atthkgen

August 15, 2005

Abstract

The task **atthkgen** produces a FITS file with a single bintable extension, containing the entire attitude information for a complete observation.

1 Instruments/Modes

Instrument	Mode
EPIC MOS	ALL
EPIC PN	ALL
RGS	ALL
OM	ALL

2 Use

pipeline processing	yes
interactive analysis	yes

3 Description

We need to be able to make use of OM and AOCS attitude information to create GTIs. These GTIs may be based upon the presence of AOCS or OM data, the quality of these data, offsets of the attitude data from the average pointing, or differences between the AHF and OM data.

The task **atthkgen** produces a FITS file with a single bintable extension containing the entire attitude information for a complete observation, by accessing the particular ODF in question. The task **tabgtigen** can then be used to create GTIs from this file.

Once the whereabouts of the particular ODF in question are known, (set via the environment variable $SAS_ODF) the observation start and end times are read in by **atthkgen** via an OAL call. The task **atthkgen** then loops through every second, say (or whatever the user defines via the parameter `timestep`), of the observation, obtaining the attitude information and quality for this time. The task accesses the attitude data from both the Attitude History File (AHF) and from the OM Tracking History Data files (THF).

The attitude information at the requested point in time is computed by an OAL call. If the closest AHF or OM THF points lie further than 20 seconds away from the requested point in time, the attitude quality is deemed bad and the RA, Dec and position angle are set by the OAL call to bad.

The file will contain (per second, say) the following columns: firstly, along with the time (column name `TIME`), the AHF and OM attitude information (i.e. RA, Dec, position angle - `AHFRA`, `AHFDEC`, `AHFPA`, and `OMRA`, `OMDEC`, `OMPA`). Here, NULL values (i.e. 'INDEF' in field) in all three fields will indicate that the quality is bad, hence quality filtering can be done by **tabgtigen** (by searching for these NULL values) to create attitude quality GTI files. If the attitude quality is good, then the absolute pointing difference between the AHF instantaneous star-tracker pointing and the previously calculated median value of the star-tracker pointing is given as `DAHFPNT`. Similarly the OM equivalent (`DOMPNT`) is given and the difference between the AHF and OM pointings (`DAHFOM`) (in the cases where the quality is bad, NULL values ('INDEF') are given).

Also included as attributes in the primary header will be the mean and median values of the nine tabulated attitude columns. These will be named `AAHFRA`, `AAHFDEC` etc (the 'A' indicating average [i.e. mean]) and `MAHFRA`, `MAHFDEC` etc (the 'M' indicating median). These values can be accessed by the task **attcalc**.

4 Parameters

This section documents the parameters recognized by this task (if any).

Parameter	Mand	Type	Default	Constraints
atthkset	yes	filename	atthk.dat	none

output fits file name

Parameter	Mand	Type	Default	Constraints
timestep	yes	real	1.0	>0.0 s

Duration (in sec) of 'step' through attitude information (output file entries are separated by this duration)

5 Errors

This section documents warnings and errors generated by this task (if any). Note that warnings and errors can also be generated in the SAS infrastructure libraries, in which case they would not be documented here. Refer to the index of all errors and warnings available in the HTML version of the SAS documentation.

badTimestep *(error)*
Parameter `timestep` should be greater than zero

BadAhfAttitude *(warning)*
No good AHF attitude found
corrective action: Continue, with warning message

BadOmAttitude *(warning)*
No good OM attitude found
corrective action: Continue, with warning message

BadAhfOmAttitude *(warning)*
No good simultaneous AHF and OM attitude found
corrective action: Continue, with warning message

6 Input Files

1. Attitude History File and one or more of the OM Tracking History Data files held within the specified ODF

7 Output Files

1. FITS file with a single bintable extension (ATTHK), containing the entire attitude information for the complete observation. The file will contain, along with the time (TIME), the AHF and OM attitude information (i.e. RA, Dec, position angle - AHFRA, AHFDEC, AHFPA, OMRA, OMDEC, OMPA), with NULL ('INDEF') values in all three fields indicating bad attitude quality. If the attitude quality is good, then the absolute pointing differences between the instantaneous AHF and the median AHF star-tracker pointing (DAHFPNT), between the instantaneous OM and the median OM THF pointing (DOMPNT), and between the AHF and OM pointings (DAHFOM) are also given (NULL ('INDEF') values will be given in the bad quality cases). All columns are of type real64, and all, except TIME (in sec) are given in units of degrees. Attributes in the primary header give the mean and median values of the nine tabulated attitude columns. They are named as the columns prefixed by an 'A' for average (i.e. mean) and an 'M' for median. Keywords written to file: TELESCOP DETNAM FILTER OBS_ID OBS_MODE ORIGIN DATE-OBS DATE-END RA_OBJ DEC_OBJ RA_NOM DEC_NOM AAHFRA AAHFDEC AAHFPA AOMRA AOMDEC AOMPA ADAHFPNT ADOMPNT ADAHFOM MAHFRA MAHFDEC MAHFPA MOMRA MOMDEC MOMPA MDAHFPNT MDOMPNT MDAHFOM NATT NGAHF NGOM NGAHFOM

8 Algorithm

```
subroutine atthkgen

  * get ODF
  * get start and end times of complete observation
  * open output fits file
  * loop through time (timestep)
      set attitudeFromAhf to true + call OAL_getAttitude (get AHF attitude)
      set AHF info to OAL_getAttitude info (or to NULL if bad)
      calculate summed attitude information for AHF
      set attitudeFromAhf to false + call OAL_getAttitude (get OM attitude)
      set OM info to OAL_getAttitude info (or to NULL if bad)
      calculate summed attitude information for AHF OM
      calculate AHF-Om difference
  * end loop through time
  * get median infomation at correct point in loop (AHF/OM values)
  * calculate mean attitude information (AHF/OM)
  * loop through time (timestep)
      calculate differences (AHF-PNT, OM-PNT)
  * end loop through time
```

```
   * get median infomation at correct point in loop (Diff PNT values)
   * calculate mean attitude information (Diff PNT)
   * fill fits file columns (AHF, OM)
   * fill in differences columns
   * add keywords, means, medians and history to fits file

end subroutine  atthkgen
```

9 Comments

- The OM Tracking History Files give only relative displacements as attitude information, and how this will be translated into absolute RA and Dec is still uncertain. Perhaps in the future it could be done via the task **omatt** in conjunction with OAL_getAttitude though this is still unknown, and may imply that a large fraction of the OM pipeline may need to be run early in the PPS.
- It is thought, at the moment, that the AHF may only have a very few number of entries in it, and as such, **atthkgen** may seem not well suited to such a situation. Note though that it is envisaged that the movement offset threshold at which new AHF entries will be input may be reduced from 2.5 arcsec to 0.5 arcsec. This will give many more AHF entries.
- If GTIs are to be produced from this file, then it may be important that the output be an additional PPS product. If however, the file is easily and quickly recreatable by the user (e.g. so long as the OM chain does not have to be re-run, for instance), then it may not need to be a product.
- This file is needed as input for the **attcalc** task, where the mean/median attitude values are taken as the PNT attributes.

10 Future developments

As discussed above, we are still unsure as to how the absolute OM pointing information will be obtained.

11 Examples

- *atthkgen* (full attitude information in ODF [set via the environment variable $SAS_ODF] entered every second into file atthk.dat)
- *atthkgen atthkset=newatthk.dat timestep=10* (full attitude information in ODF entered every 10 seconds into file newatthk.dat)

References