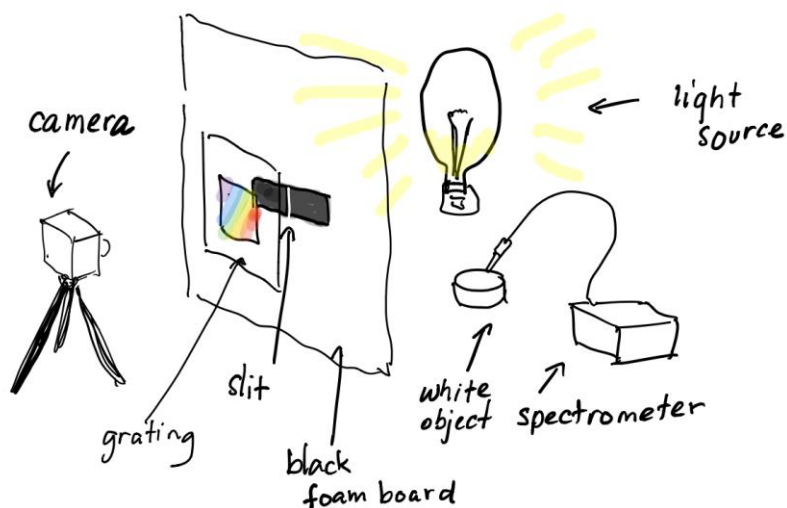

AP 187 ACTIVITY 9 – MEASURING THE SPECTRAL SENSITIVITY OF A CAMERA

Materials needed:

Broad light source (e.g. tungsten halogen lamp, xenon arc lamp, white LED), grating, spiky light sources (Gas discharge tube of Helium, Hydrogen, etc.), spectrometer, camera (you can use your Raspberry Pi or your smart phone), thin slit (you can make your own using a microscope slide and black electrical tape or a black cardboard and cutter), camera holder or tripod, black foam board or illustration board, white flat object

Procedure:

1. Arrange the materials as shown below



2. Arrange the light source and camera such that the camera sees the spectrum spread out by the grating for both broad and spiky light sources. Keep the camera and grating fixed once the setup is optimized. Capture an image of the spectrum of the spiky light source using the camera under test and measure its emittance spectrum with the spectrometer.
3. Replace the light source by a broad light source. Capture an image of the spectrum with the camera and measure its emittance. Remember, if the light is too bright for the spectrometer do not point it directly to the source, instead use the reflection from a flat white object.
4. From the image of the spiky spectrum extract a thin rectangle across the spectrum and do the same in the exact same location in the image of the broad spectrum.
5. Use the spiky spectrum intensity profile to make a pixel-to-wavelength calibration curve.

6. Apply the pixel-to-wavelength calibration to the RGB intensity profile of the broad spectrum rectangle. The intensities of the red, green, and blue channel will be the spectral sensitivity of the camera multiplied by the light source.
7. If all goes well you should get images like in Figure 1 and a result like that in Figure 2.
8. For added accuracy, fit the broad light source spectrum across the sensitivity spectrum such that it envelopes the intensities captured. Wavelength-per-wavelength, divide the sensitivity values by the intensity of the source. The resulting curve is the spectral sensitivity regardless of light source.

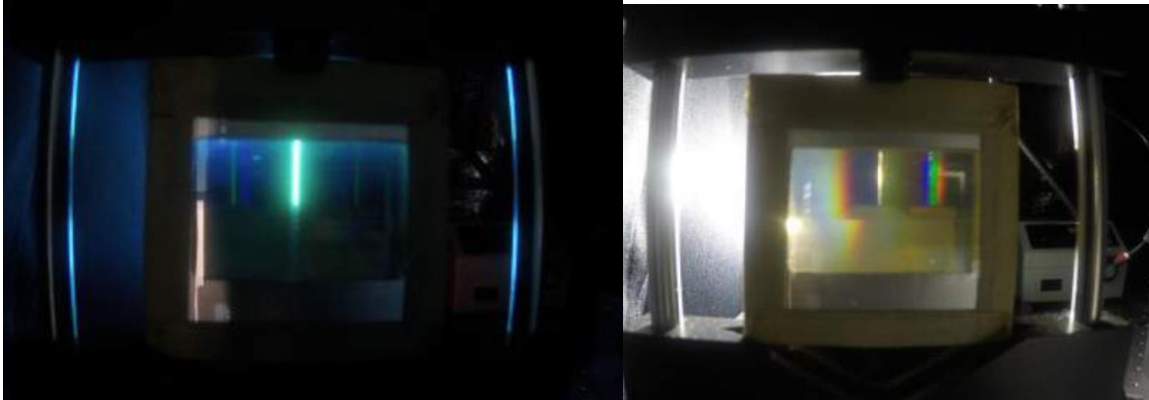


Figure 1. Left – image of grating spreading out light from a Helium gas discharge tube. Right- same setup with Helium replaced by white LED. © KG Jubilo 2016 BS App Phys Thesis

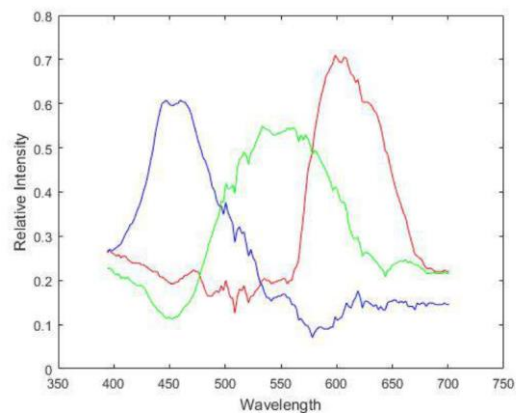


Figure 2. Measured sensitivity of a GoPro camera. © KG Jubilo 2016 2016 BS App Phys Thesis