Latent-Image Flagging

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Preliminaries

- **AIM**: To self-consistently flag pixels containing a latent by predicting forward in time which pixel intensities in an ensemble of images are likely to persist as latents in subsequent images of the ensemble.

- Will be performed at the post BCD level and comprise a BQD product.

- Main products:
  - Each BCD will have an accompanying 8-bit FITS image (called an L-mask) which specifies latent pixels with the value “1” and “0” if not.
  - For storage limitations, L-mask is only produced if latents are found.
  - A table which reports latent-pixel locations.

- Will involve ensemble processing of BCDs within a **single AOR**. There will be no crossing of AOR boundaries.
Proposed Algorithm

**Step 1:**

- From a latent decay model, compute the pixel threshold intensity (or total count) $D_{Nthres_i}$ in each image $i$ of the AOR ensemble which will produce a latent above some noise level in all subsequent images.
- The predicted latent intensity has following functional dependence:

$$DN_{pred}(L)_i = f(T_L, DN_i, \Delta T_{Li}),$$

- $T_L =$ Total time between resets in latent-reporting image (i.e. “frame time”). This determines the number of (latent) charge traps released.
Algorithm continued..

- \( DN_i \) = Total count within exposure time of the initial illumination frame \( i \) (or “fluence”).
- \( \Delta T_{Li} \) = Time elapsed since the start of the latent reporting image \( L \) and the end of illumination period in frame \( i \) - i.e. the latent decay time.

- From above model, we want to determine the threshold \( DN_i \) (\( DN\text{thres}_i \)) above which a latent will persist above some factor of the noise \( x\sigma_L \) in image \( L \):

  \[
  x\sigma_L = f(T_L, DN \text{thres}_i, \Delta T_{Li})
  \]

- In the above example, each initial illumination frame will have a list of thresholds corresponding to each subsequent “latent-reporting” image:

  **Img 1**: \( DN\text{thres}_1(T_2, x\sigma_2, \Delta T_{2-1}), DN\text{thres}_1(T_3, x\sigma_3, \Delta T_{3-1}), DN\text{thres}_1(T_4, x\sigma_4, \Delta T_{4-1}) \ldots \)

  **Img 2**: \( DN\text{thres}_2(T_3, x\sigma_3, \Delta T_{3-2}), DN\text{thres}_2(T_4, x\sigma_4, \Delta T_{4-2}), DN\text{thres}_2(T_5, x\sigma_5, \Delta T_{5-2}) \ldots \)

  \[
  \vdots
  \]
Algorithm continued..

**Step 2:**

- Flag all “suspected” latent pixels in each image of the ensemble by flagging those pixels in the preceding illumination images that have a total count (fluence) above the corresponding predicted thresholds.

- In the above example, suppose we desire a latent image report for image number 4 in the ensemble. This will be accomplished by flagging all pixels in images 1 -- 3 which have a total count:

\[
DN > DN_{thres_1}(T_4, \sigma_4, \Delta T_{4-1}).
\]

\[
& DN > DN_{thres_2}(T_4, \sigma_4, \Delta T_{4-2}).
\]

\[
& DN > DN_{thres_3}(T_4, \sigma_4, \Delta T_{4-3}).
\]
Require from Instrument Team

- Require a model in terms of a look-up table which shows the dependence of latent fluence (in electrons) on:
  - The initial source intensity (fluence) at $t = 0$ for a fixed exposure time ($T_{\text{EXP}}$). This can be later re-scaled for arbitrary $T_{\text{EXP}}$.
  - Time since the illumination was turned off.
  - Latent image frame time. (Duration in which the resulting latent fluence was measured).

- Pixel dependent noise model in the form of a look-up table, otherwise a single noise value will be computed from the distribution of background pixel counts.