inthist

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Abstract

Plot histograms of the intensity distributions of sets of EPIC images for user selected pixels size.

1 Instruments/Modes

Instrument	Mode
EPIC MOS	Imaging
EPIC pn	Imaging

2 Use

pipeline processing	yes
interactive analysis	no

3 Description

This task takes the EPIC images in the input list of images, divides them by the images in the input list of 'exposure maps', rebins the resulting images to a user-specified bin size and plots the corresponding intensity (count-rate) histograms (number of image bins containing a countrate within a certain interval) to a single PostScript file. The last bin includes all rebinned pixels brighter than the maximum value shown in the x-axis and it is marked with an arrow.

The rationale for developping this task is to allow the user to estimate quickly the intensity background in a number of bands, and to assess the significance of the detection of faint sources. To achieve this, it is necessary that the input images are in a useful set of energy bands (such as the default EPIC IMAGING energy bands), and that the images listed in the parameter `exposuresets` are their corresponding exposure maps.

Furthermore, if the user-selected bin size `binsize` is the size of the point spread function, the number of pixels above a given countrate is roughly the number of sources with fluxes above that countrate.

4 Parameters

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

Parameter	Mand	Type	Default	Constraints
sets	yes	list of data-sets	M1_image1.fits M1_image2.fits M1_image3.fits M1_image4.fits M1_image5.fits	list of valid data sets

List of FITS files containing the input images in different bands

exposuresets	yes	list of data-sets	M1_expmap1.fits M1_expmap2.fits M1_expmap3.fits M1_expmap4.fits M1_expmap5.fits	list of valid data sets

List of FITS files containing the exposure maps for the corresponding images listed in sets.

tmpflatsets	no	list of file-names	flat_1.img flat_2.img flat_3.img flat_4.img flat_5.img	list of valid file names

List of FITS files that will contain the temporary flatfielded images (images divided by their corresponding exposure maps). If this parameter is left blank, the temporary flatfielded images are called `flat_`i`.img`, where i goes from 1 to the number of images in parameter `sets`.

binsize	yes	real	0.01667	> 0.0

Size of the rebinned pixels in degrees for histogramming. It will be rounded to the nearest integer multiple of the pixel size in the input image

outfile	yes	file-name	inthist.ps	valid file name

Name of the output Post Script file containing plots of the histograms

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.

InvalidDataType *(fatal)*
Data type in input image is not permitted

IncNumImg *(fatal)*
The number of images in `sets` is not equal to the number of images in `exposuresets`

IncNumFlat *(fatal)*
The number of images in `sets` is not equal to the number of temporary files in `tmpflatsets`

ErrFarith *(fatal)*
The FTOOLS task `farith` cannot be run in the process explained by the associated message

ErrFstruct *(fatal)*
The FTOOLS task `fstruct` cannot be run in the process explained by the associated message

ErrFkeypar *(fatal)*
The FTOOLS task `fkeypar` cannot be run in the process explained by the associated message

ErrIntmakehist *(fatal)*
Problem raised while trying to create histograms using module `intmakehist`

badDevice *(fatal)*
Specified PGPLOT device cannot be opened

MissingFitsKeyw *(fatal)*
The WCS keyword `CDELT1` is not included in the input image

AllocationError *(fatal)*
Failed allocation for internal array

BadParamValue *(fatal)*
The requested bin size is smaller than one of the input images pixel size, larger than one of the input image's size or it results in a binned image with only one pixel

NotImage *(warning)*
One of the input images is not an EPIC image
corrective action:

NotExpMap *(warning)*
One of the input exposure maps is not an EPIC exposure map
corrective action:

EmptyHistogram *(warning)*
All intensities in one or more of the bands are equal
corrective action: Check input file names

6 Input Files

1. List of input Images. Each Image is a PPS product called "EPIC IMAGE".
2. List of Exposure maps for the corresponding images in sets. Each Exposure map is a PPS product called "EPIC EXPOSURE MAP".

7 Output Files

1. Post Script file in which each physical page will be divided in 6 boxes. In each box a histogram for each of the input images will be plotted. The last one will contain some useful information such as the binned pixel size, exposure time, etc.

   This file is a PPS product named "EPIC Postscript intensity histogram".

8 Algorithm

inthist is a perl task which does the following:

1. Read input parameters and check for errors
2. Run the FTOOLS task `farith` to flat field the input images
3. Run the F90 module `intmakehist`:

```
module intmakehist

     Read input flatfielded images and parameters

     Open output Post Script file

     Foreach (input image){

         Rebin to specified binsize

         Estimate histogram mean and variance using sigma clipping

         Compute optimal histogram binsize and display range based on
         mean and variance

         Build and plot intensity histogram
     }

     Close Post Script file

end module intmakehist
```

9 Comments

- If the proper (recommended) binning size is used, it should be possible to measure source counts with the positive tail of the histograms
- Rounds up rebinned pixel size to the nearest integer multiple of the elementary pixel size of the input images
- Ignores pixels on the edges that do not fit in an integer number of rebinned pixels
- Temporary files are created with the names specified in the parameter `tmpflatsets` and are deleted when they are no longer needed, at the end of the task.

10 Future developments

In the future, and with low priority, the task might include the possibility to overlay histograms from template (source-free) images for comparison. In this way it would be possible, for example, to check for the presence of extended low surface brightness sources.

References