a vacuum even when there is no medium which transmits the sound. A demonstration of high efficiency of holographic vibration analysis, which is used for nondestructive ultrasonic control, includes detection and study of flaws, imperfections, and fissures in solid bodies [13]. Two plates of cold rolled steel were prepared with one of them having a crack. Then using a solonoid, vibrations of frequencies of 110 to 617 Mc were induced in the plates. The interference pictures for these plates differed strongly from each other and showed different frequency responses. In the place where the crack was

located, one always observed swelling, since the metal was weakened there and the oscillations had their largest amplitude at this point.

Holographic control of unfinished surfaces may be used in a variety of situations. These applications are based on the interference method of comparison of several states, using a double-exposure of a single hologram. Thus it is possible to investigate all changes in solid bodies which are due to the form and the quality of their surfaces [14]. The changes may also be caused by heating, pressure or swelling. Thus in holographic interferometry, there is comparison of different states of the same object is utilized.

This clearly indicate that, the holographic interferometry, which has many advantages over the conventional one, can be applied in many fields of engineering. Hence the features of holographic interferometry-the appearance of fringes on a rough surface, the multiplex recording of a state of objects, self-compensation of initial conditions, and so on-are utilized in the mechanical experiments. The new character of the technique produces a new method. Experiments in 3-D may be promising in engineering by using the reproducibility of 3-D information, which is also one of the distinctive features of holography. Thus holography makes the recording

of interference phenomena easier than with a classical interferometer. Precision optics are no longer required.

In Chapter-I, we have given a brief historical background of the subject. The description of the method to recording and illumination of hologram is also explained. The principle of holography is described in simple manner. The details regarding some of the important properties of light like interference, diffraction are also outlined. Moreover, the coherent property of laser light is discussed in detail.

In Chapter-II, we have presented the formation geometries of different types of holograms like Phase, Volume, Fresnel, Fourier transform, Lensless Fourier transform, Fraunhofer, Image plane and Piggyback holograms. some of these types are explained in detail alongwith appropriate theories. The same chapter includes the experimental work on recording different kinds of holograms. For this purpose, we have used suitable objects and recorded transmission and reflection type holograms. The method of recording and wavefront reconstruction is also presented.

The role of various optical components used in recording holograms is described. Similarly, the experimental conditions and precautions, that are to be followed during recording, are mentioned and procedure of development and fixing of photographic plate is explained.

In the same Chapter, we have reported a critical assessment of different kinds of holograms. To understand the details about the formation geometry, reconstruction process and generation of image from hologram, the critical assessment is summarized in a tabular form. From the table it is seen that, Fresnel, Piggyback and Fraunhofer are easy to record and reconstruct. While Fourier and lensless Fourier transform are difficult to record and reconstruct. It is also found that, image plane hologram is difficult to record but is easy to reconstruct.

In Chapter-III, we have presented the basic principle and technique of holographic interferometry like Real-time, Double-exposure and Time-average interferometry. Also, the advantages and limitations of these different types of 'Holographic Interferometry' are discussed. In addition to this, applications of 'Double-exposure Holographic Interferometry' for non-destructive testing is explained briefly. The process of fringe lccalization and their visibility is also described. Attempt has been made to take a survey of literature on the 'Holographic Interferometry'. The recent trends in 'Eolographic Interferometry'are presented.

Chapter-IV, accounts for complete experimental aspect of 'Holographic Interferometry'. This Chapter gives the details of 'Experimental work on Holographic Interferometry' carried out by us. The nethod of

experimental procedure for recording the double-exposure hologram is elaborated. The stressing concept which plays an important role for the formation of fringes on the surface of object is discussed. In the present investigation, we have employed a mechanical stressing for recording of holograms through 'Double-exposure Holographic Interferometry'. This technique is used to study the surface displacement in the case of rubber cork and and metal disc.

From the present dissertation following points emerge.

i. We have successfully recorded different kinds of holograms in our laboratory.

ii. From the critical assessment of studies, it is found that, some of the holograms are easy to record and reconstruct.

iii. Double-exposure Holographic Interferometry is very easy technique for studying defects, flaws in the materials.

iv. For rubber cork it is observed that, with increasing load the number of fringes goes on increasing indicating thereby increase in the surface displacement. It is also found that, with increase of load on the top surface of the rubber cork, the fringe width goes on decreasing.

v. In the case of metal disc it is noticed that, with increasing current to the vibrator, the number of fringes and surface displacement goes on increasing while, the fringe width decreases.

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