
Engineering Note

Topic: CCD Detector and Linearity

Product Affected: Sony ILX511 CCD Detector

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Description

All CCD detectors are inherently nonlinear; 2x the number of photons produce <2x the number of counts. The nonlinearity of the Sony ILX511 is necessary.

We correct for the nonlinearity of the detector by running an experiment where we vary the amount of light the detector receives; we keep the intensity of the light source constant but vary the integration time. When we analyze this data, we have a bunch of points that are counts/sec vs. counts. We look at 9 pixels across the detector (the nonlinearity of each pixel is identical) and normalize each pixel's counts/sec to 1. When we combine the data from all 9 pixels, they overlap on a plot of normalized counts/sec vs. counts. We fit this smooth function to a 7th order polynomial. This polynomial produces a correction factor for each intensity. If we observe 2000 counts, we plug 2000 into the resulting polynomial and we get a number less than 1 (typically around 0.9). We divide the number of counts by this correction factor.

After correcting for the nonlinearity of one of our spectrometers, the detector response is linear to >99.8%. Before completing the nonlinearity correction, the detector response is linear to 93%.

Though Sony lists the ILX511 on their Discontinued Device List, Ocean Optics has secured enough of these detectors to last us more than a year, after which we will replace the ILX511. We will not replace the ILX511 with Sony's ILX554B as this detector is not suitable for spectroscopy.

