Optics 513 - Optical Testing and Testing Instrumentation Lab

Lab #10 - Lateral Shearing Interferometry

The purpose of this lab is "to learn to appreciate the enjoyment of working with a lateral shear interferometer". Three different lateral shear interferometers will be used; shear plate, two-frequency crossed grating, and Wollaston prism interferometer.

Procedure:

- Setup the laser, spatial filter, and collimator to produce a collimated beam. Use the Murty shear plate interferometer to test the quality of the collimating lens. Turn the lens around and re-test the lens. Sketch the interferograms obtained. Leave the collimator lens in the position that gave the least aberration.

- Remove the Murty interferometer and put the focusing lens in the optical setup. Put the two-frequency crossed grating at the focus of the focusing lens. Scan the grating in both horizontal and longitudinal directions and note how the test pattern changes. Turn the focusing lens around and re-test the lens. Tilt the lens and try to obtain hyperbolic and elliptical patterns.

- Put the Wollaston prism at the center of curvature of the nearly spherical mirror. Using the fiber optic illuminator illuminate the mirror through one side of the Wollaston and adjust the mirror so the light goes through the other side of the Wollaston. Image the mirror under test onto the viewing screen. Adjust the Wollaston up and down to get the best contrast fringes and move longitudinally to obtain the desired defocus. Adjust the longitudinal position of the Wollaston to get nearly one beautiful color. Put your hands under the beam and look at the heat waves.

Questions:

<u>Shear</u> <u>Plate</u>

1) What aberrations are present in the collimating lens?

2) How can you tell if the beam is collimated?

3) If you were testing the overall quality of a collimated beam, how many measurements would you need to make? Explain.

Two-Frequency Crossed Grating

4) Why does this test not experience the bad diffraction effects seen in the Ronchi test?

5) Calculate (approximately) the two grating frequencies.

6) What changes do you notice when the lens is rotated 180^{o}?

7) How would you make a two-frequency crossed grating?

Polarization Lateral Shear Interferometer (Wollaston Prism)

8) Why do polarizers have to be placed before and after the crystal?

9) How should the polarizers be oriented with respect to the axes of the Wollaston prism?

10) Do you need a polarizer before and after the crystal if the source emits polarized light?

11) Why does moving the Wollaston vertically change the fringe contrast. What do you know about the location of the optical axis and center of the Wollaston to obtain the best contrast fringes? Explain any assumptions being made.

12) If you adjust the interferometer to obtain one dark fringe, where has all the light gone?

All Tests

13) Which technique has the highest accuracy? What factors influence your judgment?

14) How would you compare shearing interferometry to wavefront interferometry for testing optical components?

15) Which of these tests will work in white light? Explain why or why not.