Detector Noise Statistics in the Non-linear Regime

P. L. Shopbell, J. Bland-Hawthorn (Rice U.)

We have examined the statistical behavior of an idealized linear detector in the presence of threshold and saturation levels. We assume that the noise is governed by the statistical fluctuations in the number of photons emitted by the source during an exposure. Since physical detectors cannot have infinite dynamic range, our model illustrates that all devices have non-linear regimes, particularly at high count rates. The primary effect is a decrease in the statistical variance about the mean signal due to a portion of the expected noise distribution being removed via clipping. Higher order statistical moments are also examined, in particular, skewness and kurtosis. In principle, the expected distortion in the detector noise characteristics can be calibrated using flatfield observations with count rates matched to the observations. For this purpose, we describe some basic statistical methods that utilize Fourier analysis techniques.