

Holography – Instruction Notes

Keywords: optical wave, phase, coherence, laser, off – axis holography

I. GOALS OF THE EXPERIMENT

Holography is a process for recording images with the three-dimensional information. Due to the high demands on the coherence of the light source, holographic techniques became more important with the development of the laser. A holographic image stores the interference pattern of an object produced by two coherent electromagnetic waves, the image of original object can be reconstructed by diffraction on the interference pattern again. The real image from the hologram can be viewed by a microscope or recorded by a camera, thus holography is useful for many purposes. For example, holographic interferometry measures microscopic displacements on the surface of an object and small changes in index of refraction of transparent objects. In optical data processing, digital holograms and holographic optical elements are often used to multiply data channels and create optical connections on and between processor chips.

The experiment will give an insight into the measuring methods of holographic interferometry.

II. LEARNING CONTENT

Optic-Basics

- Maxwell-Equations
- derivation and solutions of the wave equation
- superposition Principle
- coherence

Lasers

- laser - schematic setup
- population inversion
- Einstein coefficients
- two, three and higher level systems

Holography

- white light holography
- in –line and off-axis holography
- holographic interferometry

III. PROCEDURE

FIRST LAB SESSION

- adjustment of the spatial filter
- adjustment of the optical setup (positioning of objective, alignment of reference and

object-beam)

- mixing of chemicals for finishing and fixing the exposure on photo plates
- alignment of object for Off-Axis exposure method

SECOND LAB SESSION

- holographic interferometry for two objects (translation and rotation)
- white light holography

IV. REFERENCES:

- (1) Wernicke G.; Osten W. (1982), *Holographische Interferometrie*, Physik Verlag, Weinheim
(handout from advisor)
- (2) Smith H. M. (1975), *Principles of Holography*, Wiley, New York
- (3) Experiment folder – handout from advisor