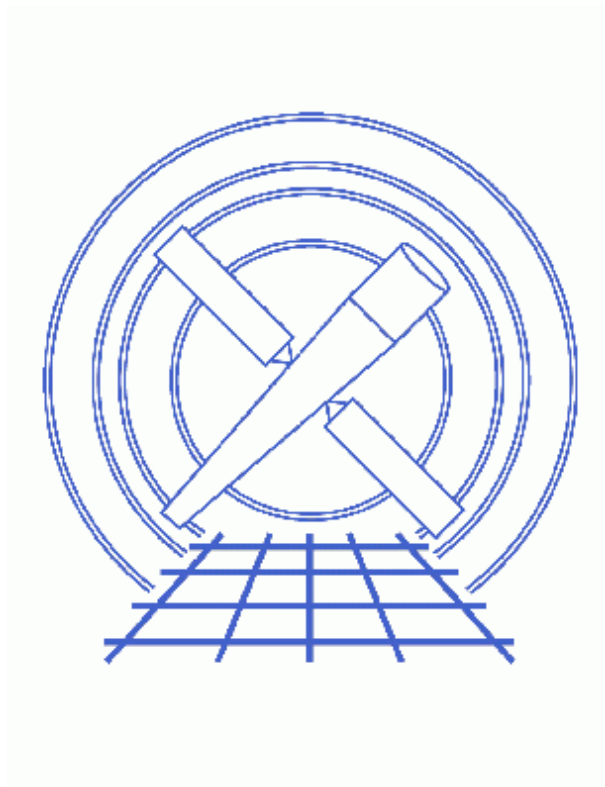


Reprojecting Coordinates of a Solar System Object



CIAO 3.4 Science Threads

Table of Contents

- *Choosing the Ephemeris Files*
- *Run sso freeze*
- *Display the Results*
- *Parameter files:*
 - ◆ *sso freeze*
- *History*
- *Images*
 - ◆ *Comparison of original and "frozen" images*

Reprojecting Coordinates of a Solar System Object

CIAO 3.4 Science Threads

Overview

Last Update: 1 Dec 2006 – reviewed for CIAO 3.4: no changes

Synopsis:

When an object is observed moving with respect to the observer, e.g. a planet or comet, the resulting event file looks "blurred" when viewed in (x, y) coordinates. The `sso_freeze` tool reprojects the coordinates to the frame of the object, eliminating this blurring.

Purpose:

To reproject coordinates from the frame fixed to the celestial sphere to a reference frame which is fixed to the moving solar system object (SSO).

Read this thread if:

you are working with any observation of a solar system object.

Proceed to the [HTML](#) or [hardcopy \(PDF: \[A4\]\(#\) | \[letter\]\(#\)\)](#) version of the thread.

Choosing the Ephemeris Files

Sample ObsID used: 1463 (ACIS-S, Jupiter)

File types needed: evt2; eph1

There are two ephemeris input files needed for the tool to run. One is the spacecraft ephemeris file ([scephemfile](#)) and the other is the SSO ephemeris file ([ssoephemfile](#)).

Due to a bug in *ChaSeR*, it is necessary to obtain both of these files from the CDA FTP site.

The ephemeris files are selected based on the start time (TSTART) of the observation:

```
unix% dmkeypar acisf01463N002_evt2.fits TSTART echo+  
59968797.485273
```

Now connect to `cda.harvard.edu`, using the login "anonymous" and your email address as the password:

Solar System Coordinates – CIAO 3.4

```
unix% ftp cda.harvard.edu
Connected to cda.
220 cda FTP server (Version wu-2.6.1(1) Mon Aug 7 15:20:43 EDT 2000) ready.
Name (cda.harvard.edu): anonymous
331 Guest login ok, send your complete e-mail address as password.
Password:
230- Welcome to the FTP server at the CXC Science Center
230-
230- This server is cda.harvard.edu
230-
230-If your FTP client crashes or hangs shortly after login please try
230-using a dash (-) as the first character of your password. This will
230-turn off the informational messages that may be confusing your FTP
230-client.
230-
230-Publicly available files are in /pub
230-
230-Problems with this ftp site? Contact cxcftp@head-cfa.harvard.edu
230-
230- +-----+
230- | PLEASE NOTE: (ChaSeR users only)
230- |
230- | If the directory provided to you by ChaSeR appears
230- | to be empty, this is a sign that your tar file is
230- | not yet ready. Please try again in a little while.
230- |
230- | If your directory seems to contain several tar
230- | files, e.g., file.tar.0, file.tar.1, ...
230- | retrieve all files, then untar as follows:
230- | cat file.tar.* | tar xvf -
230- | We are limiting the size of individual files to
230- | less than 2 GB, but these files need to be
230- | concatenated before submitting them to tar.
230- |
230- +-----+
230-
230 Guest login ok, access restrictions apply.

ftp> cd /pub/arcftp/bary/ephem
250 CWD command successful.
ftp> ls
200 PORT command successful.
150 Opening ASCII mode data connection for file list.
asteroid_1998_wt24f124416300N001_eph1.fits
comet_1999_s4_linearf079920300N001_eph1.fits
comet_1999_s4_linearf081475500N001_eph1.fits
..(cut)..
jupiterf059875200N001_eph1.fits
jupiterf059875200N002_eph1.fits
jupiterf093312000N001_eph1.fits
jupiterf162475200N001_eph1.fits
marsf110592000N001_eph1.fits
moonf110563500N001_eph1.fits
moonf112492800N001_eph1.fits
moonf117504000N001_eph1.fits
moonf200016000N001_eph1.fits
moonf202550400N001_eph1.fits
moonf207316800N001_eph1.fits
orbitf050397000N001_eph1.fits
orbitf050420100N001_eph1.fits
orbitf050745900N001_eph1.fits
```

Solar System Coordinates – CIAO 3.4

```
orbitf052088700N001_eph1.fits
orbitf053208300N001_eph1.fits
orbitf054122700N001_eph1.fits
..(cut)..
orbitf246888300N001_eph0.fits
orbitf246888300N001_eph1.fits
saturnf166665600_eph1.fits
saturnf190944000N001_eph1.fits
saturnf191505600N001_eph1.fits
titanf158112000N001_eph1.fits
uranusf145120000N001_eph1.fits
venusf095299200N001_eph1.fits
226 Transfer complete.
21088 bytes received in 1.2 seconds (17.64 Kbytes/s)
ftp>
```

The files that begin with "orbit" are spacecraft ephemeris files; the SSO ephemeris files are identified by the object name and file start time. In each case, we want to choose the file that has the highest start time *less than* the start time of the data (59968797):

```
ftp> ls orbitf059*
200 PORT command successful.
150 Opening ASCII mode data connection for file list.
orbitf059227500N001_eph1.fits
orbitf059486700N001_eph1.fits
orbitf059832300N001_eph1.fits
226 Transfer complete.
remote: orbitf059*
93 bytes received in 0.0014 seconds (66.49 Kbytes/s)

ftp> get orbitf059832300N001_eph1.fits

ftp> ls jupiter*
200 PORT command successful.
150 Opening ASCII mode data connection for file list.
jupiterf059875200N001_eph1.fits
jupiterf059875200N002_eph1.fits
jupiterf093312000N001_eph1.fits
jupiterf162475200N001_eph1.fits
226 Transfer complete.
remote: jupiter*
132 bytes received in 0.03 seconds (4.36 Kbytes/s)

ftp> get jupiterf059875200N002_eph1.fits

200 PORT command successful.
150 Opening ASCII mode data connection for jupiterf059875200N002_eph1.fits (63360 bytes).
226 Transfer complete.
local: jupiterf059875200N002_eph1.fits remote: jupiterf059875200N002_eph1.fits
63462 bytes received in 0.13 seconds (462.57 Kbytes/s)
```

If there is more than one version of a file – e.g. N001 and N002 – choose the newest (higher number) version available.

So the two ephemeris files for this observation are `orbitf059832300N001_eph1.fits` and `jupiterf059875200N002_eph1.fits`.

Run sso_freeze

Once you have the necessary input files, you are ready to run the tool:

```
unix% punlearn sso_freeze
unix% pset sso_freeze infile=acisf01463N002_evt2.fits
unix% pset sso_freeze scephemfile=orbitf059832300N001_eph1.fits
unix% pset sso_freeze ssoephemfile=jupiterf059875200N002_eph1.fits
unix% pset sso_freeze outfile=frozenjupiter.fits
unix% sso_freeze
Input event file or stack (acisf01463N002_evt2.fits):
Input spacecraft ephemeris file (orbitf059832300N001_eph1.fits):
Input solar system object file (jupiterf059875200N002_eph1.fits):
Output event file name (frozenjupiter.fits):
```

The contents of the parameter file may be checked using `plis sso_freeze`.

Display the Results


The new object-centered coordinates are stored in the `ocx` and `ocy` columns of the file. When displaying the "frozen" image, we must specify to bin on those columns (*note* that the binning syntax for `ds9` is not the same as for the DM):

```
unix% ds9 "frozenjupiter.fits[bin=ocx,ocy]" &
```

Alternatively, the image can be loaded in the usual way into `ds9`:

```
unix% ds9 frozenjupiter.fits &
```

Then the binning may be changed with the "Bin -> Binning Parameters..." dialog box. Choose "ocx" and "ocy" with the buttons in the "Bin Columns" section.

Figure 1  shows the original and "frozen" images side-by-side.

Parameters for /home/username/cxcds_param/sso_freeze.par

```
#-----
#
# sso_freeze.par- Parameter file for planetary transformations routine
#
#-----
      infile = acisf01463N002_evt2.fits Input event file or stack
      scephemfile = orbitf059832300N001_eph1.fits Input spacecraft ephemeris file
      ssoephemfile = jupiterf059875200N002_eph1.fits Input solar system object file
      outfile = frozenjupiter.fits Output event file name
      (logfile = STDOUT)          debug log file ( STDOUT | stdout | <filename>)
      (scale = 0)                 Image pixel scale (km/pixel, 0=angular coords)
      (lookuptab = ${ASCDS_CALIB}/dmmerge_header_lookup.txt -> /soft/ciao/data/dmmerge_header_lookup.txt) lo
      (clobber = no)              Overwrite existing output dataset with same name?
      (verbose = 0)              debug level (0-5)
```

(mode = q1)

History

03 Jan 2005 reviewed for CIAO 3.2: no changes

16 Dec 2005 updated for CIAO 3.3: bug in *ChaSeR* means that orbit ephemeris files must be retrieved from the CDA FTP site

01 Dec 2006 reviewed for CIAO 3.4: no changes

URL: <http://cxc.harvard.edu/ciao/threads/ssofreeze/>

Last modified: 1 Dec 2006

Image 1: Comparison of original and "frozen" images

