makethumbs

June 2, 2019

Abstract

This task creates thumbnail GIF(s) around source locations.

1 Instruments/Modes

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPIC</td>
<td>Imaging</td>
</tr>
</tbody>
</table>

2 Use

<table>
<thead>
<tr>
<th>pipeline processing</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td>interactive analysis</td>
<td>yes</td>
</tr>
</tbody>
</table>

3 Description

3.1 Overview

The task makethumbs reads an EPIC image, as well as optionally the source list file in each observation (as is included in the standard distribution of the pipe-line processing) and/or the external catalogue file in the format of the 2XMM catalogue, then outputs the thumbnail GIF images of the sources of user’s choice. This task is mainly designed to produce a GIF image of each source or simply of a sky position so that the user can have a quick look at it.

This task has two processing modes: a single source (hence a single output file) and multiple sources (hence multiple output files). Only in the former case (single-source mode), users can specify the name of the discrete and complete output filename via the command-line parameter outfile. If not, users can specify the root filename via gifroot and can control the rules of subsequent identifier via a few command-line arguments. If none is specified, the default filename(s) will be used.

Note that SAS tasks in default have the clobber setting activated. Therefore, unless users explicitly specify --noclobber (see Section 9 for an important note for --noclobber option), all the existing files with the identical names will be overwritten.
The basic input parameters for each source, such as its celestial coordinates, are read from the given source-list and/or the external catalogue in default. Only in the single-source mode, the position can be given via the command-line arguments, \texttt{ra} and \texttt{dec}. Some strings displayed in all the output GIF files can be given via several command-line arguments.

In determining the output filenames (unless a user specifies the discrete filename in the single-source mode), this task uses either or all of \texttt{SRC.NUM} (source number, which can be given via the command-line parameter \texttt{srcnum} in the single-source mode), \texttt{DETID} (meaning detection ID in the 2XMM catalogue) or \texttt{SRCID} (unique source ID in 2XMM), all of which are derived from either the input source-list or the given external catalogue.

Users can also make a fine control over the size and colour of the output GIF image, size and thickness of the hair-line cross in the image and strings of information displayed in the image.

See the following and Section 4 for detail.

### 3.2 Note on the processing speed

Generating GIF files itself with this task is reasonably quick. However, to read an external catalogue may not be so, in particular the given external catalogue is a large one, such as the 2XMM catalogue FITS file.

The least required (or desirable) columns for the external catalogue given to this task are listed in the following Section 2. If a user wants to give a large external catalogue as the input to this task, s/he is encouraged to trim (delete) the unnecessary columns in the catalogue before it is given to this task.

Unfortunately, it will take nevertheless 20 min or longer in the case of the catalogue based on the entire 2XMM catalogue, even if it is trimmed down to a minimised set of columns (in other words, it would take hours or longer if the raw 2XMM catalogue is given). The bottle neck is known to be in reading the column for the source names in the external catalogue. However, there is no plan that this problem will be fixed in the foreseeable future, because this problem is rooted in a technical reason in the SAS scheme for Fortran.

As the work-around for this problem, the task \texttt{ingestsrncnames} is provided in this package. With the task, users can ingest the all those parameters, which may be used in processing with this task, to the input source-list. Then, even though the process of ingesting takes as long time as this task would do, it is a one-off process, and once it is done, users can produce GIF files with this task \texttt{makethumbs} for any of the sources listed in the source list without waiting much, as the external catalogue is no longer given every time this task is run.

### 3.3 Detail of the process

#### 3.3.1 Source matching

The external catalogue is used to specify the source name and some IDs of each source. The matching between the sources in the source list or user-specified source and the one in the external catalogue is based on \texttt{OBS.ID} and \texttt{SRC.NUM} (see Table 2, where the information is derived from).
Table 1: Parameters needed for source matching

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Command-line</th>
<th>Input image</th>
<th>Source</th>
<th>Catalogue</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBS_ID</td>
<td>obsidstr*</td>
<td>header*</td>
<td>—</td>
<td>Column</td>
</tr>
<tr>
<td>SRC_NUM (single)</td>
<td>srcnum</td>
<td>—</td>
<td>(Column)</td>
<td>Column</td>
</tr>
<tr>
<td>SRC_NUM (multiple)</td>
<td>—</td>
<td>—</td>
<td>Column</td>
<td>Column</td>
</tr>
</tbody>
</table>

(*): The command-line argument, if specified, has a priority over the header attribute.

Table 2: Required columns in the input source list

<table>
<thead>
<tr>
<th>Columns</th>
<th>Data-Type</th>
<th>Mandatory/Optional</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRC_NUM</td>
<td>Double</td>
<td>Mandatory</td>
<td></td>
</tr>
<tr>
<td>RA</td>
<td>Double</td>
<td>Optional</td>
<td>Recommended.</td>
</tr>
<tr>
<td>DEC</td>
<td>Double</td>
<td>Optional</td>
<td>Recommended.</td>
</tr>
</tbody>
</table>

3.3.2 Determination of coordinates

The source coordinates are determined in the following order of priority, if given.

1. User-specified (only if single source)
2. Source-list
3. External catalogue

3.3.3 FITS columns used in processing

Table 2 and Table 3 tabulate the column names used by this task. Some other column names are also permitted (See Table 4 for the list of candidates).

The order of the priority, in which each source parameter (obviously except for OBS_ID and SRC_NUM) is read, is as follows:

1. Command-line argument (such as, RA and DEC)
2. External catalogue

Table 3: Required columns in the (optional) external catalogue

<table>
<thead>
<tr>
<th>Columns</th>
<th>Data-Type</th>
<th>Mandatory/Optional</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBS_ID</td>
<td>String</td>
<td>Mandatory</td>
<td></td>
</tr>
<tr>
<td>SRC_NUM</td>
<td>Int32</td>
<td>Mandatory</td>
<td></td>
</tr>
<tr>
<td>IAUNAME</td>
<td>String</td>
<td>Optional</td>
<td>Source name</td>
</tr>
<tr>
<td>DETID</td>
<td>Int32</td>
<td>Optional</td>
<td>Detection ID</td>
</tr>
<tr>
<td>SRCID</td>
<td>Int32</td>
<td>Optional</td>
<td>Unique source ID</td>
</tr>
<tr>
<td>RA</td>
<td>Double</td>
<td>Optional</td>
<td>Usually unnecessary.</td>
</tr>
<tr>
<td>DEC</td>
<td>Double</td>
<td>Optional</td>
<td>Usually unnecessary.</td>
</tr>
</tbody>
</table>
Table 4: Name of the possible column names

<table>
<thead>
<tr>
<th>Type</th>
<th>Names in order of priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation ID</td>
<td>OBS_ID</td>
</tr>
<tr>
<td>Observation ID</td>
<td>OBSID</td>
</tr>
<tr>
<td>Source ID</td>
<td>SRCNUM</td>
</tr>
<tr>
<td>Detection ID</td>
<td>DETID</td>
</tr>
<tr>
<td>Detection ID</td>
<td>SRCID</td>
</tr>
<tr>
<td>Is the source in?</td>
<td>INCATFLG</td>
</tr>
<tr>
<td>Right Ascension</td>
<td>RA</td>
</tr>
<tr>
<td>Declination</td>
<td>DEC</td>
</tr>
<tr>
<td>Source name</td>
<td>IAUNAME</td>
</tr>
</tbody>
</table>

Note that the lower-case column names are also accepted.

3. Source list.

This may be of particular importance when an external catalogue is given as a command-line argument, where the source-list is already ingested with some columns, such as IAUNAME.

3.3.4 Sources out of catalogue

When an external catalogue is given, if a source listed in the source list is not included in the external catalogue, then the source is ignored in processing. The same information can be obtained from the column INCATFLG in the input source-list, that is, if the value in INCATFLG is false, the source is not processed.

On the other hand, if an external catalogue is not given, and if the input source-list is given but does not contain the column INCATFLG, then all the sources specified (a single source or all) are processed.

3.4 Examples

Here are a few simple examples of the use of this task.

1. User-specified coordinates

```
makethumbs imageset=P0123456789M1S001IMAGE_8000.FIT
                withsrclist=no outfilename=out.gif
                ra=123.45 dec=-67.89
```

2. User-specified coordinates with catalogue

```
makethumbs imageset=P0123456789M1S001IMAGE_8000.FIT
                srcnum=5 cattab='cat2xmm.fits:SRCLIST'
                withsrclist=no outfilename=out.gif
```

3. Simplest (single source)
makethumbs imageset=P0123456789M1S001IMAGE_8000.FIT
srclisttab='P0123456789EPX000BSMLI0000.FIT:SRCLIST'
srcnum=5 gifroot='m1image_'

4. Simplest (multiple sources, with the catalogue input)

makethumbs imageset=P0123456789M1S001IMAGE_8000.FIT
srclisttab='P0123456789EPX000BSMLI0000.FIT:SRCLIST'
cattab='cat2xmm.fits:SRCLIST'
gifroot='m1image_'

4 Parameters

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mand</th>
<th>Type</th>
<th>Default</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>imageset</td>
<td>yes</td>
<td>dataset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>withsrclist</td>
<td>no</td>
<td>boolean</td>
<td>true</td>
<td></td>
</tr>
<tr>
<td>srclisttab</td>
<td>yes</td>
<td>table</td>
<td></td>
<td></td>
</tr>
<tr>
<td>withcoords</td>
<td>no</td>
<td>boolean</td>
<td>false</td>
<td></td>
</tr>
<tr>
<td>ra</td>
<td>no</td>
<td>real</td>
<td>-360 &lt;= ra &lt;= 360</td>
<td></td>
</tr>
<tr>
<td>dec</td>
<td>no</td>
<td>real</td>
<td>-90 &lt;= dec &lt;= 90</td>
<td></td>
</tr>
<tr>
<td>withcat</td>
<td>no</td>
<td>boolean</td>
<td>false</td>
<td></td>
</tr>
<tr>
<td>cattab</td>
<td>yes</td>
<td>table</td>
<td></td>
<td></td>
</tr>
<tr>
<td>withsrnum</td>
<td>no</td>
<td>boolean</td>
<td>false</td>
<td></td>
</tr>
<tr>
<td>srcnum</td>
<td>no</td>
<td>int</td>
<td>0</td>
<td>srcnum ≥ 0</td>
</tr>
<tr>
<td>autofname</td>
<td>no</td>
<td>boolean</td>
<td>true</td>
<td></td>
</tr>
</tbody>
</table>

Input image FITS file.

Whether to use the source list in the observation.

Mandatory if withsrclist is true. Source list (e.g., P0123456789EPX000BSMLI0000.FIT:SRCLIST) in the observation.

Whether to give the coordinates in the command-line arguments. This parameter is read if withsrclist is false. Note that if cattab is also false, this has to be true.

Right Ascension of the source position (aka the output GIF image centre).

Declination of the source position (aka the output GIF image centre).

Whether to use the (bigger) external catalogue set, which tabulates the source IAUNAME etc.

Mandatory if withcat is true. Catalogue table name (e.g., 'cat2xmm.fits:SRCLIST')

Whether to specify SRC_NUM. This is mandatory if withsrclist=no and withcat=yes.

ID number (SRC_NUM) of the source in the given source list to process (0 (Default) means all the sources, which is valid only when withsrclist=yes).

Whether to use the (bigger) external catalogue set, which tabulates the source IAUNAME etc.

Mandatory if withcat is true. Catalogue table name (e.g., 'cat2xmm.fits:SRCLIST')

Whether to specify SRC_NUM. This is mandatory if withsrclist=no and withcat=yes.

ID number (SRC_NUM) of the source in the given source list to process (0 (Default) means all the sources, which is valid only when withsrclist=yes).
Whether to automatically determine the output GIF filenames (true) or use user-specified single filename (false). If no, either withsrclist has to be false or srcidnumber has to be non-zero.

**outfilename**
Mandatory if autofname is false. Filename of the output GIF (with suffix mandatory).

**gifroot**
Read if autofname is true. Root of the output filenames.

**fnamestyle**
Read if autofname is true. Style in naming the output GIF files.

**gifsuffix**
Read if autofname is true. The suffix of the output GIF filename.

**fnameseparator**
Read if autofname is true. The separators in the output GIF filenames: eg., ‘ROOT@@@@-A’ for ‘@@@@-A’.

**srcindexstyle**
Style of the index printed in the GIF.

**srcindexseparator**
The separator between the source name and index displayed in the output image. Default is ‘:’ and ‘/’ for srcindexstyle=’detid’ and ’srcnum’, respectively.

**iaunamelprefix**
Prefix for the IAUNAME in case the catalogue (if given) is missing it.

**obsidstr**
String expression of OBS_ID.

**erangestr**
String expression of the energy band, such as, ‘0.5-10 keV’.

**inststr**
String expression of the instrument.

**commlower**
Comment appearing at right-hand side in the second row in the output image.

**commupper**
Comment appearing at right-hand side in the first row in the output image.

**imagesize**
Size of the output image in unit of arcmin.

**lwidth**

Lwidth of the cross in the image (0 (Default) means automatically calculated).

<table>
<thead>
<tr>
<th>sizeratiocross</th>
<th>no</th>
<th>real</th>
<th>0.0</th>
<th>sizeratiocross $\geq 0$</th>
</tr>
</thead>
</table>

Ratio of the size of closeness of the cross to the source (0 (Default) means automatically calculated).

<table>
<thead>
<tr>
<th>fontnumber</th>
<th>no</th>
<th>int</th>
<th>0</th>
<th>fontnumber $\geq 0$</th>
</tr>
</thead>
</table>

Font number in PGPLOT used in output images (Default=0 (not specified)).

<table>
<thead>
<tr>
<th>colourmapid</th>
<th>no</th>
<th>int</th>
<th>3</th>
<th>colourmapid $\geq 0$</th>
</tr>
</thead>
</table>

Colour Map ID (Default=3, heat).

<table>
<thead>
<tr>
<th>printparams</th>
<th>no</th>
<th>boolean</th>
<th>false</th>
</tr>
</thead>
</table>

Display to STDOUT the source parameters if yes.

<table>
<thead>
<tr>
<th>dryrun</th>
<th>no</th>
<th>boolean</th>
<th>false</th>
</tr>
</thead>
</table>

Dry-run if true.

## 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.

**imageTooSmall** *(error)*

ImageSize value has to be positive.

**allFilesFailed** *(error)*

Failed in creating every output file.

**NoSrcNumSpecified** *(error)*

srcnum is mandatory when withsrclist=no and withcat=yes.

**NoCoordsSpecified** *(error)*

ra and dec are mandatory when withsrclist=no and withcat=no.'

**NotFoundDETID** *(error)*

DETID is not found in the table, even though it has to be used.

**NotFoundSRCID** *(error)*

SRCID is not found in the table, even though it has to be used.

**NoObsIdFoundInCat** *(error)*

No column of OBSID (or alike) is found in the given catalogue.

**WrongDataTypeObsId** *(error)*

OBS_ID datatype is wrong.

**noPgplotGifDevice** *(error)*

Failed to open the PGPLOT GIF device. Check your PGPLOT environment.
tooManyMatches *(error)*
More than one entry match for the corresponding source in the catalogue.

fileExists *(warning)*

*(warning)*

corrective action:
corrective action: Output file exists and clobber is not set. NoSrcTableSource table is not found in 1st Extension or before.

smallerDimensionForSumIAuname *(warning)*

*(warning)*

corrective action:
corrective action: The size of IAUNAME found may be too big, so it may be trimmed. NotFoundObsIdInPrimaryOBS attribute is not found in the primary header but in the header in one of the subsequent extensions.

typeMismatchInAttribute *(warning)*

*(warning)*

corrective action:
corrective action: The datatype of the attribute is different from what is supposed to be. catalogueNotReadSRC_NUM is not specified, hence the given catalogue is not read.

NotUseDetidInSrcList *(warning)*

*(warning)*

corrective action:
corrective action: Although the column DETID is found in the source list, that from the external catalogue is used. NotUseSrcidInSrcList Although the column SRCID is found in the source list, that from the external catalogue is used.

NotUseCatnameInSrcList *(warning)*

*(warning)*

corrective action:
corrective action: Although the column IAUNAME or alike is found in the source list, that from the external catalogue is used. srcOutOfField The source location is out of the field of view of the input image, hence the output image is not created.

tooSmallLWidth *(warning)*

*(warning)*

corrective action:
corrective action: Lwidth for PGPLOT is set to be the minimum value, 2. noMatchingSrc No match is found in the catalogue for the source of interest.
6 Input Files

   1. Image set
   2. Source list (optional)
   3. External catalogue (optional)

7 Output Files

   1. Thumbnail image GIFs

8 Algorithm

    call readParameters()
    call readArrayData(imageSetName, image)
    Get_string_expressions_of_InstStr_ObsId
    call loadSources(thumbOnes, ComArgs) ! optionally with the catalogue
    Set_thumbCommon
    call calcSrcImageCoords(imageSet, thumbOnes, thumbCommon)

    if (withSrcList) then
       if ( srcIdNumber <= 0 ) then ! All sources
          srcBegin = 1
          srcEnd = numSources
       else ! One specified source
          srcBegin = srcIdNumber
          srcEnd = srcIdNumber
       end if
    else ! Single source mode
       srcBegin = 1
       srcEnd = 1
    end if

    Set_srcIndexForPrint

    do iSrc = srcBegin, srcEnd
       if (.not. srcInCatFlag(iSrc)) cycle

       if (isAutoFname) then
          thumbOnes(iSrc)\%filename = trim(getThumbnailName(thumbOnes(iSrc), outFilenameStyle))
       else
          thumbOnes(iSrc)\%filename = trim(outGifName)
       end if

       if (isFileExistingAndQuit(trim(thumbnailName))) cycle
       if (isDryRun) cycle ! In reality this is out of this loop.
       call makeAndSaveThumbnail(thumbOnes(iSrc), thumbCommon)

    end do
9 Comments

- Like many other SAS tasks, `--noclobber` option is not recommended to specify when you run this task. It may always fail, if it is specified. It is rooted in one of the basic SAS libraries (DAL) and there is no plan of it being fixed in the foreseeable future.

References