### TIRS Radiance to Brightness (Apparent) Temperature

#### Background/Introduction

Image data that has been converted to spectral radiance may be converted into apparent temperature (i.e. - the temperature of a blackbody with emissivity of 1.0 that would produce the spectral radiance when integrated over the band relative spectral response).

For a given calculated spectral radiance for a particular band, a look-up table (LUT) is created that relates the temperature of a blackbody (T in Deg K) to the integrated spectral radiance in the band (L in W/m^2-sr-mu). The spectral radiance is calculated through the Planck blackbody equation and then multiplying by the spectral response function of the band per wavelength and integrating over wavelength as,

 (1)

Where *Lb(T)* is the integrated spectral radiance for the spectral band at a given blackbody temperature, *R’b(λ)* is the relative spectral response of the band, and *B (λ,T)* is the Planck radiance at the given blackbody temperature T.

The Look-Up Table (LUT), example in Figure 4‑105, stores values of spectral radiance and corresponding apparent blackbody temperature between 240K and 360K allowing for conversion between the two, for each TIRS band, in steps of 0.01K.



Figure 4‑105. Example TIRS-1 10.8 µm Band Look-Up Table (LUT)

#### Inputs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Description** | **Symbol** | **Units** | **Level** | **Source** | **Type** |
| Planck Function | *B (λ,T)* | W/m2 sr µm | Nband | Derived | Float |
| Relative Spectral Response | *R’b(λ)* |  | Nband | CPF | Float |

#### Outputs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Descriptions** | **Symbol** | **Units** | **Level** | **Source** | **Type** |
| Integrated spectral radiance | *Lb(T)* | W/m2 sr µm | Nband | Derived | Float |
| Look Up Table (Rad vs Temp) | LUT | W/m2 sr µm vs Deg K | Nband | Anc File | Float |

#### Procedure

1. Read *R’b(λ)*

For each TIRS-2 band

1. Generate LUT between 180 K to 360 K to cover possible scene temperatures:

For T from 180 to 360 , 0.1 increments

* 1. Calculate *B (λ,T)*
  2. Calculate *Lb(T)*
  3. Print T, *Lb(T) to LUT*

1. convert recorded band radiance (L\_bandmeasured) into apparent temperature (T\_apparent) via LUT:

T\_apparent = LUT(L\_bandmeasured)