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

MEMORANDUM
June 10, 2011

To:	Jonathan McDowell, SDS Group Leader
From:	Glenn E. Allen, SDS
Subject:	DELTOCLK spec
Revision:	1.1
URL:	http://space.mit.edu/CXC/docs/docs.html#deltoclk
File:	/nfs/cxc/h2/gea/sds/docs/memos/deltoclk_spec_1.1.tex

1 Description

Occasionally the values of DELTOCLK in exposure-records files are anomalously high or anomalously low. Since inaccurate values of DELTOCLK lead to inaccurate pulse heights, events that are processed using anomalous values have a STATUS bit set to one and are discarded from Level 2 event-data files.

2 Input

1. One or more Level 0 event-data file (acis*evt0.fits) or a Level 1 event-data file (acis*evt1.fits)
2. One or more exposure-records file (acis*exr0.fits)
3. An exposure-statistics file (acis*stat1.fits)

3 Output

1. An updated event-data file
2. An updated exposure-statistics file

4 Parameters

1. `infile,f,a,"",,,"Name of input event-data file(s)"`
2. `outfile,f,a"",,,"Name of output event-data file"`
3. `exrfile,f,a,"",,,"Name of input exposure-records file"`
4. `expstatsfile,f,a,"",,,"Name of exposure-statistics file"`
5. `expnowidth,i,h,5,3,1001,"Number of frames in the sliding time window (must be odd)"`

6. minnumframes,i,h,3,3,1001,"Minimum number of frames in window with useful data"
7. deltoclkthresh,i,h,3,1,4096,"Minimum offset in adu that is considered anomalous"

5 Processing

1. Verify that the infile, exrfile, and expstatsfile exist. If clobber=no, then verify that the outfile does not exist. Verify that the values of the parameters expnowidth, minnumframes and deltoclkthresh are in the valid ranges for these parameters. Note that expnowidth must be an odd number.

2. If the data are being reprocessed by a user, then perform the following two steps.

   (a) Set STATUS bit 10 (of 0-31) to zero (i.e. unset it) for all of the events in the outfile. Subsequent processing sets this bit to one for the appropriate events.

   (b) Remove the contents of the HDU "BADOCLK" in the expstatsfile. This HDU is updated appropriately in subsequent processing.

3. Perform the following steps separately for each node of each CCD.

   (a) For each valid[1] frame i, compute the expected value M_i of DELTOCLK. In most cases, M_i is the median[2] of the values of DELTOCLK for the frames from $i - w$ to $i + w$, inclusive, where $w = (\texttt{expnowidth} - 1)/2$. There are some cases that require special treatment.

      i. If the frames range from $i = 1$ to N, then for the first frame (i.e. for $i = 1$) M_1 is the median value of DELTOCLK for the frames from 1 to $1 + w$, for the second frame (i.e. for $i = 2$) M_2 is the median value of DELTOCLK for the frames from 1 to $2 + w$, etc.

      ii. If the frames range from $i = 1$ to N, then for the last frame (i.e. for $i = N$) M_N is the median value of DELTOCLK for the frames from $N - w$ to N, for the second to the last frame (i.e. for $i = N - 1$) M_{N-1} is the median value of DELTOCLK for the frames from $N - 1 - w$ to N, etc.

      iii. If one or more frames in the range for which M_i is being computed is invalid[1] and if the total number of valid frames in this range is greater than or equal to minnumframes, then perform the computation using the data for the valid frames.

      iv. If one or more frames in the range for which M_i is being computed is invalid[1] and if the total number of valid frames in this range is less than minnumframes, then set M_i equal to the value of DELTOCLK for frame i (i.e. there is too little data to determine whether the value of DELTOCLK is anomalous).

   (b) If the value of DELTOCLK for a frame is greater than or equal to $M_i + \texttt{deltoclkthresh}$ or is less than or equal to $M_i - \texttt{deltoclkthresh}$, then

      i. modify the outfile to set STATUS bit 10 (of 0-31) to one for all of the events in frame i for the particular CCD and node in question and

      ii. update the "BADOCLK" HDU of the expstatsfile to include the EXPNO, CCD_ID, and NODE_ID information for the frame, CCD, and node in question.

6 TBD

1. How should dropped frames be handled (as described here or otherwise)? Look at the data to get an idea.

[1] Here, a frame is valid if there is DELTOCLK data available for it. If no DELTOCLK data are available for the frame, then it is considered invalid.

[2] If the number of elements in the set for which the median is being computed is odd, then the median is the middle value of the set after the set has been sorted (e.g. the median of [1,1,1,4,5,6,7] is 4). If the number of elements is even, then the median is the mean of the middle two values of the sorted set. If the mean is not an integer, then the mean is truncated to obtain an integer (e.g. the median of [1,1,1,4,5,6] is 2, not 2.5 or 1).

2. Should there be tests on the absolute values of the overclocks (not just the values of the DELTOCLKs) or should such tests be part of V&V?

3. Add some diagnostic plots (e.g. a histogram of `DELTOCLK` $- M_i$ [for different definitions of the median?], a plot of the fraction of the data that satisfy the `deltoclkthresh` condition as a function of `deltoclkthresh` [separately for each node?], and a plot of the rate at which anomalous values of `DELTOCLK` occur as a function of time [separately for each node?]).