Dynamic Calibration (dynacal)

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WSDC - IPAC/Caltech
sky-offsets / bad-pixel transients

scan ~250 frames

segment ~45-65 frames

sky-offset cal

reject bad frames

stack trimmed median, need min # frames to filter stars

subtract global median so level ≈ 0, = “sky-offset”

bad-pix transients

in-frame outlier detection: $|p_i - med| > N\sigma$

if pixel outlier persists for $\geq N_p$ consecutive frames at same $x,y$, set bit in all frame masks

tag decaying transients as separate mask bit

final ical run: apply sky-offsets, propagate masks; repeat on all segments
## Frame-mask updates

<table>
<thead>
<tr>
<th>Bit #</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>from static mask: excessive dark current</td>
</tr>
<tr>
<td>1</td>
<td>from static mask: excessive read noise not due to high dark current</td>
</tr>
<tr>
<td>2</td>
<td>from static mask: dead or very low responsivity</td>
</tr>
<tr>
<td>3</td>
<td>from static mask: low responsivity</td>
</tr>
<tr>
<td>4</td>
<td>from static mask: high responsivity</td>
</tr>
<tr>
<td>5</td>
<td>from static mask: saturated anywhere in ramp</td>
</tr>
<tr>
<td>6</td>
<td>from static mask: high, uncertain, or unreliable non-linearity</td>
</tr>
<tr>
<td>7</td>
<td>from static mask: broken pixel or '-ve SUR (raw frame value = 32767)</td>
</tr>
<tr>
<td>9</td>
<td>broken pixel or intrinsically '-ve SUR (downlink value = 32767)</td>
</tr>
<tr>
<td>10-18</td>
<td>saturated in sample reads 1-9 (downlink values = 32753-32761)</td>
</tr>
<tr>
<td>21</td>
<td>new/transient bad pixel from dynamic masking (tempcal)</td>
</tr>
<tr>
<td>22</td>
<td>flat-fielding (responsivity correction) unreliable (ical)</td>
</tr>
<tr>
<td>23</td>
<td>sky-offset correction unreliable (tempcal)</td>
</tr>
<tr>
<td>25</td>
<td>contains probable latent flux (tempcal)</td>
</tr>
<tr>
<td>26</td>
<td>non-linearity correction unreliable (ical)</td>
</tr>
<tr>
<td>27</td>
<td>contains cosmic-ray or outlier that cannot be classified (awod)</td>
</tr>
<tr>
<td>28</td>
<td>contains positive or negative spike-outlier (ical)</td>
</tr>
</tbody>
</table>
Quality Assurance

• See Round-Up issue 273 or:
  http://web.ipac.caltech.edu/staff/fmasci/home/wise/QAoutput_icl03.txt

• Plan: one metadata table per scan. Metrics are listed for each segment and band, e.g:

  dynacal:MinInFrames  Minimum number of frames desired for segment creation
  dynacal:MinGoodFrames Minimum number of frames required for sky-offset creation
  dynacal:NumSegments   Number of segments in scan
  dynacal:Seg<i>NumFrames Number of input frames in segment <i>
  dynacal:Seg<i>NumFiltFrames Number of frames used in segment <i>, post filtering
  dynacal:Seg<i>utcsbgn   Earliest UTCs in frame stack of segment <i> [sec]
  dynacal:Seg<i>utcsend   Latest UTCs in frame stack of segment <i> [sec]
  dynacal:Seg<i>SkyOffMean Mean pixel value in sky-offset for segment <i> [DN]
  dynacal:Seg<i>SkyOffMedian Median pixel value in sky-offset for segment <i> [DN]
  dynacal:Seg<i>SkyOffStdDev Unbiased pixel standard dev. in sky-offset for segment <i> [DN]
  dynacal:Seg<i>SkyOffSig  Pixel sigma in sky-offset from 0.5*(84%-16%) for segment <i> [DN]
  dynacal:Seg<i>SkyOffUnc  Median pixel uncertainty in sky-offset for segment <i> [DN]
  dynacal:Seg<i>MinPersist Minimum run length to diagnose transients in segment <i>
  dynacal:Seg<i>NumTransients Number of bad-pixel transients tagged in segment <i>
  dynacal:Seg<i>NumDecays  Number of significantly decaying transients tagged in segment <i>
  dynacal:Seg<i>MedTrans   Median transient run length in stack in segment <i>
  dynacal:Seg<i>MedDrops   Median number of pairwise pixel drops in segment <i>
  dynacal:Seg<i>MedFdropLat Median of ratio: num 'drops/run length for decays' in segment <i>

• Note: #bad-pix transients/frame already written to ical metadata tables. Scan-trend plot also present.
EG: 30-orbit sim (~mid Jun’09)

W1 sky-offset product

Non-zero bias $\Rightarrow$ asymmetric trimming thresholds need tuning
EG: 30-orbit sim (~mid Jun’09)

Transient lengths in stack of 50 frames [left] VS. Ground “static” W1 mask used in sim [right]

Note: - transient detection algorithm only sensitive to hot/low-response pixels
- not all static lo/hi bad-pixels recovered (and with run lengths ~50) since threshold dependent
To do…

- Refinements in Round-Up issue 174:

  - always perform transient pixel detection, irrespective of sky-offset creation or segment length

  - more generic scan partitioning algorithm when assigning frames to segments: allow for overlap

  - QA metadata

  - above are not critical for IOC, but expect to always run in “dynacal” mode to monitor products, metrics offline, and tune parameters