Tampere University

Roosa Kuusivaara & Väinö-Waltteri Granat

Signal processing in digital holography - Report

Faculty of Information Technology and Communication Sciences (ITC)
Laboratory Report

Abstract

Roosa Kuusivaara & Väinö-Waltteri Granat: Signal processing in digital holography - Report
Laboratory Report
Tampere University
Master's Degree Programme in Signal Processing
November 2023

This report documents the work done in the Signal processing in digital holography assingment as a part of the Advanced signal processing laboratory course. In this assignment we familiazired ourselves with basics of intereference based holography.
Keywords: M.Sc. thesis, layout, writing style.

Contents

1 Introduction

In this report we describe our work done in the 'Signal processing in digital holography' laboratory assignment for the Advanced Signal Processing Laboratory course. In this assignment we used a Mach-Zehnder interferometer to record holographic images and Matlab to reconstruct the object from the recorded wavefront.

2 Methodology

This section describes the method we used to capture the holograms and reconstruct the objects.

2.0.1 Experiment setup

Holographic imagery relies on the phenomena of light wave superpositions. In this assignment the object is captured using a Mach-Zehnder interferometer, where a monochromatic laser is used to produce two wavefronts. The first wavefront passes trough the object which we want to record, and the second wavefront is used as reference wavefront. The wavefront are the combined to a single wavefront via the interference phenomena, so that one of the wavefronts is combined with the other wavefront in a slight angle, causing a phase difference. The resulting total wave is then captured with a CMOS camera to produce a image file. The phase difference is detectable as fringes in the captured images. The complete setup for the experiment is shown in figure 2.1.

2.0.2 Object reconstruction

The object can be extracted from the captured hologram, using a two step method.

First step is to use Fourier filtering to extract the object wave.

The hologram is defined by the following equation:

$$H(x,y) = E_0(x,y)^2 + E_r(x,y)^2 + U_0(x,y)U_r^*(x,y) + U_0^*(x,y)U_r(x,y) \tag{2.1}$$

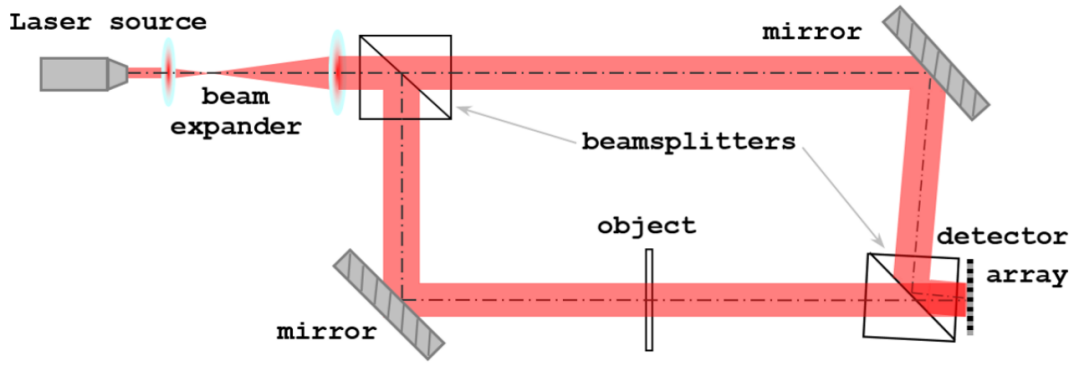

Figure 2.1 *Experiment was done using a Mach-Zehnder interferometer. Taken from [**assignment**]*

3 Results

4 Conclusions