### TIRS Bias Removal

#### Background

Conversion from instrument digital counts (DN) to radiance (W/m^2-sr-µm) occurs in 3 steps: response linearization, bias removal, and gain application. The second step (bias removal) is described in this document. Although the name implies this algorithm just removes the detector bias, it actually removes the dark response and background response (which can come from the dark and background response determination algorithms or from per detector means of deep space look collects), as well as an offset that is part of the gain function that converts linearized, background subtracted DN to radiance. Note that the order of these three steps is different than OLI because the “bias” being removed is a function of detector voltage and temperature and must be linearized before being subtracted.

Bias removal is accomplished by subtracting a value (in linearized DN) from each pixel of the input image. This value varies by detector for all bands. The values are determined initially during ground testing and made available via the CPF. In-flight calibration observations (space-look data) can be used to verify the per-detector background signal and adjust the CPF periodically if necessary.

#### Input

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Description** | **Symbol** | **Units** | **Level** | **Source** | **Type** |
| Scene (Linearized DN) | QL | DN | Nband x NSCA x Ndet x Nframes | Response Linearization | Float |
| Pre-acquisition Deep Space Averages | Sa | DN | Nband x NSCA x Ndet | BPF | Float |
| Post-acquisition Deep Space Averages | Sb | DN | Nband x NSCA x Ndet | BPF | Float |
| Dark Response | D | DN | Nband x NSCA x Ndet | Dark Response Determination or CPF | Float |
| Background Response | B | DN | Nband x NSCA x Ndet | CPF | Float |
| Gain Function Offset | Go | DN | Nband x NSCA x Ndet | CPF | Float |

**Output**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Description** | **Symbol** | **Units** | **Level** | **Target** | **Type** |
| Scene (Bias Subtracted, Linearized DN) | QLB | DN | Nband x NSCA x Ndet x Nframes | TIRS Second Linearization | Float |

#### Options

* Dark and Background Response Selection
  1. Pre-acquisition deep space averages (Sa)
  2. Post-acquisition deep space averages (Sb)
  3. Average of pre-and post-acquisition deep space averages (Sab) (default)
  4. dark and background responses from the CPF (or dark response determination in the case of dark response)

#### Procedure

1. If pre- or post-acquisition deep space averages have been selected, then retrieve the selected deep space averages. Whichever is selected will be referred to as *S(b,s,d)* for the remainder of the algorithm, where *d*=detector, *s*=SCA, and *b*=band

If the average of the pre-and post-acquisitions is selected then retrieve the selected deep space averages and calculate S using equation (1).

 (1)

If the dark and background responses from the CPF are desired, then retrieve the dark and background responses from the CPF (or dark response determination in the case of dark response) and calculate *S* using equation (2).

 (2)

1. To calculate the total bias, add the gain function offsets to the combined dark and background responses.

 (3)

1. Remove the bias from the linearized scene.

 (4)

#### Maturity

This algorithm will likely be correct for the flight FPA. A native C implementation will be completed by the end of 2010 as part of the TIRS Science Data Processor pipeline, and the plan is to integrate it with the CalVal toolkit.

All of test data used was simulated or calculated from TVAC2 test data during a collect where the focal plane was looking at a cold plate meant to simulate deep space. The gain offsets, however were calculated from OBC data. The first useful in-flight Background Response CPF values will come from the “space-look” data collected during the 90 day checkout.

Expect to have more extensive test data sets as other algorithms are completed.