Optics 513 Final Exam

December 18, 2008

1 (10 Pts)

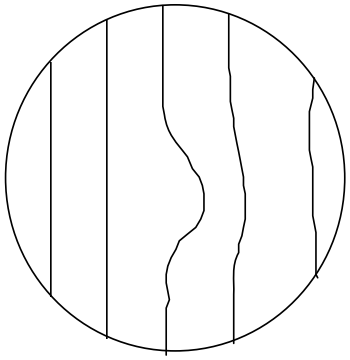
Compare the relative maximum dimension in the geometrical spot image at

a) paraxial focus for a system having 4 waves of third-order spherical aberration and

b) sagittal focus for a system having 4 waves of third-order astigmatism.

2) (20 Pts)

The following interferogram was obtained using a two beam interferometer to test a sample at a wavelength of 500 nm.



If the sample being tested is a flat mirror, what is maximum departure from flatness if

a) the sample is tested at normal incidence in a Twyman-Green interferometer?

b) the sample is tested at an angle of incidence of 60 degrees in a Twyman-Green? Sketch the interferometer setup.

If the sample being tested is a plane parallel plate of refractive index 1.5,what is the maximum thickness variation if

c) the sample is tested in a Twyman-Green interferometer?

d) the sample is tested in a Mach-Zehnder interferometer?

3) (10 Pts)

a) Give 5 main sources of error for phase-shifting interferometry.

b) Why are at least 3 separate measurements required in phase-shifting interferometry?

4) (5 Pts)

In phase shifting interferometry the measured phase values at six consecutive data points are 0°, 150°, 300°, 90°, 240°, and 30°. We know that for the particular sample being measured the phase difference between consecutive data points must be less than 180°. What are the phase values after correcting for the 2 π ambiguities arising from using the arc tangent function?

5) (10 Pts)

I am testing a nearly parallel plate in a Twyman-Green interferometer to determine the wedge angle. If the plate is not present a single fringe is present. The refractive wavelength of the plate is 1.5 and the wavelength of the light source is 633 nm.

a) What is the wedge angle in units of micro-radians if fringes of 4 mm spacing are obtained when the plate is placed in the test arm of the interferometer. Assume unit magnification between the plate and the interferogram.

b) How can you determine the thin portion of the glass plate if putting the plate into the test arm of the interferometer produces straight equi-spaced fringes?

6) (15 Pts)

You are given the job of measuring a corner cube.

a) Sketch both the single pass and double pass interferometric setups.

b) What is generally more accurate, single pass or double pass? Why?

c) A perfect corner cube is being measured. Sketch the resulting fringes for both single pass and double pass interferometric test.

7) (10 Pts)

A Fizeau interferometer having a HeNe laser as the light source is used to test flat surfaces. Let the reference surface in the Fizeau be perfect, but the 10 cm diameter collimator lens used in the interferometer has 2 waves of third-order spherical aberration. Give the approximate maximum error in the test results if the separation between the reference surface and the test surface is

a) 1 cm

b) 1 meter.

8) (10 Pts)

I am using two-wavelength holography to test a concave aspheric mirror. The two wavelengths being used are 488 and 514.5 nm. If the diverger lens has no spherical aberration at 488 nm and 1 wave of spherical aberration (single pass) at 514.5 nm, how much error will result in the measurement of the surface of the aspheric mirror?

9) (10 Pts)

a) What is known about the fringe that passes through the "hot spot" in a scatterplate interferogram?

b) Give at least 2 tradeoffs on the optimum ratio of scattered to unscattered light for a scatterplate.