MICRO-517

Optical Design with ZEMAX OpticStudio

Lecture 11

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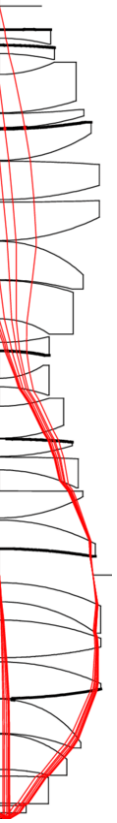
Ye Pu
Sciences et techniques de l'ingénieur
École Polytechnique Fédérale de Lausanne
CH-1015 Lausanne

Design Projects

Choices of Designs

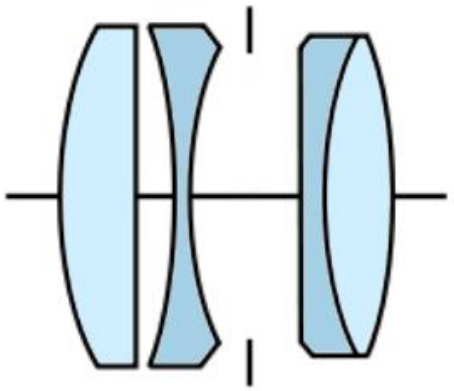
- The Tessar lens
- Keplerian telescope system
- High-NA long-WD microscope objective
- Double-telecentric lens system



Requirements and Grading

- Due 01.02.2024
- Main reference: C. Velzel, *A Course in Lens Design*
- Use F.d.C. wavelengths in all design
- Use at least 0, 0.7, 1.0 field settings
- Full score 100 points
- Report: 50 points
  - Intro 10 points: what we are designing, specification
  - Design 30 points: ideas, analyses, layout, predesign, optimization
  - Insights 10 points: remaining issues, what did we learn, what can be improved
- ZEMAX design: 50 points
  - Functionality 25 points: works as specified
  - Performance 25 points: how well it works (aberration correction)
- Bonus points

The Tessar Lens



Tessar 1912

Tessar 1952

Specification

- f 50mm, F/2.8
- Field of view (full) $2w = 20°$
- For 1-inch image sensor
- Use dedicated stop plane

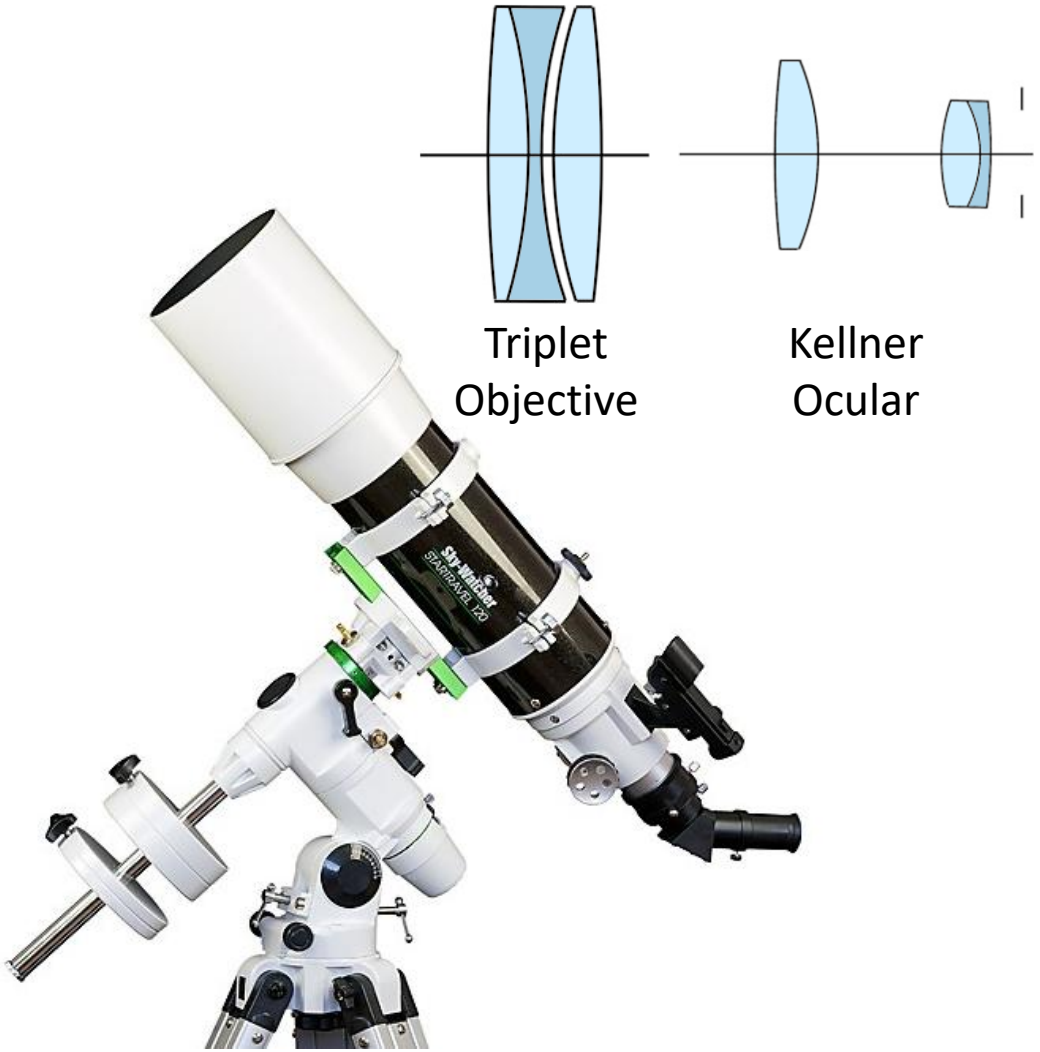
Bonus points

- Use of aspherical surfaces: +5
- Evaluate different stop sizes: +5

Hints

- Begin with a Cooke Triplet
- Split element 3 into doublet with same power (not for color correction)
- Element 3 glass: similar *V* different *n*

Keplerian Telescope System



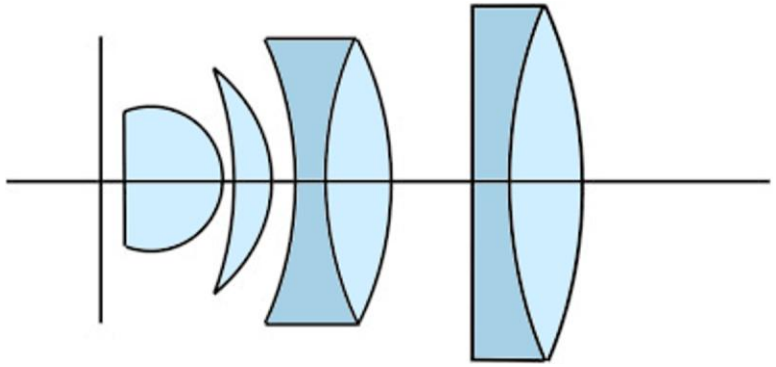
Specification

- 180mm aperture
- Magnification (angular) 120x
- Achromatic objective + ocular
- Designed separately
- May need field lens
- Fill human vision span (120°)

Bonus points

- Apochromatic (triplet objective): +10
- Use of aspherical surfaces: +5
- 90° axis steering prism: +5

High-NA Long-WD Microscope Objective



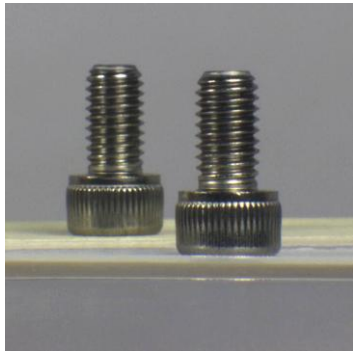
Specification

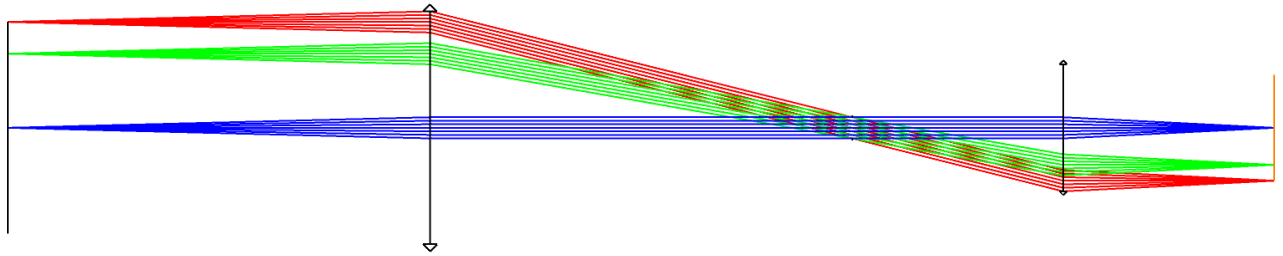
- 20×, NA 0.8, WD 3 mm
- Infinite-conjugation
- 200 mm tube length
- Full field of view 500 µm

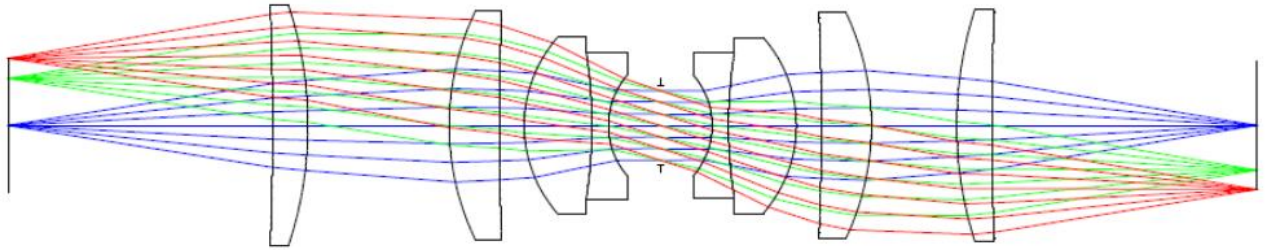
Bonus points

- Challenge: +5
- Apochromatic: +10
- Use of aspherical surfaces: +5
- Use of aplanatic surfaces: +5

Double-telecentric Lens System







Specification

- Double telecentricity
- Magnification 3:1 (0.333×)
- For full-frame image sensor

Bonus points

- Challenge: +10
- Apochromatic: +10
- Use of aspherical surfaces: +5
- Use of aplanatic surfaces: +5

Hints

- Object distance must be finite
- Strategic stop position
- Design left and right half separately and combine

Questions?

- User specifications may not be always clear
- May not even be reasonable or feasible
- When in doubt, communication is very important
- You should always raise your questions before committing serious design efforts

Appendix: Image Sensor Sizes