ECR: Update CALALIGN align matrices (2007-Apr)
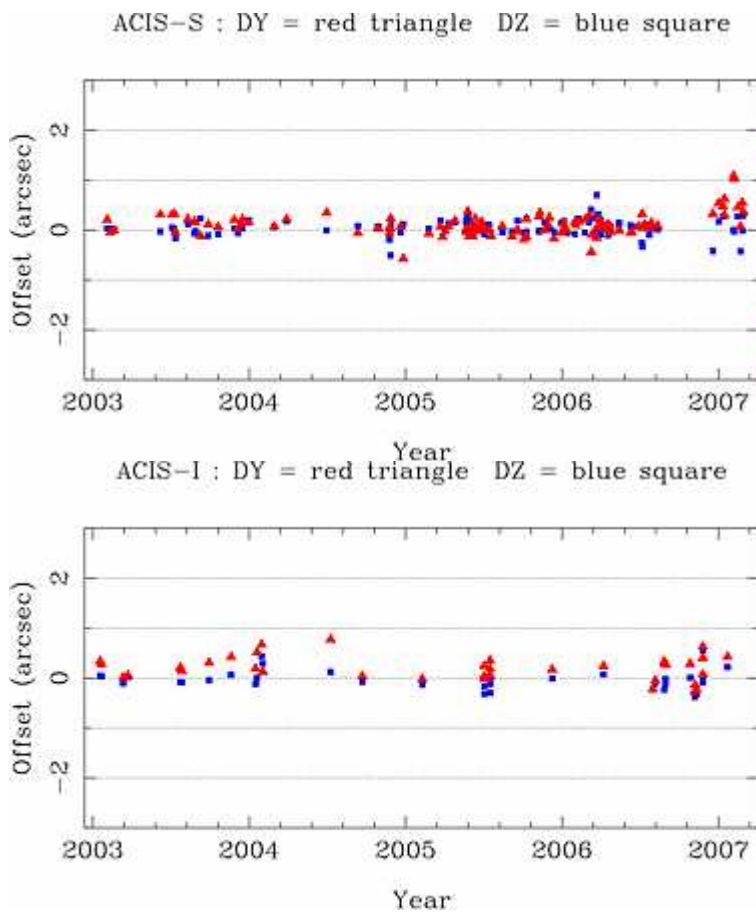
Overview

This ECR is to update the values of the CALALIGN columns aca_misalign and fts_misalign in order to improve absolute astrometric accuracy. A previous ECR for this operation is available at: http://cxc.harvard.edu/mta/ASPECT/boresight/UPDATE_2002-Apr/. The justification for the creation of these new CALALIGN columns may be found on: http://cxc.harvard.edu/cal/ASPECT/celmon/ and is also repeated here for reference:

Justification

In Mar-2007 a systematic offset of approximately 0.5 arcsec in the spacecraft Y direction was apparent in data taken after approximately Dec-2006. This is believed to be the result of a changed thermal environment following the procedure to cool the ACA CCD from -15C to -19C that took place between late Nov-2006 and early Jan-2007. The offset is most evident in the ACIS-S and ACIS-I time-history plot plots below.

Based on this evidence that the ACA CCD cooling operation can affect the aspect fiducial transfer system alignment, the aspect offsets since Jan-2003 have been analyzed to determine optimal alignment values for each of the three operational ACA CCD temperature values (-10 C, -15 C, and -19 C). The new CALALIGN files are version N0006.

Determining Alignment Values

As the alignment values have temperature dependence, the mission thus far was divided into three approximate temperature epochs

	Epoch 1	Epoch 2	Epoch 3
CCD Temp	-10	-15	-19
TSTART	2002-12-01	2003-06-09	2006-12-10
TSTOP	2003-06-09	2006-12-10	2007-04-01

and average DY DZ offsets (arcsec) for each epoch were calculated using the plot_offsets.pl tool in its batch mode. (No HRC data was used for epoch 3)

detector	Δ type	epoch1	epoch2	Δ 2 vs 1	epoch3	Δ 3 vs 1
ACIS-S	dy	-0.03	0.05	+0.08	0.41	+0.44
ACIS-I	dy	0.10	0.23	+0.13	0.45	+0.35
HRC-S	dy	0.03	0.31	+0.28		
HRC-I	dy	0.08	0.12	+0.04		
mean Δ dy				+0.10		+0.40

detector	Δ type	epoch1	epoch2	Δ 2 vs 1	epoch3	Δ 3 vs 1
ACIS-S	dz	0.04	0.05	+0.01	0.17	+0.13
ACIS-I	dz	-0.05	-0.05	+0.00	0.22	+0.27
HRC-S	dz	0.02	0.06	+0.04		
HRC-I	dz	-0.08	0.00	+0.08		
mean Δ dz				+0.00		+0.20

Creation of New CALALIGN Files

To create new CALALIGN files, first N0006 versions of the all files were made from the in-use N0005 files using the copy_existing.py script. Then, new CALALIGN files were created for epoch 2 and 3 using the offsets determined above (epoch 2 : dy,dz = +.10, +.00, epoch 3 : dy, dz = +.40, +.20) . The new offsets were applied to the pcadD2002-12-01alignN0005.fits file using time_align.pro.

Epoch	File	Comments
1	pcadD2002-12-01alignN0006.fits	previously existing file modified to have a new tstop
2	pcadD2003-06-09alignN0006.fits	new file with epoch 2 offsets
3	pcadD2006-12-10alignN0006.fits	new file with epoch 3 offsets

All files in this update are N0006. With the exception of the 2002-12-01 file (as noted above), all previous N0005 alignment file contents were unchanged.

Verification

For Epoch 2 and 3, at least 4 observations were reprocessed using the new CALALIGN files. For each observation, a bright point source identified with a Tycho optical source or an ICRS radio source was detected, and its position was compared to the relevant catalog position and its position in the event file created using the original CALALIGN file. Those results are tabulated below. Epoch 1 was not verified, as no changes (except a change to TSTOP) were made to those CALALIGN files.

The results (changes in DY and DZ) are as expected for each observation and over each Epoch.

Epoch 2

Obsid	Detector	Date	C_RA	C_DEC	OrigDY	OrigDZ	CorrDY	CorrDZ	VsDY	VsDZ
4492	ACIS-I	2004-01-30T05:52:46	128.97	-50.97	0.64	0.38	0.58	0.38	-0.06	0.00
4477	ACIS-I	2004-07-09T13:46:37	261.18	-34.21	0.68	0.14	0.52	0.17	-0.16	0.03
6134	HRC-I	2004-11-25T21:28:11	332.17	45.74	0.33	-0.03	0.28	0.11	-0.05	0.14
5102	HRC-S	2004-11-28T05:42:35	332.17	45.74	0.44	0.21	0.21	0.12	-0.22	-0.09
5719	ACIS-S	2006-03-26T05:52:18	225.20	47.85	0.20	0.14	0.11	0.13	-0.09	-0.00
Mean Values					0.46	0.16	0.34	0.18	-0.12	0.02

Epoch 3

Obsid	Detector	Date	C_RA	C_DEC	OrigDY	OrigDZ	CorrDY	CorrDZ	VsDY	VsDZ
8015	ACIS-I	2007-01-07T09:54:05	149.74	2.25	0.44	0.25	0.02	0.03	-0.43	-0.22
8277	HRC-S	2007-01-29T01:00:07	279.24	38.78	0.58	0.18	0.09	0.02	-0.50	-0.16
7360	ACIS-S	2007-02-25T23:11:04	194.05	-5.79	0.46	-0.03	0.04	-0.22	-0.43	-0.19
8275	HRC-I	2007-03-19T12:10:41	199.09	29.10	0.46	0.04	0.09	-0.17	-0.37	-0.21
Mean Values					0.49	0.11	0.06	-0.09	-0.43	-0.19

Key

Obsid	Obsid
Detector	Detector
Date	Date Observed
C_RA	Catalog RA
C_DEC	Catalog DEC
OrigDY	DY of source from catalog position using In-Use CALALIGN
OrigDZ	DZ of source from catalog position using In-Use CALALIGN
CorrDY	DY of source from catalog position using proposed new CALALIGN
CorrDZ	DZ of source from catalog position using proposed new CALALIGN
VsDY	DY of source (In-Use vs Proposed)
VsDZ	DZ of source (In-Use vs Proposed)

Source Documents

The analysis directory for this ECR is available at /proj/sot/ska/analysis/aca_cal_align/update_2007-may/ .

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History: r51 - 08 May 2007 - 18:29:48 - TomAldcroft

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