Fourier optics

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Arbeitsgruppe: Prof. Roskos

Zur Vorbereitung

- Paraxial light propagation and diffraction
- 2D Fourier transformation; Fourier transforming properties of lens
- Image construction using the system with two lenses

Durchführung

- **Fourier transforming properties of lens**

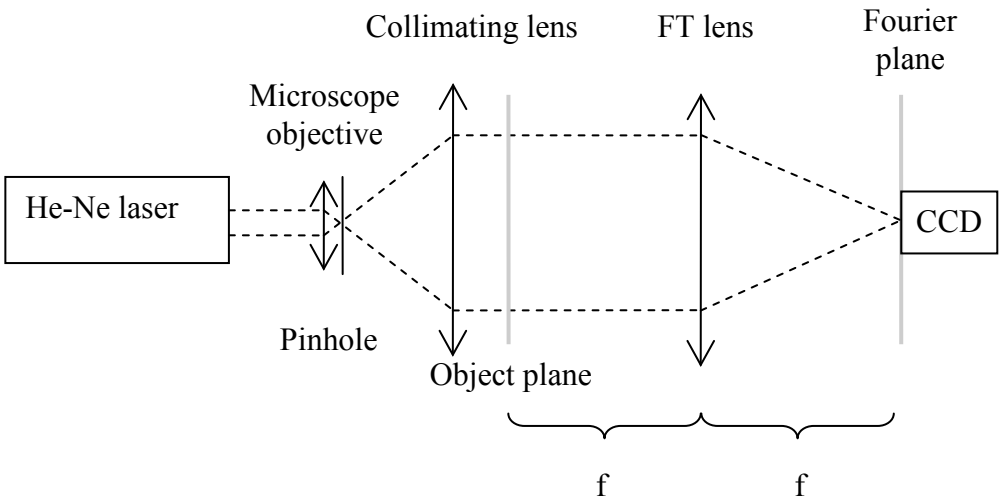

Fig. 1. Optical setup for observation of 2D Fourier transform.

Build an optical setup shown in Fig. 1. When an object is placed in the back focal plane of FT lens, in the forward focal plane a 2D Fourier images of object intensity is formed. Place into Fourier plane a CCD camera and record Fourier transform images of following objects: several gratings with different grating constants and filling factors, 2D mesh.

- **Spatial filtering**

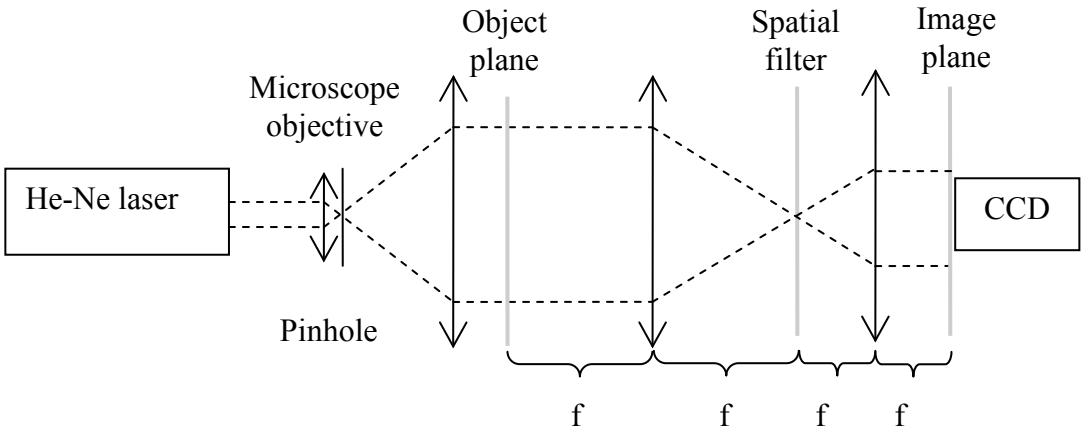

Fig. 2. Setup for spatial filtering and optical character recognition.

Build the setup for imaging as shown in Fig.2. Record images of objects without spatial filtering and with part of special frequencies blocked. Then place a slit in the Fourier plane and remove high spatial frequencies. Low spatial frequencies can be removed by placing a wire into a Fourier plane.

- **Optical character recognition**

Continue working with the previous setup. Place matched filters (Van der Lugt filters) into a Fourier plane and record a correlation images.

Zur Ausarbeitung (stets das Messprotokoll beifügen!)

- Describe 2D Fourier transformation.
- Show how it is possible to achieve 2D Fourier transform using the lens.
- Present recorded Fourier images and explain main features of Fourier transformation
- Present results of spatial filtering
- Give a summary of your experiments; outline its main features and limitations.

Besondere Hinweise zum Versuch

- In order to minimize aberrations of optical system it is very important to stay on optical axis. Therefore, before starting carefully check the alignment of lenses.
- The experimental computer contains also programs for numerical 2D Fourier transform. After experiments you can compare optically and numerically calculated Fourier images.

Material zur Vorbereitung

Verwendete Literatur

- Joseph W. Goodman, *Introduction to Fourier Optics*.

Empfohlene Literatur

- E. Hecht, *Optik*.
- D G Feitelson, *Optical Computing: A Survey for Computer Scientists*, MIT Press, 1988.