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Exercises
Lecture Optical design with Zemax– Part 6

6 Correction

6.1 Triplet

A classical Cooke triplet with object in infinity, entrance pupil diameter 20 mm, spectal sampling lines d, F, C and the data

Surf	Type	Radius	Thickness	Glass	Diameter	Conic
OBJ	STANDARD	Infinity	Infinity		0	0
1	STANDARD	22.01359	3.258956	SK16	19	0
2	STANDARD	-435.7604	6.007551		19	0
3	STANDARD	-22.21328	0.9999746	F2	10	0
STO	STANDARD	20.29192	4.750409		10	0
5	STANDARD	79.6836	2.952076	SK16	15	0
6	STANDARD	-18.39533	42.20778		15	0
IMA	STANDARD	Infinity			36.34532	0

is given.
a) Optimize the system with the required data:

- finite object distance 150 mm
- entrance pupil diameter 6 mm
- wavelengths: 450 , 550 , 650 nm
- field height 12.5 mm
- overall site (total track) from first surface until image plane: 210 mm
- performance diffraction limited

b) Increase the numerical aperture until the diffraction limit is violated.

6.2 Schmidt telescope

Setup a system with a focussing spherical mirror with focal length f = 25 mm, an incoming beam with diameter D = 20 mm at the wavelength λ = 632.8 nm.
a) The system is far from beeing diffraction limited. In the so called Schmidt telecope, an aspherical plate is located in front of the mirror to correct the spherical aberration. Optimize a Schmidt corrector,

if it is a plate made of N-BK7, has a thickness of 2 mm and is located in the focal plane of the mirror. Only the 4th order of asphericity is allowed. Is the system now diffraction limited ?
b) Determine the maximum field angle of the system, which guarantees a diffraction limited behavior. The pupil should be assumed to be at the corrector plate.
c) Determine the spectral range, for which the system is diffraction limited on axis.
d) If now for the nominal wavelength the mirror and the corrector plate are allowed to be aspherical, what is the largest achievable field angle for a diffraction limited behavior ?

6.3 Retrofocus lens

A system which consists of a negative and a stronger positive lens acts as a retrofocus lens, where the focal length is shorter than the free working distance.
a) Setup a retrofocus lens out of ideal lenses for a wavelength of 546.07 nm an incoming collimated beam diameter of 10 mm with a negative lens of f_1 = -50 mm. The positive lens should be determined in a way, that the free working diameter is twice the focal length and the numerical aperture in the image space is NA = 0.2.
b) To realize the system, now single lenses of finite thickness are inserted. Optimize the shape of the lenses for the monochromatic radiation on axis, if a heavy flint glass is used. What is the dominant degradation effect for the quality ?
c) If the correction is considered, the positive lens is much more critical than the negative lens, because the ray height is larger and the ray bending angle stronger. Therefore this lens shoud be splitted into two lenses and the bending of the negative lens is allowed to be changed too. Optimize the corresponding system.
d) It is seen, that the performance is not diffraction limited. Therefore try to find better glasses in the correction. What is the best achievable Strehl ratio ?