FRIEDRICH-SCHILLER-
UNIVERSITÄT
JENA

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Lens Design I (SS' 24)

Seminar 2

Exercise 2-1: “GRIN Lens”

Establish a GRIN rod focusing Wood lens:

- Rod diameter = 8 mm;
- Rod length = 25 mm;
- Refractive index on axis (n) = 1.5;
- Radial gradient profile with quadratic coefficient n_{R2} = –0.0046262;
- Incoming beam diameter = 4 mm;
- Wavelength = 500 nm

Questions / Tasks:

a. Determine the paraxial pitch length of the lens. It is defined by the length of the periodically sine-wave path of the marginal ray.

b. Cut the lens exactly in the focal point and determine the spot diameter in this location. Compare the diameter with the diffraction limited Airy diameter. Why is the spot so large? What is the smallest spot radius rms value and where is this optimal focus position?

c. Compare the marginal ray path in the paraxial approximation with the real ray. What is the size of the numerical aperture in the focal point?

d. Now give the lens a length of 60 mm. Introduce a finite field angle of 25°, the front surface of the lens should be the stop location. Discuss the ray path in the lens drawing considering the diameter and the field ray bundle

Exercise 2-2: “Grating spectrometer”

Establish a simple spectrometric system.

A blazed linear grating is illuminated by a collimated beam with a spectral broad wavelength. The spectrum is observed in a sensor plane, which is obtained after a symmetrical bi-convex lens in a telecentric arrangement.

- Grating line density = 0.3 Lp/µm;
- Beam diameter = 10 mm
- Wavelengths = 400, 500, 600 and 700 nm;
- Grating is blaze for order # = +1st;
- Lens focal length = 100 mm;
- Lens thickness = 10 mm;
- Lens material = SF6;

Questions / Tasks:

a. Set the system in Zemax;

b. What is the spreading of the spectrum in the sensor plane?