barycen

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Abstract

Convert time tags from the local satellite frame to Barycentric Dynamical Time

1 Instruments/Modes

not applicable

2 Use

pipeline processing	no
interactive analysis	yes

3 Description

3.1 Introduction

The **barycen** task converts times expressed in the local satellite frame to Barycentric Dynamical Time (TDB) whose spatial origin lies at the solar system barycenter. In more detail, the task requires as main input a table in a data set which contains a column with times in XMM MET (Mission Elapsed Time) frame[1]. On this table, the following operations are carried out:

1. Check whether the barycentric conversion has been performed already (based on value of attribute `TIMEREF`) and, if found true, exit
2. Correct all time tags stored in a specified column of the table
3. If a Good Time Interval extension exists, convert all interval start and stop times to TDB as well
4. Correct all time tags stored in the EXPOSU tables, if the parameter `processexposutables` is enabled.
5. Update the values of the attributes `TIMEREF`, `TSTART`, `TSTOP`, and `TELAPSE` where necessary

In accordance with NASA/OGIP recommendations, the value of the `TIMEREF` keyword is either `LOCAL` or `SOLARSYSTEM` depending on whether the times are expressed in local satellite time or TDB. Note that the conversion to TDB does not affect the actual *time system* in use, i.e., all times keep being referred to the fixed mission reference time 1998-01-01T00:00:00 TT [1].

The conversion of a satellite time tag to TDB requires the knowledge of the satellite's position at that time. Therefore, the task needs access to the orbit file in the ODF which covers the time period in question. This access is done transparently via the ODF access layer which, however, needs to be pointed to the directory containing the ODF.

In addition to the satellite position data, the time conversion algorithm in use by **barycen** requires the barycentric vectors for the time period in question to be known a priori. This information is comprised in the JPL ephemeris data set in FITS format which is part of the **barycen** package.

4 Parameters

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

Parameter	Mand	Type	Default	Constraints
withtable	yes	boolean	true	Whether to convert table in a dataset

should be set to *true* if a table containing events to correct has been specified and to *false* otherwise.

table	yes	string		name of existing table

a specifier which must point to a table in a data set. It must be in either of the two forms `setname:`, or `setname:tableid` where `setname` must be the name of an existing data set and `tableid` an identifier of a table in that data set. If the first form, `setname:`, is used, the table data are sought in the *first* block of the named data set.

timecolumn	no	string	TIME	name of existing column

the name of an existing column of type real64 in the table given via the parameter *table* (see Sect. 4). The values in the column are interpreted as XMM MET tags and corrected for barycentric propagation delays. Please note: This process is *irreversible* - if the original time column is to be kept a copy of the data set should be made a priori.

withsrccoordinates	no	boolean	false	true—false

The barycentric correction algorithms needs the coordinates of the celestial source. This boolean parameter determines from where these are obtained. If set to false, the coordinates are attempted to be read from the attributes `RA_OBJ/DEC_OBJ` in the table or the associates set. If this fails, the attributes `RA_NOM/DEC_NOM` are read instead. If this fails as well a fatal error condition is raised. If *withsrccoordinates* is set to true, the user has to provide the coordinates through the parameters *srcra*/*srcdec*.

srcra/srcdec	no	string		source coordinates

If *withsrccoordinates* is set to true the coordinates of the celestial source have to be specified through these parameters in the equatorial, earth-centered J2000 reference frame. The coordinates should be entered as decimal degrees; for *srcra* (Right Ascension)

1. 123.45678 (decimal degrees)

and for *srcdec* (Declination)

1. 123.45678 (decimal degrees)

processgtis	no	boolean	true	true—false

Boolean switch determining whether any present GTI tables should be corrected as well or not. The parameter has no effect if the set does not contain any GTI tables.

processexposutables	no	boolean	true	true—false

Boolean switch determining whether any present EXPOSU tables should be corrected as well or not. The parameter has no effect if the set does not contain any GTI tables.

time	no	real		0

A single time on which to perform the barycentric correction. Only used if *withtable* is false.

ephemeris	no	string	DE200	DE200—DE405

Name of an ASCII earth ephemeris file extension in the JPL format to be used in lieu of a standard one. This file contains barycentric vectors needed by the TDB conversion algorithm.

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.

ThisIsNotXMM *(error)*
No XMM data set given

NoCorrectionNecessary *(error)*
The specified table has already been processed with **barycen**

NoEphemerisFile *(error)*
The JPL ephemeris file was not found

NoPositionData *(error)*
There is no position data available for a particular time — set time to NaN

EXPOSUTableSelected *(warning)*
An EXPOSU table was selected as input table, in this case, any other EXPOSU table will be corrected.
corrective action: If you want to correct all the EXPOSU tables, introduce as input the EVENTS table.

NoSuchAttribute *(warning)*
A keyword, representing the start or end date of the observation is missing from the input table
corrective action: The absolute time values may be wrong if this key word isn't set correctly. If this is important to you then add the keyword to the file header

TDBConversionImpossible *(warning)*
The date of the start or end of the observation, taken from the file header keywords, could not be understood
corrective action: Check that the DATE-OBS and DATE-END keywords are written correctly in the table header

6 Input Files

1. a data set with a table containing a time column to be processed

7 Output Files

1. the input data set with modified time column

8 Algorithm

```
subroutine barycen

   check if barycentering has been applied already - if yes, exit

   locate ODF orbit file
   locate earth ephemeris file

   foreach row in table
       compute TBD from time value of current row
   end

   update timing related attributes
```

```
      foreach GTI extension
         forach row in GTI table
            compute TBD of START and STOP time
         end
      end

   end subroutine barycen
```

9 Future developments

References

[1] *Time system standards in XMM science data sets*, TN to be written by TBD

References