Frfread
- Astro D data reformatter

Robin H.D. Corbet

Department of Astronomy and Astrophysics, The Pennsylvania State University
525 Davey Laboratory, University Park, PA 16802

corbet@astro.psu.edu

1 Introduction

Frfread will take Astro D data files in telemetry format (with or without a FITS wrapper) and convert them to FITS format files. The output files are suitable for use with programs such as the FTOOLS suite of utilities or the PROS package via fits2qp. Frfread exists in two versions, one of which uses an X based graphical user interface (GUI) and another (frfreadng) which is suitable for use in a pipeline. The core of the two programs is the same with the interface and plotting portions of the program being replaced by other routines in the non-GUI version.

2 Installation

Frfread has been tested on Sun SPARCstations and DECstations, it also compiles and runs on DEC Alpha machines. The source code can be obtained by anonymous ftp from ftp.astro.psu.edu (128.118.147.28) in the directory pub/astrod/Frfread. When uncompressed and untared a top-level directory containing four subdirectories will be created. These will be:
Docs - this file and a man page.
Frfread - the code for frfread itself.
ARK - an X based plotting package.
Fitsio - Bill Pence's FORTRAN FITS routines.
ARKc and Fitsioc contain Makefiles which are used if f2c rather than a FORTRAN compiler is used.

The code is written in a mixture of C and FORTRAN. To create both the GUI and non-GUI versions for the Sun simply type "make" in the top-level directory. To create the non-GUI Sun version type "make frfreadng". The GUI version uses the XView 3.0 toolkit (a port of XView to DECstations may be obtained from media-lab.mit.edu). If you do not have a FORTRAN compiler on your machine then you can use the public domain f2c converter and the corresponding make command is "make f2c". (f2c make be obtained from research.att.com - log on as "netlib").

If you already have Bill Pence's FITSIO package then, in principle you should be able to link against this rather than using the version supplied with Frfread. The file Make.proto in the Frfread directory may be editted to change the location of the FITSDIR definition to link with a previously installed version. The Makefiles in the version of FITSIO (currently 3.4) supplied with Frfread have been altered to build the appropriate version (Sun, DEC, Alpha). (Note though that versions of FITSIO before 3.3 did not allow a sufficiently large number of simultaneously open FITS files for the needs of Frfread.)

If you are planning on looking at older data sets with frfread (e.g. ground test data) then you should make sure that "OLD_GIS_FORMAT" is defined in the Makefile. The default is to use the data format appropriate to flight data.

3 Compiling

The Makefile in the top directory now contains options for compiling on either a Sun, a DECstation or an Alpha. It might also be necessary to edit some of the specifications for file locations (e.g. the FITSIO routines, the XView include files). XView binaries for the DECstation may be obtained by anonymous ftp from media-lab.mit.edu. When running on a DECstation the definition of SYSPEC must also be changed in the makefile in Fitsio. The makefile provided in the Fitsio directory does not work with DEC's version of make. It does, however, work with gmake. With the release of frfread v3.022, the Makefiles for FITSIO have been altered so that users do not need to change SYSPEC.

4 On an Alpha

```
- As with the DECstation version you need to get the appropriate fonts
(should be available on ftp.x.org) and add these to the font path using
the xset command.

e.g.
% xset fp+ /usr/myhome/xview_font/pcf/75dpi/,/usr/myhome/xview_font/pcf/misc/
% xset fp rehash

- To compile the GUI of frfread you'll also need the XView libraries.
Dynamic versions of these should be available from
sunmoon.nectar.cs.cmu.edu:/afs/cs.cmu.edu/user/mjchan/pub/xview3.2-alpha-dist.tar.gz
Place the libraries in some place such as /usr/myhome/xview/lib

- set the environment variable OPENWINHOME to the top level location of
the XView files (e.g. /usr/myhome/xview). This is used in the Makefile.

- compile!

- when running frfread you'll probably also need to set LD_LIBRARY_PATH
to the location of the XView libraries.

I have successfully built and run frfread on an alpha with the GUI
displayed on my Sun, but have not yet used an alpha directly.

We are not providing a binary of frfread for the Alpha because we don't
have static versions of the XView libraries for this machine
```

5 Running Frfread

Frfread is invoked by typing either "frfread" for the GUI version or "frfreadng" for the non-GUI version. The GUI version takes standard X and OpenWindows command line arguments. Both versions also take an argument of "-debug". This specifies that the debug_level value takes effect. For the GUI version it also means that an additional panel is shown which enables the debug level to be altered. If you use the GUI version you will be presented with a control panel which will enable you to select only to to read specified types of data, to produce certain types of plots, and to write out certain types of data. The "standard" way to run frfread is to select to read all data modes and to write out the event lists. Frfread produces pairs of output files for each instrument on Astro D. For each instrument there is one file containing photon information and another containing housekeeping data. Whenever the observing mode of the instrument changes then the current files are closed and new files are opened. The structure of the FITS files is described in separate documentation. The input file format that can presently be read is the "Quick Look" format which has no FITS headers but has header information before each frame. The final version of frfread will also be able to read telemetry data which has FITS headers.

To get help when running the GUI version press the button marked "Help" on a Sun with the cursor located above a button you want help on. For this to work correctly the file frfread.info must be located in a directory included in the environment variable HELPPATH.

The save button settings etc. click on the button marked "Save Settings". This will create a parameter file called "frfread.par" in your current working directory. Clicking on the "Read Settings" button will load the settings from the frfread.par file.

To use the non-GUI version you must already have a parameter file. frfreadng simply reads from this file with no user interaction. A sample parameter file is supplied with the distribution.

6 The Parameter File

The parameter file currently read by frfread is based on the format of those used by IRAF programs. It is hoped that this will make it easier to integrate frfread into other packages. The parameter file is named frfread.par. An example of an frfread parameter file is:

```
frf_filelist,s,a,".frffiles",,,"filename containing list of input telemetry files"
output_directory,s,a,".",,,"Directory for output files"
origin,s,a,"PSU",,,"FITS ORIGIN keyword"
object,s,a,"DEFAULT",,,"FITS OBJECT keyword"
seqpi,s,a,"Astro D team",,,"FITS SEQPI keyword"
ranom,s,a,"0.01",,,"FITS RA-NOM keyword"
decnom,s,a,"0.01",,,"FITS DEC-NOM keyword"
start_sf,i,a,0,,,"start superframe"
end_sfme,i,a,0,,,"end superframe"
min_grade,i,a,0,0,7,"minimum grade"
max_grade,i,a,7,0,7,"maximum grade"
bin_size,i,a,16,0,0,"mkfilter bin size (seconds) for output of HK parameters"
split_threshold,i,a,0,,,"split threshold"
combine,i,a,1,0,1,"combine faint mode pha values into one pha value"
which_sis,i,a,2,0,2,"which sis to read (0,1,2; 2 = both 0 and 1)"
which_ccd,i,a,4,0,4,"which ccd to read (0,1,2,3,4; 4 = all 4 ccds)"
override,i,a,1,0,1,"override default input parameter file list"
commonhk,i,a,0,0,1,"create common HK file?"
insthk,i,a,0,0,1,"create instrument HK files?"
```

```
aea,i,a,1,0,1,"change file when AE-A status (AEANLGS) changes? (SIS)"
clobber,i,a,1,0,1,"clobber output files?"
display_spectrum,i,a,0,0,1,"display spectrum?"
display_ltcurve,i,a,0,0,1,"display light curve?"
display_image,i,a,0,0,1,"display image?"
display_summary,i,a,0,0,1,"display summary?"
write_spectrum,i,a,0,0,1,"write spectrum to file?"
write_ltcurve,i,a,0,0,1,"write light curve to file?"
write_image,i,a,0,0,1,"write image to file?"
write_events,i,a,1,0,1,"write events to output files?"
write_diag,i,a,0,0,1,"write diagnostic mode images to output files?"
read_faint,i,a,1,0,1,"process faint mode data?"
read_bright,i,a,1,0,1,"process bright mode data?"
read_fast,i,a,1,0,1,"process fast mode data?"
read_hist,i,a,1,0,1,"process histogram mode data?"
read_frame,i,a,1,0,1,"process frame mode data?"
read_dark,i,a,1,0,1,"process dark mode data?"
read_integ,i,a,1,0,1,"process integration mode data?"
read_ph,i,a,0,0,1,"process ph mode data?"
read_mpc,i,a,0,0,1,"process mpc mode data?"
read_pcal,i,a,1,0,1,"process pcal mode data?"
print_spectrum,i,a,0,0,1,"print spectrum?"
print_ltcurve,i,a,0,0,1,"print light curve?"
print_image,i,a,0,0,1,"print image?"
print_summary,i,a,0,0,1,"print summary?"
debug_level,i,a,0,0,4,"debug level?"
```

As the format is based on IRAF parameter files not all items in each row are necessarily used. The first item in each row is the parameter name. The second specifies the variable type (e.g "i" = integer). Item 3 is unused ("a"). Item 4 is the value of the parameter. The following two items specify the lower and upper values allowed. The final item is just a description of the parameter.

A large number of the items, although specified to be integer ("i") are in fact really Boolean with values of 0 (false) or 1 (true) allowed.

For pipeline processing where all possible output is to be converted then all items from *read_faint* to *read_pcal* should be set to 1. To create the output event files *write_events* must be 1. Setting *write_diag* to 1 is needed to get output for the so-called SIS diagnostic modes. This flag is also used if you want to output GIS memory check files. Companion housekeeping files are automatically generated for each event or diagnostic output file if insthk is true. The directory the output files are written to is controlled by *output_directory* - the default is the current directory (.).

The items origin, object, seqpi, ranom and decnom correspond to the values of FITS keywords that are written to the headers of all output files. If parameters are not present in the frfread.par file then default values are automatically inserted.

Set items such as *write_spectrum* to 1 only if you want to generate a summed spectrum (or image etc.) for quick look purposes. The SIS spectrum is written as sis_spectrum.dat, the GIS spectrum as gis_spectrum.dat. For the non-GUI (pipeline) program selecting a "display" option such as *display_spectrum* has no effect. The "print" options (e.g. *print_spectrum*) is only possible if you are using the GUI version and have already displayed the spectrum or whatever. The spectrum is not actually printed but a PostScript file is created. The PostScript files created are called: summary.tmp.ps and spectrum.tmp.ps. The summed images are called imageS1.fits and imageS0.fits (SIS only) and the summed SIS spectrum is named temp.tmp.

Files to be processed are specified in two different ways. (i) If override is set to 1 then a single file is processed with the directory and filename taken from the filename and directory fields in the GUI. (ii) If override is 0 then a directory and a list of filenames is read from the file specified by the *frf_filelist* parameter. For example the frf_filelist may look like:

```
frf_directory,s,a,"/bulk3/astrod/data/",,,"frf directory"
frf_file,s,a,"r9207090026",,,"frf telemetry file"
```

Multiple *frf_file* entries are allowed. The directory specified by *frf_directory* applies until a new *frf_directory* is given and that is taken as the directory for subsequent *frf_file*s.

The debug_level parameter controls the number of debug print statements that are sent to the screen. 0 specifies the smallest amount and 4 the most. **Note** this flag only has any effect if frfread is invoked with the "-debug" option.

For pipeline processing where all data is to be processed both *start_frame* and *end_frame* should be 0. *min_grade* should be 0 and *max_grade* should be 7. Set *which_ccd* to 4 and *which_sis* to 2. For standard processing set *combine* to 0. (Setting *combine* to 1 causes faint mode SIS data to be converted to bright mode format. The value of *split_threshold* is used as the split event threshold). *bin_size* is used to limit the frequency of output of certain housekeeping parameters needed by mkfilter.

7 Plotting etc.

Frfread also has limited ability to display certain types of data - summed spectra and a plot of the modes used by the SIS. The plots produced may also be saved as PostScript format files. Although there is a button labelled "Light Curve" this feature is not enabled. The summed spectrum and also a summed image can be saved as files. The summed spectrum is an ASCII file and the summed image is a standard FITS image suitable for display with programs such as SAOimage. To select only a subset of the data for plotting and data conversion use the "Set Restrictions" button to bring up an additional control panel. This enables selection by SIS and CCD number.

8 Bug Reports

The "official" way to report bugs is via email to frfread@astro.psu.edu. Mail sent to this address will be read by all relevant people at Penn State and your message will be archived. More informal email may be sent to corbet@astro.psu.edu.