Reference Pixel Analysis

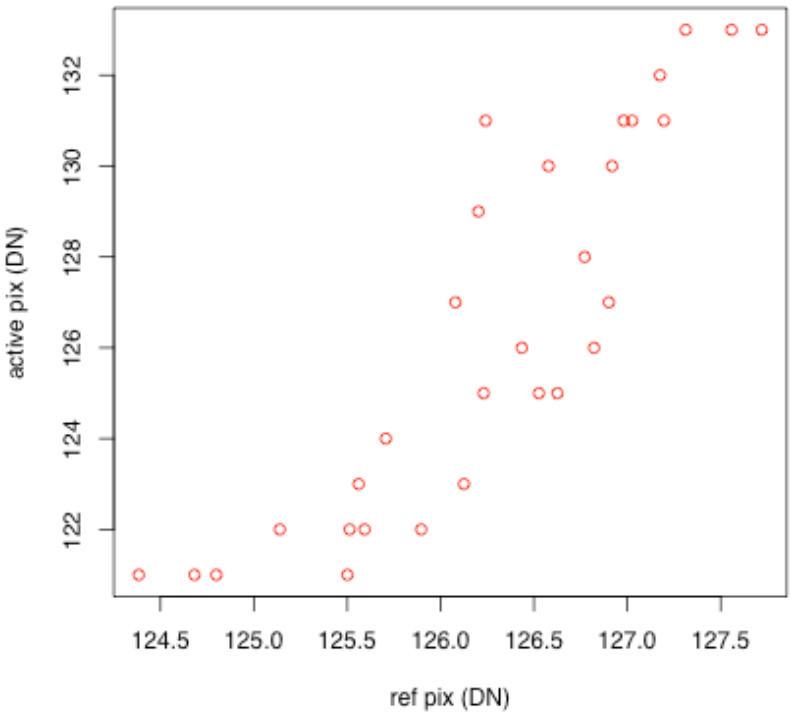
F. Masci, 7/27/2009

- The goal is to determine whether there is a significant contrast between reference and active pixel values in order to detect data bitshift problems in the downlink.
- The next two slides show plots of active vs. reference pixel values for dark and illuminated (flat) data from the MIC2 tests. These plot the mean (and in some cases the median) pixel value of a subset of frames.
- Overall, the reference pixel signal appears to be correlated with the active signal.

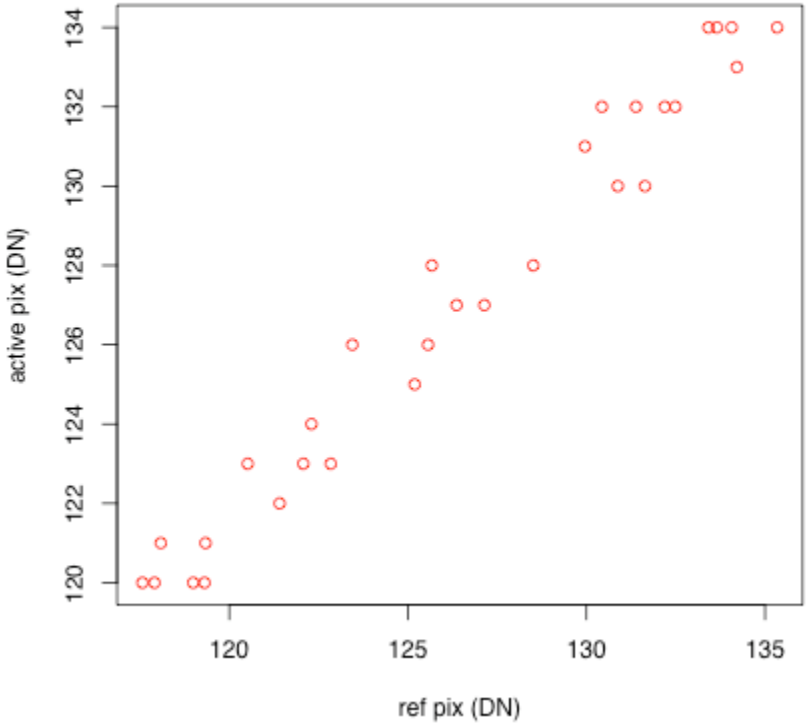
Summary:

- **band 1:** the astrophysical background is expected to be ~ 3 - 6 DN (from Ned's sims and the latest calibration plan). This is a small fraction of the dark+bias level shown on the vertical axis of the w1 plot, and is also close to the reference pixel value. Hence very little contrast is expected.
- **band 2:** the background is expected to be ~ 17 - 37 DN. From the w2 plot, we expect contrasts as measured by the ratio (dark+bias+bckgnd)/ref.value of ~ 1.11 - 1.31.
- **band 3:** the background is expected to be ~1275 - 2285 DN. From the w3 plot (on the right), we can crudely interpolate the illuminated flat data to derive a range of contrasts: (dark+bias+bckgnd)/ref.value ~ 5.7 - 10.2.
- **band 4:** the background is expected to be ~750 - 2580 DN, From the w4 plot (on the right), we can crudely interpolate the illuminated flat data to derive a range of contrasts: (dark+bias+bckgnd)/ref.value ~ 3.5 - 12.3.

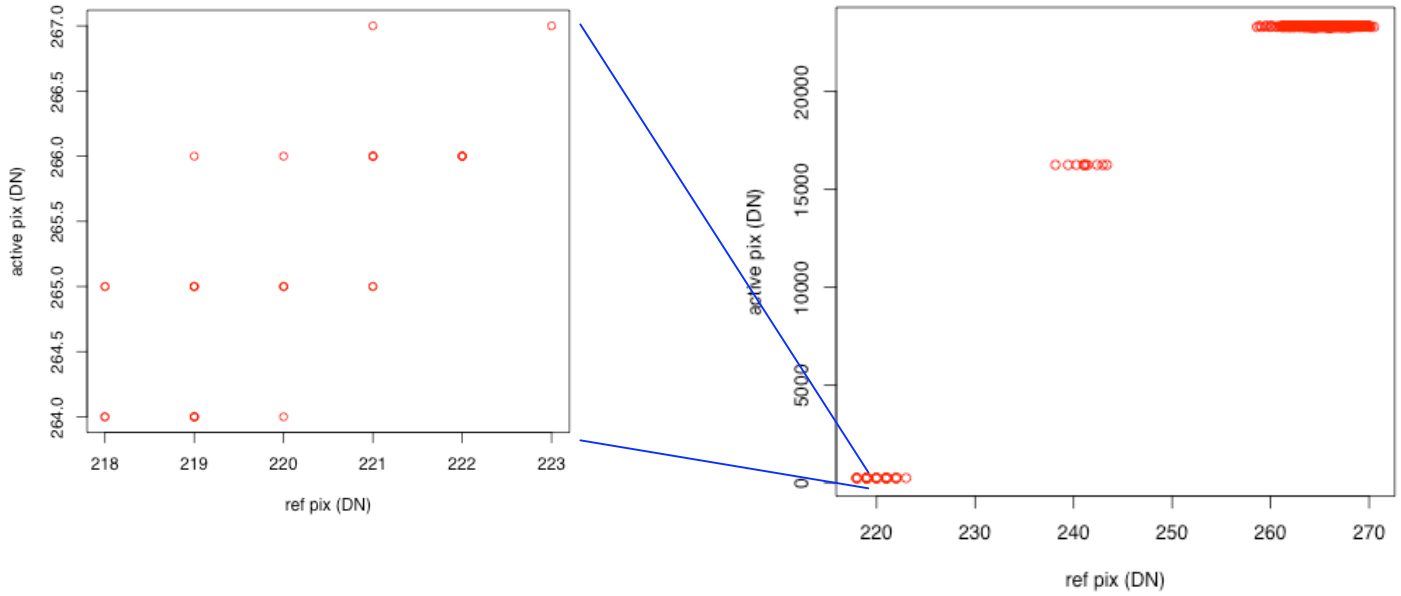
W1


active pix (DN)
122
124
126
128
130
132
124.5
125.0
125.5
126.0
126.5
127.0
127.5
ref pix (DN)

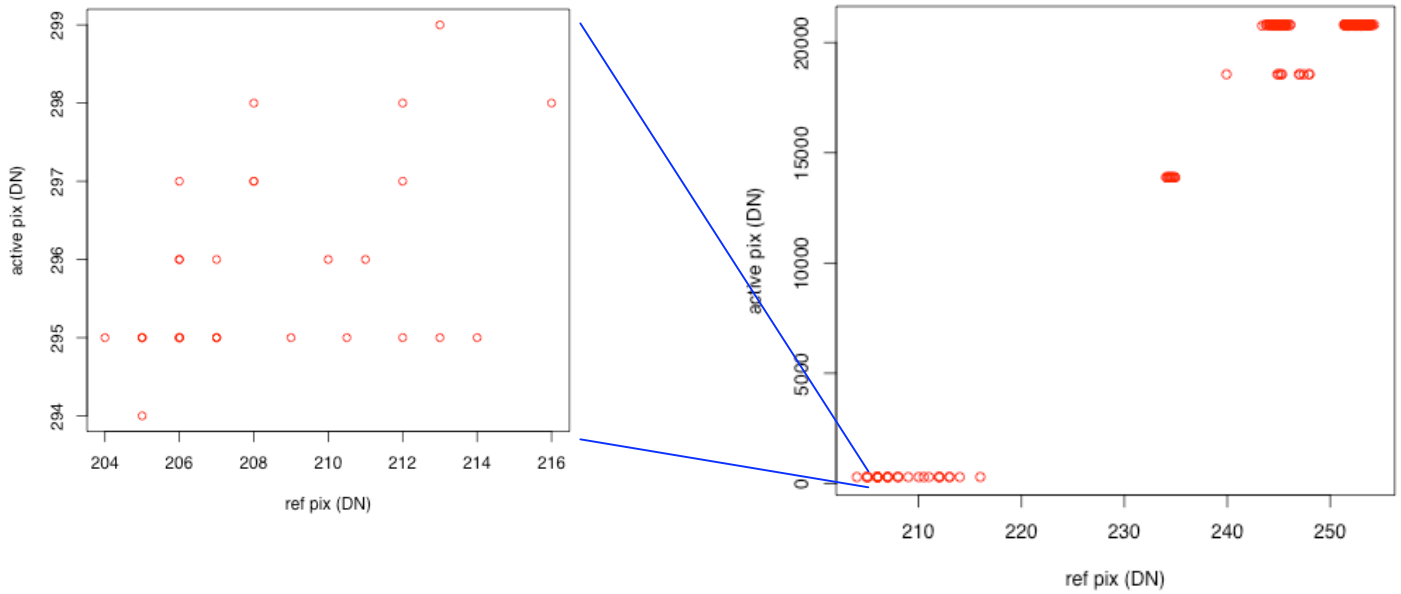
W2


active pix (DN)
120
122
124
126
128
130
132
134
120
125
130
135
ref pix (DN)

W3


active pix (DN)
264.0
264.5
265.0
265.5
266.0
266.5
267.0
218
219
220
221
222
223
ref pix (DN)
active pix (DN)
0
5000
10000
15000
20000
220
230
240
250
260
270
ref pix (DN)

W4


active pix (DN)
294
295
296
297
298
299
204
206
208
210
212
214
216
ref pix (DN)
active pix (DN)
0
5000
10000
15000
20000
210
220
230
240
250
ref pix (DN)

Thoughts

- In summary, according to the MIC2 lab data, the band 1 reference pixel boundary may be difficult to identify. Band 2 is a possibility unless the noise is high. Bands 3 and 4 have no problem.
- For bands 2, 3 and 4, one can make the reference pixel identification more reliable by searching for a spatial correlation in the expected minimum contrast. E.g., one must require that > N out of M pixels in a column, i.e., at a reference-active boundary to have some expected contrast or greater.
- Another idea is to search for pixel columns where the noise (RMS) is lower than in active columns. This is expected since reference pixels will not be affected by Poisson noise.
- One can also "self-calibrate" the contrast from each frame itself, i.e., using QA metrics on the reference and active pixels instead of using the predictions above. One would only want to use the first or first+second reference pixel columns/rows for these statistics to avoid being contaminated by possible "shifting". Then, if this contrast is significant, you can attempt to search for a shift. That's how I would do it. This is far more reliable than any guessing done from ground lab data.