COMPUTATIONAL OPTICS AND IMAGING HACKATHON

ITMO HACK

Optical Simulation

Challenge Description

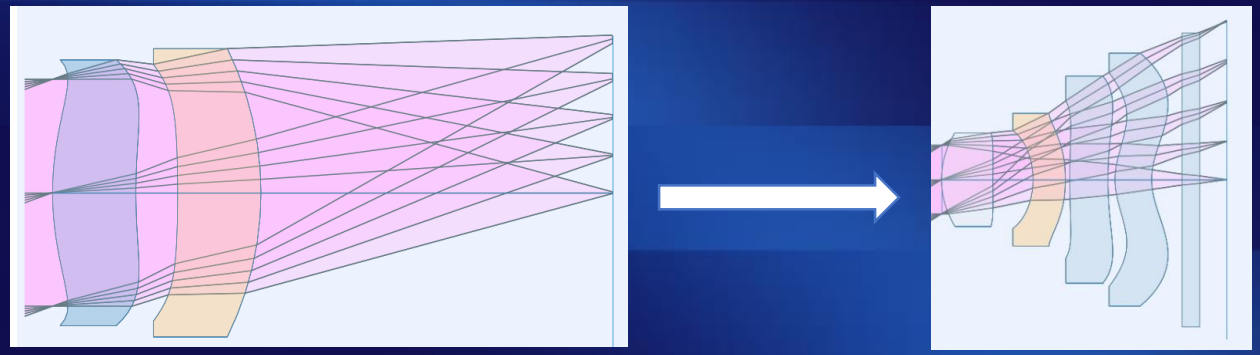
Our goal

Develop an algorithm to find the optimal optical scheme for the specified parameters:

Our optical parameters:

Parameter	Value
Wavelength	470-650 nm
Field of view (sensor)	2,0 mm
Symmetry	axis

From a 2-lens optical system to 5 and more elements optical system



Allowed materials for optical elements

For the purpose of this challenge, let's assume that we have the technology of mixing two materials:

Material	n	Abbe number
Plastic 1	n_1=1.54	$Abbe_1$=75.0
Plastic 2	n_2=1.67	$Abbe_2$=39.0
Plastic mix, k∈[0,1]	n_1*k+n_2*(1-k)	$Abbe_1$*k+$Abbe_2$*(1-k)

```
def add_surface(self, surf_data, **kwargs):
add a surface where `surf_data` is a list that contains: [curvature, thickness, refractive_index, v-number, semi-diameter]
The `curvature` entry is interpreted as radius if `radius_mode` is **True**
The `thickness` is the signed thickness
```

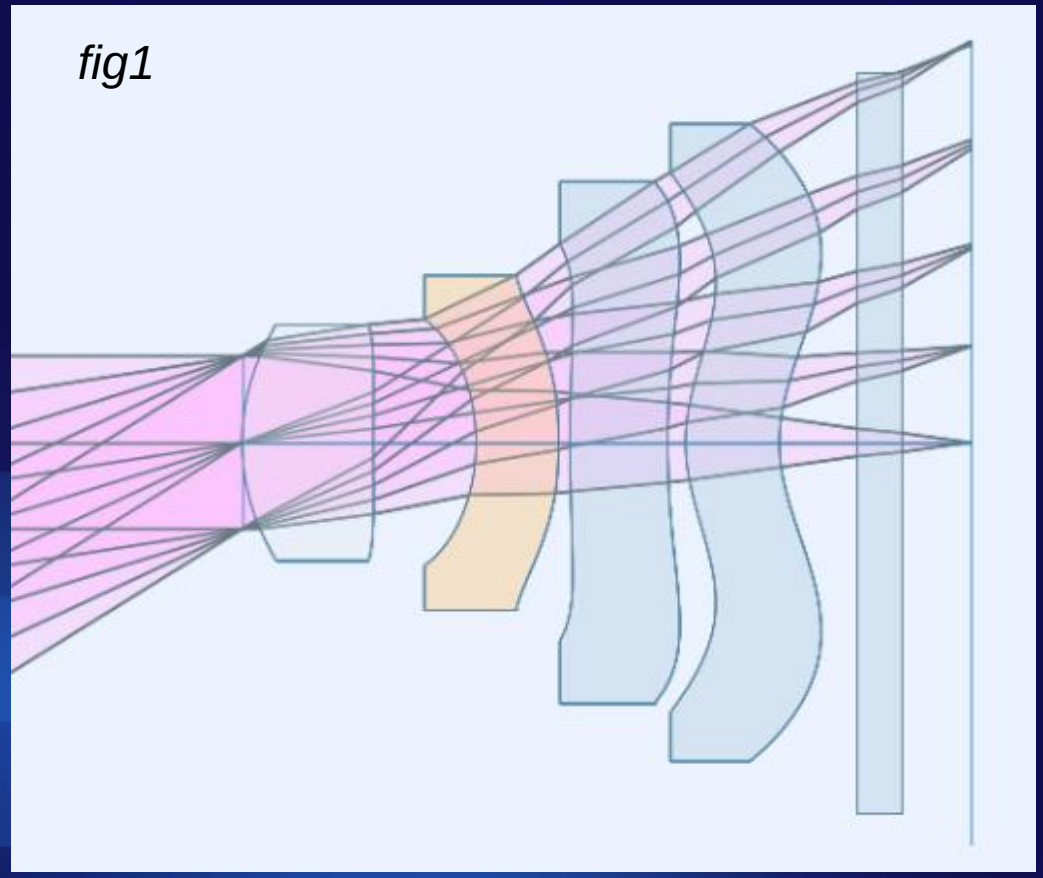
What type of surfaces we can use

- Any spherical convex and concave surfaces
- Aspheric surfaces
- Any other surfaces, the main requirement is that they have a minimum thickness and work correctly in ray-optics package

What about loss function

Parameter	design limitations
Focal distance	5,0 mm
F/#	≤2,1
Total length	≤7mm
Lens thickness	≥100μ
Air thickness	≥0

Parameter	optical quality limitations
Spot RMS	the smaller the better
Encircled energy in D20μ	≥80%



* Spot Root Mean Square shows how well parallel incoming rays are focused at the destination, and is calculated for 5 different points of view (refer to fig1)

Criteria for grading

- We use open source Python ray tracer:

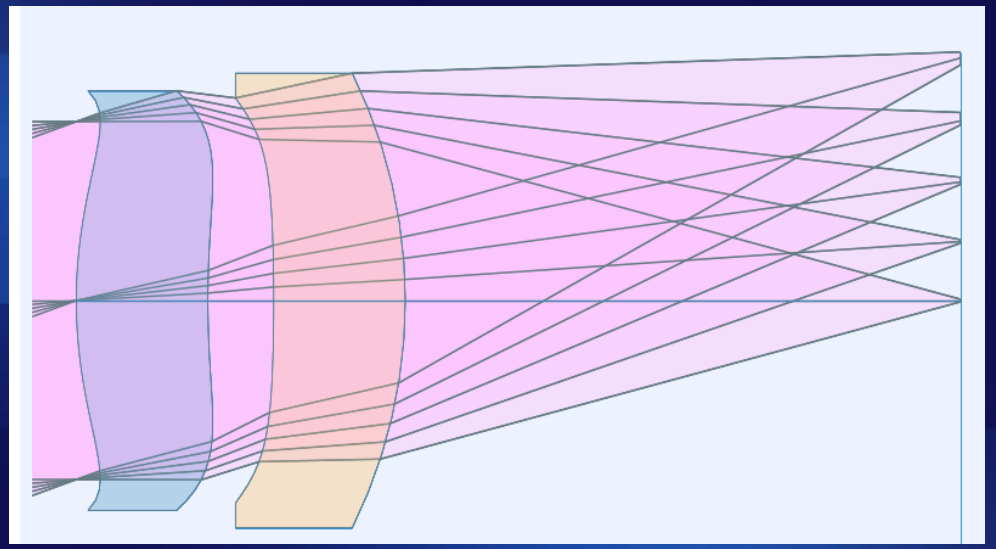
https://ray-optics.readthedocs.io/en/latest/index.html

*.roa format optical scheme

- Example of calculations of the loss value available in check_os.py
- Note: the final loss function, which will be used for grading & making the leaderboards, might be different from the example

Let's start

- Install ray-optics: https://ray-optics.readthedocs.io/en/latest/install.html
- Try with test.roa



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Thank You!