

Resolution, Contrast and Distortion Testing

Background: Read www.normankoren.com/Tutorials/MTF5.html for the various aspects of testing lenses.

Introduction: In this lab, we explore some of the various techniques for assessing resolution and estimating the Modulation Transfer Function (MTF) of optical systems. In addition, we will look at measuring distortion.

- USAF 1951 Resolution Target** – Mount the USAF 1951 resolution target in front of a white light source. Calculate the needed lens power to fully image this target onto the CCD array. Setup this imaging configuration and capture an image. What is the magnification of your system? For the various groups and elements on the target create a table of spatial frequencies on the camera sensor. Analyze the image in Photoshop or equivalent. Calculate the contrast of the bar patterns. Based on these results, plot the approximate MTF of your system. Add a 3 diopter cylinder lens oriented horizontally to your imaging lens. How does your MTF plot change?
- Spoke Pattern** – Set up an imaging system to image the spoke pattern. Estimate the spatial frequency on the camera sensor as a function of radial distance from the center of the target. At approximately what spatial frequency does contrast go to zero? Change your lens in ± 0.25 diopter steps. Pick a spatial frequency with reasonable contrast for the original image. Plot the contrast at this frequency for various levels of defocus. Return to the original lens and add a 3 diopter cylinder lens. How does the spoke pattern change? How is this change related to the orientation of the cylinder lens?
- Distortion** – With the system from 3, image the distortion charts. Estimate the distortion of the lens. Try this with your cell phone camera (if you have one). What is the distortion in the phone lens?
- Visual Acuity** – Have one of the people in your group read the letters from largest to smallest. Have another group member record the letters. Once completed determine the visual acuity from the scale at the bottom of the chart.

