MIT
Center for Space Research Chandra X-Ray Center

MEMORANDUM
March 16, 2005

To:	CXC DS
From:	Glenn Allen (SDS) for the ACIS Background Working Group
Subject:	acis_make_bkgd
Revision:	1.1
URL:	http://space.mit.edu/CXC/docs/memo_acis_make_bkgd_1.1.ps
File:	/nfs/cxc/h2/gea/sds/docs/memos/memo_acis_make_bkgd_1.1.tex

1 acis_make_bkgd

1.1 Description

When users perform spectral analyses of ACIS imaging data, they should try to estimate their background spectrum using data from nearby, on-chip, source-free regions. One advantage of using an on-chip background is that the background events have been processed in the same fashion as the source data. Another advantage is that the background spectrum represents the charged-particle radiation environment experienced during the source observation. If the background spectrum is obtained from other observations, then the radiation environment the CCDs experienced may be different. However, in some cases it is not possible or convenient to use an on-chip background. For example, if the observed source is extended it may fill the entire field of view. There may not be a source-free region to use to determine the background. For such observations, data from other ACIS observations can be used to estimate the shape of the background spectrum. The calibration team has prepared some event data files to use for this purpose. The tool acis_make_bkgd is designed to process these calibration files to create background event data files that can be used when performing spatial and spectral analyses of large diffuse sources.

1.2 Parameters

1. infile,f,a,“”,,,“Input event file with WCS and GTI information”
2. outfile,f,a,“”,,,“Output background event file”
3. bkgfile,f,a,“CALDB”,,,“Input background event file or stack (CALDB | ⟨filename⟩)”
4. asolfile,f,a,“”,,,“Input aspect solution file”
5. geompar,f,h,“geom”,,,“Parameter file for pixlib geometry files”
6. energy_min,r,h,7,,,“Minimum energy of range used for renormalization”
7. energy_max,r,h,10,,,“Maximum energy of range used for renormalization”
8. clobber,b,h,“no”,,,“Overwrite output event file if it already exists?”

9. verbose,i,h,0,0,5,“Amount of messages produced (0=none, 5=most)”
10. mode,s,h,“ql”,,,“q=query, h=do not query and l=save values used”

1.3 Input

1. An event data file that includes GTIs (e.g. acis*evt2.fits).
2. A background event data file (e.g. acis7sD2000-12-01bkgrndN0002.fits)
3. An aspect solution file (e.g. pcad*asol1.fits)
4. Geometry files for pixlib.

1.4 Output

1. A background event data file where the coordinates have been recomputed using the WCS information in the input event data file and the aspect solution in the input aspect solution file.

1.5 Processing

1. Verify that the specified input files exist. If the parameter clobber = “no,” then verify that the output file does not exist.
2. Read the WCS information from the input event data file.
3. Read the values of the keywords SIM_X, SIM_Y, SIM_Z, RA_NOM and DEC_NOM from the aspect solution file.
4. Read the input geometry files.
5. Determine which CCDs were active from the keyword DETNAM in the header of the input event data file. If the keyword is missing, then use the column CCD_ID in the EVENTS extension of the input event data file.
6. Begin a loop over each active CCD.
7. Read the set of GTIs used for CCD_ID = i.
8. If the parameter bkgfile = “CALDB,” then identify the input background event data file to use for CCD_ID = i.
9. Read the background event data for CCD_ID = i.
10. For each background event j,

    i Randomly select a TIME t for event j from the set GTIs for CCD_ID = i. The random deviates should be uniformly distributed within the GTIs.

    ii Determine which values of RA, DEC, ROLL, dy and dz from the aspect solution file are appropriate for TIME = t. If there is no aspect information for TIME = t, then write an error message and exit.

    iii Use CCD_ID = i, the coordinates CHIPX and CHIPY for event j, the values of RA, DEC, ROLL, dy and dz for TIME = t and the values of RA_NOM, DEC_NOM, SIM_X, SIM_Y and SIM_Z to compute the values of NODE_ID, TDETX, TDETY, DETX, DETY, X, and Y for event j.

11. Write the new values of TIME, NODE_ID, TDETX, TDETY, DETX, DETY, X and Y to the output file.

12. Copy the values of CCD_ID, PHA, ENERGY, PI, FLTGRADE, GRADE and STATUS from the input background file to the output file. Do not include the column EXPNO in the output file.

13. Set the value of ONTIMEi in the output file equal to the sum of the GTIs for CCD_ID = i.

14. Set the value of BGDCORi in the output file:

$$\mathrm{BGDCOR}i = \frac{N_{\mathrm{bkg}}}{N_{\mathrm{in}}}, \tag{1}$$

where N_{bkg} is the total number of counts in the input background file in the energy band from energy_min to energy_max for CCD_ID = i and N_{in} is the total number of counts in the input file (i.e. infile) for the same energy band and CCD.

15. Set the value of EXPOSURi (and LIVTIMEi) in the output file:

$$\mathrm{EXPOSUR}i = \mathrm{BGDCOR}i \times \mathrm{DTCOR} \times \mathrm{ONTIME}i. \tag{2}$$

16. End the loop over each active CCD.

17. Set the value of ONTIME in the output file to be identical to the value of ONTIMEn, where CCD_ID = n is the CCD at the aimpoint.

18. Set the value of EXPOSURE (and LIVETIME) in the output file to be identical to the value of EXPOSURn, where CCD_ID = n is the CCD at the aimpoint. Note that the values of EXPOSURn can exceed the difference between TSTOP and TSTART.

19. With the following exceptions, the rest of the keywords should be copied from the header of the input event file (i.e. infile) to the header of the output file.

20. Set DATAMODE=FAINT and READMODE=TIMED in the output file.

21. Set the keyword FILTER=NONE in the output file.

22. Set the keyword OBJECT in the output file:

$$\mathrm{OBJECT}_{\mathrm{out}} = \mathrm{OBJECT}_{\mathrm{in}}\ \mathrm{BACKGRND}. \tag{3}$$

For example, OBJECT='SN 1006-NE' becomes OBJECT='SN 1006-NE BACKGRND'.

23. If the keywords BPIXFILE, CTI_CORR, CTIFILE, GAINFILE, TGAINCOR and TGAINFIL exist in the input background file, then copy the values of these keywords to the output file. Otherwise, exclude the keywords from the output file.

24. If the values of any of the keywords CTI_CORR, CTIFILE, GAINFILE and TGAINCOR in the input event file (i.e. infile) differ from the values of the same keywords in the input background file, then write a warning message that there may be a mismatch between the pulse height processing of the input event file and the input background file.

25. Exclude the keywords DATE-END, DATE-OBS, OBSERVER, OBS_ID, SEQ_NUM, TIMEPIXR and TITLE from the output file.

26. Add some COMMENTs to the header of the output file, which state that the file is a background file not an event file associated with an observation.

27. TIME sort the output file.

28. Append the GTIs used to the output file.