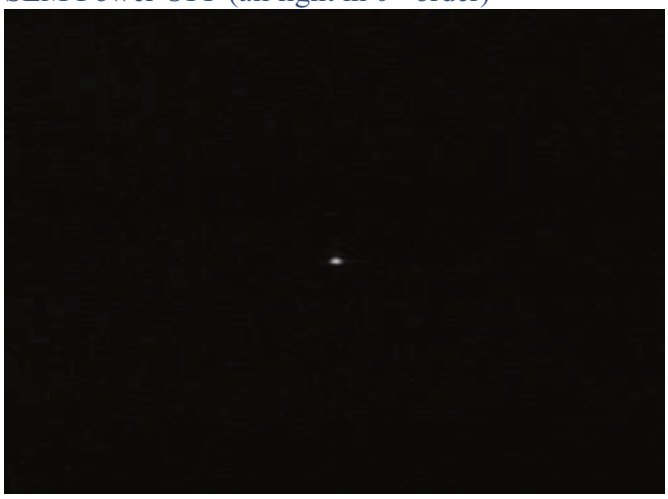
Single Spot Beamsteering in an XY plane

It is useful to start with simple examples: beamsteering a single focal point within an XY plane. The following pictures show the Fourier plane with all the light in the 0th order, and then a series of pictures showing the majority of the light diffracted to the first order with some light remaining in the 0th order. The hologram applied to the SLM is shown at right. The black to white transition represents a phase shift linearly increasing from 0 to pi. The spatial frequency of the phase ramp controls the tilt of the wavefront. Thus a low spatial frequency results in a slight tilt and beamsteering to a small angle. As the spatial frequency increases the tilt of the wavefront increases and the beam is steered to a wider angle. Most of the light is deflected to the first order, but a small percentage of the light remains in the 0th order. The beamsteering efficiency is discussed in greater detail at the end of this document.

Using the weighted Gerchberg Saxton light can be directed to discreet points in the Fourier plane. If there are 512x512 pixels at the SLM, the algorithm allows 512x512 points in the Fourier plane to steer light to. The 0th order is located at 0,0. Thus in the x axis we can steer from -256 to 256, and in the y axis we can steer to -256 to 256. The XYZ location of the steered focal point is noted above the hologram and resulting image the Fourier plane.

Although it is not necessary to use the weighted Gerchberg Saxton for single spot beamsteering (because in this case there is one solution to the problem, and this solution is well known), for consistency the same algorithm was used throughout.

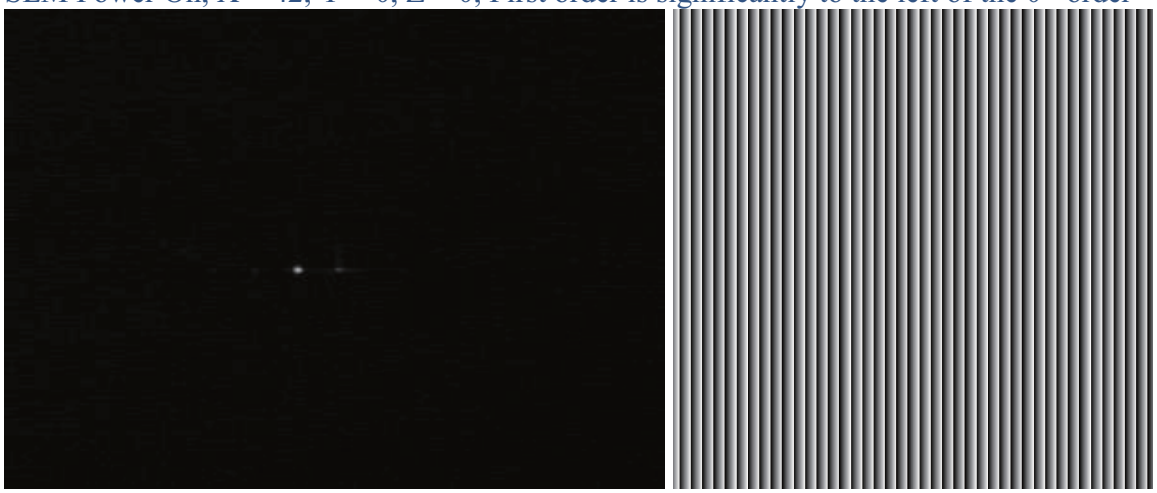
SLM Power OFF (all light in 0th order)



SLM Power On, X = 10, Y = 0, Z = 0, First order is just to the left of the 0th order

SLM Power On, X = 20, Y = 0, Z = 0, First order is further to the left of the 0th order

SLM Power On, X = 42, Y = 0, Z = 0, First order is significantly to the left of the 0th order



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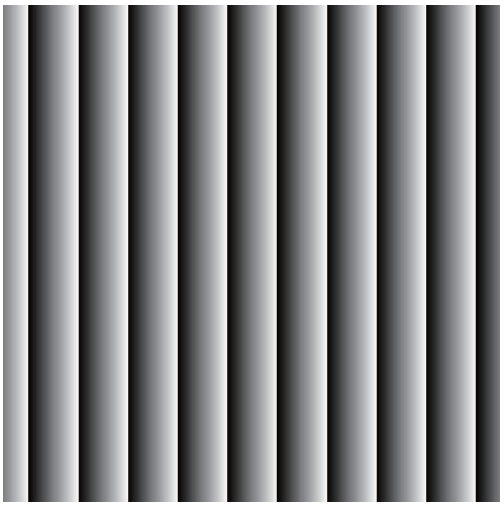
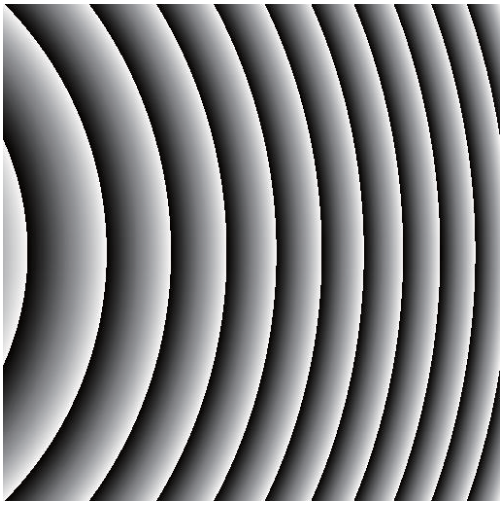
Single Spot Volumetric Beamsteering

In the following images the camera was left stationary while an X tilt and Z shift of varying degree was applied to the SLM. This shows a notable defocus of the first order spot.

SLM Power On, X = 10, Y = 0, Z = 0, First order is just to the left of the 0th order



SLM Power On, X = 10, Y = 0, Z = 10, First order is just to the left of the 0th order, and shifted axially. Because the camera is no longer in the focal plane of the 1st order the spot appears to spread.



Images were taken of the focused 1st order by translating the camera. The total span that the camera was translated was 8.75 mm as the hologram z shift was varied from Z=0 to Z = 200. The relatively constant intensity of the 1st order spot indicated that despite the high spatial frequency of the Z = 200 hologram the SLM is still accurately producing the desired phase profile.

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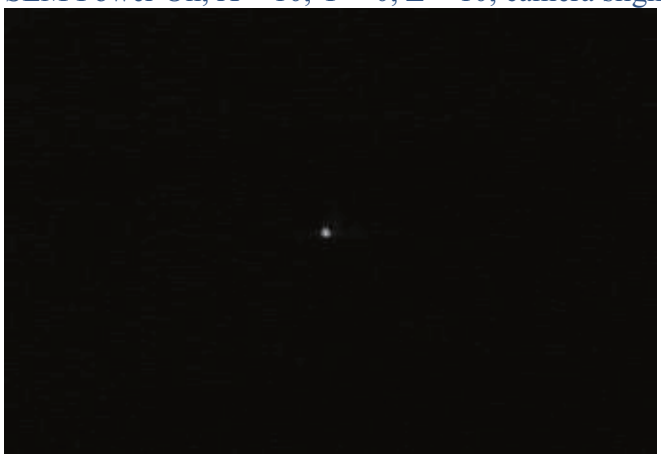
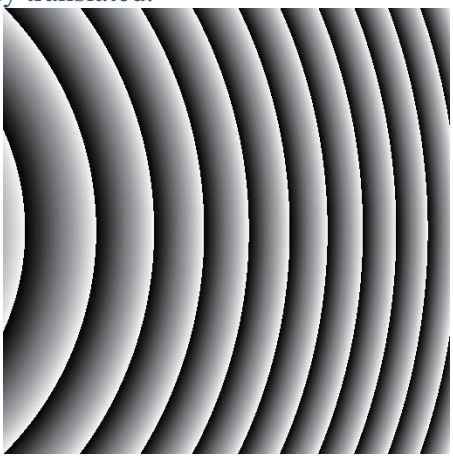
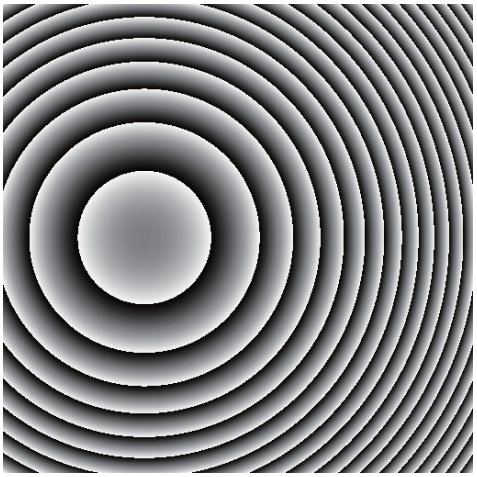
SLM Power On, X = 10, Y = 0, Z = 10, camera slightly translated.

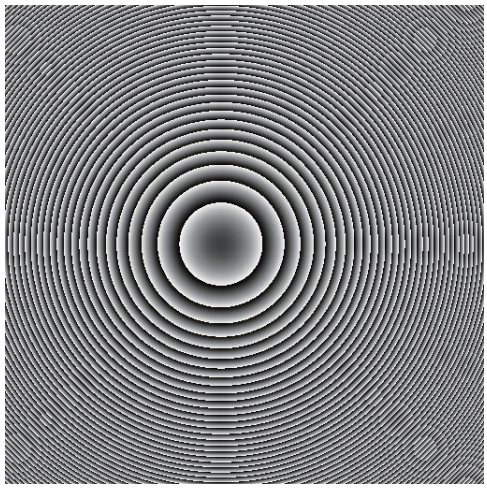




SLM Power On, X = 10, Y = 0, Z = 50, camera further translated.



SLM Power On, X = 10, Y = 0, Z = 200, camera translated a total of 8.75 mm.



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