A Method to Measure Droop from Flight Data

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Below is a simple method to estimate the "amount of droop" in the Si:As 24μm array on a pixel-by-pixel basis from acquired science data. First, to remind people what "droop" is: Droop is an un-usual observation where the counts (or readout) in one pixel is affected by counts in all other pixels on the array.

A simple model is to parameterise the *measured counts* (DN_m) in a single pixel i as:

$$DN_{m,i} = DN_{t,i} + D_i, \tag{1}$$

where $DN_{t,i}$ are the "true, droopless" counts, and D_i is the additional factor (in DN) due to droop. Since the droop appears to be proportional to the total *measured* counts in all other pixels j on the array, I have parameterised the droop factor as follows:

$$D_i = \beta \sum_{j \neq i}^{N} DN_{m,j}\,, \tag{2}$$

where β is the constant of proportionality (NOT the formal droop coefficent), and $N = 128 \times 128$ pixels.

One immediately sees that equations (1) and (2) when combined, form an equation for a straight line with slope β and intercept $DN_{t,i}$. The aim is to use an observing strategy that dithers around an extended source such as a galaxy in order to sample a large dynamic range in the total flux ($\sum_{j \neq i}^{N} DN_{m,j}$) falling on the array. One must also ensure that a portion of the pixels in the array don't contain any flux from the source. In other words, one wants the measured counts in pixel i ($DN_{m,i}$) to be due to the true counts ($DN_{t,i}$ - primarily only background and dark current) and the "droop effect".

With measures of $DN_{m,i}$ and ($\sum_{j \neq i}^{N} DN_{m,j}$), one can fit for β and $DN_{t,i}$ to determine the droop factor (eq. 2). For robustness, one can take the median of values for $DN_{m,i}$ amongst the different dithers. This is to account for any spurious point sources that fall in that pixel. This process can be repeated for a large number of pixels (which of course, must all avoid contamination from the extended source).

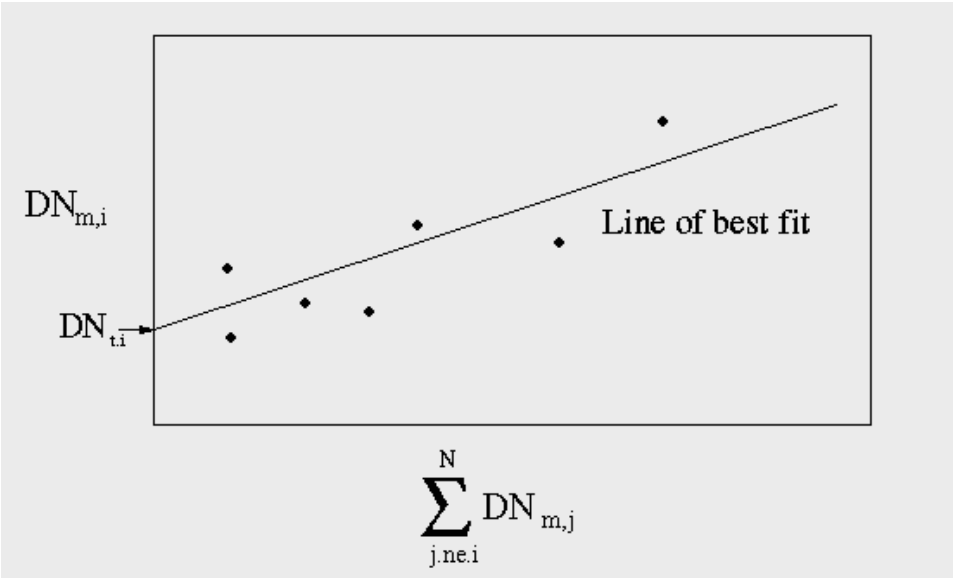

Figure 1: Schematic for measuring droop