MIT Kavli Institute **Chandra X-Ray Center**

MEMORANDUM
February 2, 2017

To:	Jonathan McDowell, SDS Group Leader
From:	Glenn E. Allen, SDS
Subject:	Temperature-dependent RMF spec
Revision:	1.00
URL:	http://space.mit.edu/CXC/docs/docs.html#trmf
File:	/nfs/inconceivable/d0/sds/specs/mkacisrmf/trmf_spec_1.00.tex

1 Description

This spec is a high-level description of how a script could be used to create a temperature-dependent RMF.

2 Parameters

The parameters for the script are identical to the parameters for the tool `mkacisrmf`, except the script includes the two additional parameters:

1. `gtifile`,f,a,“ ”,,,“Input GTI file (e.g. the evt2 file)”

2. `mtlfile`,f,a,“ ”,,,“Input mission timeline file”

3 Processing

1. The start and stop times for each one of the N_{gti} good-time intervals for the CCD_ID of interest are read from the appropriate GTI HDU of the `gtifile`. Hereafter these times for the i^{th} interval are referred to as `START`$[i]$ and `STOP`$[i]$, respectively.

2. The N_{mtl} sets of values for the time and focal-plane temperature are read from the `mtlfile`. Hereafter, the j^{th} time and temperature are referred to as `TIME`$_{\mathrm{mtl}}[j]$ and `FP_TEMP`$_{\mathrm{mtl}}[j]$, respectively. The header of the `mtlfile` is read to obtain the values of the keywords `TIMEDEL` and `TIMEPIXR`, which are hereafter referred to as `TIMEDEL`$_{\mathrm{mtl}}$ and `TIMEPIXR`$_{\mathrm{mtl}}$, respectively.

3. The CALDB is queried to obtain the N_{resp} response files associated with the time of the observation. There is one file for each temperature range calibrated. Hereafter, the k^{th} response file is referred to as `respfile`$[k]$.

4. The minimum and maximum focal-plane temperatures for each `respfile` are obtained from header keywords in the file. Hereafter these temperatures for the $k^{\rm th}$ file are referred to as, $\texttt{FP\_TEMP}_{\rm min}[k]$ and $\texttt{FP\_TEMP}_{\rm max}[k]$, respectively.

5. For each good-time interval $i = 0, 1, \ldots, N_{\rm gti} - 1$:

   (a) For each focal-plane temperature $j = 0, 1, \ldots, N_{\rm mtl} - 1$:

      i.
      $$t_0 = \texttt{TIME}_{\rm mtl}[j] - \texttt{TIMEPIXR}_{\rm mtl} \times \texttt{TIMEDEL}_{\rm mtl}. \tag{1}$$

      ii. If
      $$t_0 < \texttt{START}[i], \tag{2}$$
      then
      $$t_0 = \texttt{START}[i]. \tag{3}$$

      iii. If
      $$t_0 \geq \texttt{STOP}[i], \tag{4}$$
      then
      $$t_0 = \texttt{STOP}[i]. \tag{5}$$

      iv. If
      $$j = 0, \tag{6}$$
      then
      $$t_0 = \texttt{START}[i]. \tag{7}$$

      v.
      $$t_1 = \texttt{TIME}_{\rm mtl}[j] + (1 - \texttt{TIMEPIXR}_{\rm mtl}) \times \texttt{TIMEDEL}_{\rm mtl}. \tag{8}$$

      vi. If
      $$t_1 < \texttt{START}[i], \tag{9}$$
      then
      $$t_1 = \texttt{START}[i]. \tag{10}$$

      vii. If
      $$t_1 \geq \texttt{STOP}[i], \tag{11}$$
      then
      $$t_1 = \texttt{STOP}[i]. \tag{12}$$

viii. If

$$j = N_{\mathrm{mtl}} - 1, \tag{13}$$

then

$$t_1 = \texttt{STOP}[i]. \tag{14}$$

ix.

$$\Delta t = t_1 - t_0. \tag{15}$$

x. For each temperature interval $k = 0, 1, \ldots, N_{\mathrm{resp}} - 1$:

A. If

$$\texttt{FP\_TEMP}_{\mathrm{mtl}}[j] \geq \texttt{FP\_TEMP}_{\mathrm{min}}[k] \text{ and} \tag{16}$$

$$\texttt{FP\_TEMP}_{\mathrm{mtl}}[j] < \texttt{FP\_TEMP}_{\mathrm{max}}[k], \tag{17}$$

then

$$\tau[k] = \tau[k] + \Delta t, \tag{18}$$

where $\tau[k]$ is the exposure time associated with temperature interval k.

6. The ARF A is computed using the entire set of good-time intervals.
7. The good-time intervals GTI$[k]$ are obtained for each temperature interval k.
8. A WMAP is obtained for each temperature interval k.
9. The RMF R_k is obtained for each temperature interval k using `respfile`$[k]$ and the appropriate WMAP.
10. The ARF A_k is obtained for each temperature interval k using the appropriate WMAP.
11. The temperature-weighted RMF is given by[1]

$$R = \frac{\sum_{k=0}^{N_{\mathrm{resp}-1}} \tau[k] A_k R_k}{A \sum_{k=0}^{N_{\mathrm{resp}-1}} \tau[k]}. \tag{19}$$

[1] The source spectrum is assumed to be the same for each temperature interval.