EE 119 Lab 4: Telescopes and Binoculars

Professor: Jeff Bokor TA: Xi Luo
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Objective

The purpose of this lab is to build and to test various types of telescopes and understand their operating principles.

Experiments:

1. Astronomical Telescope

   Build a telescope with an objective lens with f = 210mm and an eyepiece lens with f = 100mm. Use it to look at letters on the other end of the lab that are 2 cm high.
   (a) What is the magnification?
   (b) What is the resolution limit of the telescope compared to your eyes?
   (c) Where is the exit pupil? How would you calculate its size? Estimate its size.
   (d) Place a screen in front of the objective lens and align a HeNe laser into the center of the eyepiece lens. Assuming the light coming out of the HeNe is collimated (how valid is this assumption?) what will happen to the beam when it exits the objective lens? What safety considerations might you need to take into account when you use an astronomical telescope lens configuration as a beam expander?
   (e) Replace the eyepiece lens with a lens that has f = 76mm and repeat parts (a) through (d).

2. Galilean Telescope

   Build a Galilean Telescope with objective lens with f = 1000 mm and eyepiece lens with f = -100 mm.
   (a) What is the magnification?
   (b) Why is the image non-inverted? What type of image is this? Where is it located?
   (c) Compare the angular field of view of this telescope with the astronomical telescope. What are the advantages and disadvantages of this configuration?

3. Binoculars

   Examine the pair of binoculars in the lab.
   (a) What optical components are in the binoculars?
   (b) What happens if have a spot on one of the objective lenses?
   (c) Where in the binoculars does having a spot matter?
   (d) What happens if you reduce the aperture of the objective lenses?