Introduction
Noise occurs in any charge coupled device because it itself is generating electrons, additionally in any signal that is desirable to be recorded there will typically be other background signals that will interfere with the target signal that is wanted. Being able to characterize the noise a camera generates along with knowing what types of images are being taken can allow one to get a good estimate on the quality of the data that will be received.

SNR = Target Signal / √{Total Signal + (Read Noise)²}

Background
Imaging is of great concern to photographers, and the quality of their images relies very heavily on the noise that is entering the imaging systems. Astronomers look to reduce noise when looking at distant galaxies and other bodies on the far reaches of space. For this project, our objective is to be able to observe objects from 2nd magnitude to images of the 12th magnitude. With this research, estimates for the dimmest observable objects in the sky can be made; as well as the quality of which observing 12th magnitude objects can be done. Shown in figure 6.

Different Frames
There are three different types of frames that will be used to calculate the noise of the camera, these are dark frames, bias frames, and flat frames. A dark frame is a frame with no incident light, and is usually taken at varying integration times and temperatures. A bias frame is a zero length dark frame. A flat frame is a frame where the camera looks at white light at varying intensities. These three frames can be used to analyze the properties of the camera.

Types of Noise
Dark Current is a type of noise that is generated from the electronics onboard the payload. In this case it will be the camera, since whenever the camera is operating there will be dark current. From measurement the dark current values can be determined, and the intensity values of an average dark frame can be subtracted to give the signal without dark current. Dark current is measured in noise vs. integration time, and noise vs. temperature.

Read noise is the noise associated with receiving an image and converting it to usable data by the camera. Even with zero dark current, read noise will still exist. It is essentially what the camera does differently every time it snaps an image.

Shot noise arises from the fact that the amount of photons striking a source from constant source will always be a little different. This small variation affects what goes into the camera resulting in another source of noise.

SNR = Target Signal / √{Total Signal + (Read Noise)²}

Acknowledgements

Figure 2
Figure 3 is a schematic of how a CCD camera receives a signal.

Figure 4
Figure 4 shows the Zeiss Planar T lens that is mounted to the camera when taking images.

Figure 5
Figure 5 shows a bias frame while figure 6 shows a dark frame with an integration time of 4 seconds. The difference of these two images is the dark current.

Figure 6
The Signal To Noise Ratio (SNR) is the overall signal of an object being measured vs. the overall signal of the noise that the camera is receiving. There are four main sources of signal that can appear on an image taken by a camera. These are the signal of the object being viewed, the signal of the background, the dark current, and the read noise. With the last three being sources of noise. The total noise is given by √(Total Signal). An SNR of greater than one means there is more signal than noise in the image being viewed.

Figure 7
Figure 8
All camera measurements are given in terms of analog digital units (ADUs), here we use the system gain to convert the ADUs into electrons.