Optics 513L - Optical Testing and Testing Instrumentation Lab

Lab #1 - Orientation Lab

The purpose of this lab experiment is to become familiar with some elementary aspects of optical alignment and interferometry. First, a laser beam will be aligned with respect to an optical bench, spatially filtered, and collimated. Then, a Twyman-Green interferometer will be set up to observe interference fringes. Each student should align the spatial filter, collimate the beam using the shearing plate, and fine-tune the Twyman-Green to obtain fringes at least once. The techniques you learn today will be needed throughout the semester in order to do the lab experiments.

Collimating a Laser Beam

1) Adjust the height and angle of laser beam to align it parallel to the optical bench.

2) Place the spatial filter assembly in front of the laser without the pinhole.

3) Adjust height and tilt of components so the reflections off the optical surfaces are reflected back on themselves.

4) Align the microscope objective so that the beam comes out in the proper orientation.

5) Replace the pinhole into the spatial filter assembly and defocus the microscope objective until light comes through the pinhole.

6) Adjust pinhole position for maximum throughput, bring microscope objective slightly back into focus, and adjust pinhole again.

7) Repeat step 6 until the pinhole is at the microscope objective's focus.

8) Insert collimating lens. Adjust height if necessary.

9) Use plane (nearly) parallel (shearing) plate to check for collimation by placing it in the expanded beam and observing fringes. The shearing plate should be oriented with the wedge going from top to bottom. When the beam is collimated, equally spaced straight horizontal fringes will be seen. Note that if the collimating lens is backwards, the fringes from the shearing plate will not be straight.

Twyman-Green Interferometer

1) Setup a Twyman-Green interferometer with equal path lengths.

2) To obtain fringes, look at the focal plane of the lens and tilt the reference mirror to place the foci of both beams on top of one another. Then observe fringes in some other plane. You should get straight equally spaced fringes.

3) Tap the table and observe what happens to the fringes.

4) Increase the path length of one beam and try to obtain fringes.

Questions

1) What is the effect of pinhole size on the spatial filter output?

2) How do you determine the optimum pinhole size?

3) Would it be easier or harder to align with the wrong size pinhole?

4) If the collimating lens is in backwards, what aberration is present?

5) How does the fringe stability of the shearing plate compare to that of the Twyman-Green? Why?

6) How large can the path difference be before the fringes are degraded?

7) What properties of the light source limit the fringe contrast as the path difference is increased?