Optics 513 - Optical Testing and Testing Instrumentation Lab

Lab #5 - Twyman-Green Interferometer

The purpose of this lab is to

- Become familiar with the use of a Twyman-Green interferometer for the testing of spherical optics.
- Learn about polarization techniques for equalizing the intensities of the two interfering beams.
- Show that if a laser having more than one longitudinal mode is used in an interferometer the maximum fringe contrast is obtained when the round trip path length difference for the two interfering beams is an even integer number of laser cavity lengths.

Procedure:

- Look over the interferometer and note the half-wave plate, quarter-wave plates, polarization beamsplitter and polarizer. Also, note that the reference mirror can be translated to vary the path difference between the two interfering beams. Locate the corner cube that can be put into the test beam of the interferometer.

- Move the corner cube into the test beam. Align the reference mirror so the returned reference beam is parallel to the beam reflected by the corner cube. This is achieved by making the two focused spots in the focal plane of the imaging lens coincident.

- Use the Twyman-Green interferometer to measure the parabolic mirror provided. Put a small aperture at the focus of the diverger lens and adjust the parabolic mirror to get the returned light back through the aperture. Rotate the half-wave plate and/or polarizer and watch the change in fringe contrast. Translate the reference mirror to obtain the path difference for optimum coherence and maximum fringe contrast. Be sure to measure the path difference. When testing the parabola, move the diverger lens so as to focus at several zones. Also, vary the tilt of the reference mirror. Sketch the interferograms obtained.

- Test the rectangular mirror using the same procedure as was used to test the parabolic mirror. Be sure to note how the fringes change when the distance between the diverger lens and mirror changes.

Questions:

1) The Twyman-Green interferometer uses polarization techniques to match the intensities of the two beams. Draw a schematic of the system. Describe the procedure used to obtain maximum fringe visibility by adjusting intensities of the two beams. The intensities can be matched by rotating either the polarizer or the half-wave plate. Which is more light efficient.

2) Is the edge of the parabola high or low relative to the inner portion of the mirror?

3) In units of laser cavity length, what is the path difference for maximum fringe contrast?

4) How can you measure the radius of curvature of the various zones of the parabolic mirror?

5) What aberration does the rectangular mirror have? Is the center high or low?

6) Why must the test surface be imaged onto the observation plane?

7) How do vibration and air turbulence change the interference fringes?