

**Laboratory #9****Week of March 13**

Read: p. 321, pp. 376-379, pp. 538-539, 544-546, and 630-634 of "Optics" by Hecht

Do:

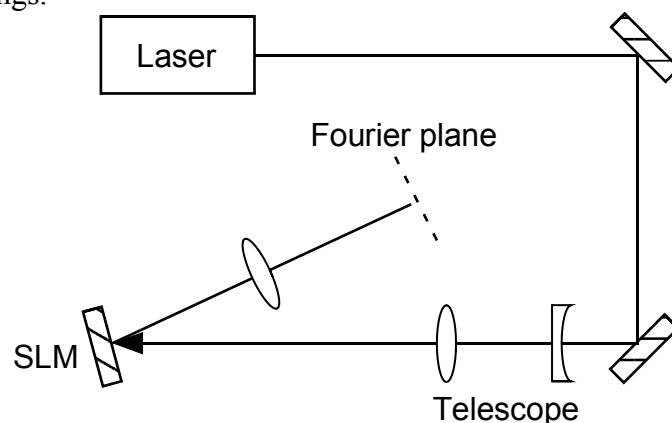
1. Experiment IX.1: SLM Diffraction efficiency
2. Experiment IX.2: Vortex beam
3. Experiment IX.3: Hologram

**Experiment IX.1: SLM Diffraction efficiency**

The liquid crystal spatial light modulator (SLM) controls the phase of the reflected light on a pixel-by-pixel basis. A gray-scale video image is sent from the computer to the SLM through the VGA connection and adjusts the phase shift of each pixel from zero to approximately  $0.8\pi$  (ideally it would be  $2\pi$ , but that costs more \$\$). The SLM thus acts as a phase grating to produce diffraction, which, in the far field, gives the Fourier transform of the displayed video image.

Connect the 5V power to the SLM before connecting the VGA cable, and then ensure that the computer recognizes the SLM as a second monitor (use the display control panel). With the small polarizer in place, you should be able to see an image on the SLM (remove the small polarizer for the rest of the experiment, but do not lose it!). Expand and collimate the laser beam so that it covers the area of the SLM (a telescope with a -25 mm lens and a 75 mm lens works well). Adjust the input polarization to be parallel to the long side of SLM chip. Direct the beam at a small incident angle such that the reflected beam can be collected with a 200 mm Fourier lens, as shown below.

Use the Holoeye software (on the desktop) to send video images to the SLM (answer yes to the question about an extra screen). Use a photodiode to measure the diffraction efficiency of the SLM up to  $\pm 3^{\text{rd}}$  order using a sinusoidal grating and a blazed grating. Measure the intensity in each diffracted beam relative to the zeroth-order beam. You may need to reimage and magnify the Fourier plane (a 25 mm lens works well). Comment on the difference between the two types of gratings.

**Experiment IX.2: Vortex beam**

Use a spiral phase pattern and add a grating pattern (prism option) to isolate a Laguerre Gaussian beam (a doughnut beam). Record an image of the beam with the CCD camera.

**Experiment IX.3: Hologram**

Use a hologram of the Holoeye logo (under open file) and produce its image in the Fourier plane. Record an image of the logo (this may work better in the original Fourier plane).

Equipment needed

Item	Qty	Source (part #)
Helium-Neon Laser	1	Melles Griot 05 LHP 121
Al mirror	3	Newport 10D10ER.1
Polarizer	1	Edmund A38,396
25 mm lens	1	Newport
75 mm lens	1	Newport
200 mm lens	1	Newport
SLM (9 $\mu\text{m}$ /pixel)	1	Cambridge Correlators SDE1024
CCD Camera (5.6 $\mu\text{m}$ /px)	1	Imaging Source DMK21AU04