binadapt

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Abstract

This task creates adaptively smoothed, background subtracted, and exposure corrected images. This task is a merger of the pre-SAS-21 *esas* subtasks *adapt* and *binimage*. It retains all the functionality of both original tasks.

1   Instruments/Modes

| Instrument	Mode
EPIC MOS	IMAGING
EPIC PN	IMAGING

2   Use

pipeline processing	no
interactive analysis	yes

3   Description

binadapt creates adaptively smoothed background subtracted and exposure corrected images. For each unmasked pixel, the program will average neighboring pixels within a circle of increasing radius until a selected number of counts is reached. The original pixel is then given the average surface brightness for the pixels within the circle. Binning by pixels can be selected. This task combines the former SAS tasks adapt and binimage into a single task.

Warning and requirements: *binadapt* was part of the singular *esas* package integrated into the SAS, but was made a standalone task for SAS-21. It is limited to work within the *esas* data reduction scheme. This is especially true with respect to the structure and names of the input files. In particular, *binadapt* assumes that other tasks from the package, like *mosspectra*, *mosback*, and if desired *combimage* must have been successfully run for the exposures to be used.
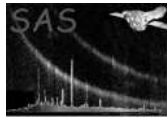
4 Parameters

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

Parameter	Mand	Type	Default	Constraints

prefix	no	string	comb	

Input inst+exposure ID (1S001, S003) OR "comb" to use combimage inputs.

The program defaults to deriving a filename of the form comb-elow-ehigh.fits. If using singular expids, enter that as the prefix.

elow	no	int	350	$0 <= elow <= 11999$

Lower energy limit for the energy band in eV.

ehigh	no	int	1100	$1 <= ehigh <= 12000$

Upper energy limit for the energy band in eV.

withpartbkg	no	bool	no	T/F

Particle background control, "yes" to subtract the model (QPB) particle background image.

withspbkg	no	bool	no	T/F

Soft proton background control, "yes" to subtract the soft proton background image.

withswcxbkg	no	bool	no	T/F

Solar wind charge exchange background control, "yes" to subtract the SWCX background image.

withmask	no	bool	no	T/F

Apply additional masking using input image?

maskfile	no	dataset	default	

The filename for an image to provide additional masking if desired.

If left blank (AND withmask=T), binadapt will derive a mask filename based on other parameters. The mask images must be the same size and projection as the other images. Since masks can come from many sources, it is recommended the user enter withmask=T maskfile=yourmaskfile together.

withbinning	no	bool	yes	T/F

Perform binning?

binfactor	no	int	2	$1 <= binfactor$

Binning factor.

withsmoothing	no	bool	yes	T/F

Perform smoothing?

smoothcounts	no	int	50	$1 <= smoothcounts <= 100$

Smoothing factor.

maskthresh	no	real	0.02	$0.001 <= maskthresh$

The scale factor for excluding regions from the smoothing based on a mask image.

In the default mode the average exposure is calculated and then any pixel with exposure less than fraction*average value is excluded.

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.

prefixORcomb *(error)*
    You must enter either inst+expid OR comb for combimage inputs

noBinNoSmooth *(error)*
    withbinning=F and withsmoothing=F is not allowed. Program would do nothing.

noClobber *(error)*
    Critical file already exists and noClobber is set

BadQDP *(warning)*
    Output QDP file cannot be opened read or written to
    corrective action: QDP not created

6 Input Files

Binadapt will create filenames based on parameters input, especially *prefix*, *elow*, and *ehigh*

The user can choose to enter either a prefix designating the instrument + expid, e.g. *1S001, 2S002, S003* OR the string "comb" to use products from the task *combimage*. Either will initiate deriving all the input filenames based on other input parameters. If no prefix is given, binadapt will derive an input filename of the form: comb-elow-ehigh.fits, the default output from combimage.

Valid input filenames derived are, in the case of a prefix being entered, e.g.:

```
binadapt prefix=1S001 withspbkg=T withpartbkg=T withswcx=T withmask=T
maskfile=mymaskimage.fits elow=400 ehigh=2000
```

mos1S001-fovimsky-400-2000.fits (from *mosspectra*)
mos1S001-expimsky-400-2000.fits (from *mosspectra*)
mos1S001-bkgimsky-400-2000.fits (from *mosback*)
mos1S001-swcximsky-400-2000.fits (from *swcx*)
mos1S001-protimsky-400-2000.fits (from *proton*)
mos1S001-maskimsky-400-2000.fits (from *emask, et al*)

[NOTE: binadapt will, by default, create a mask file name as above, but since masks can come from different tasks, if you have a mask NOT of that style, simply set withmask=T and maskfile=yourmaskname to override the default]

Valid input filenames derived are, in the case of a comb being entered, e.g.:

```
binadapt prefix=comb withspbkg=T withpartbkg=T withswcx=T withmask=T
maskfile=mymaskimage.fits elow=400 ehigh=2000
```

All of these files are produced by the task *combimage* after running any/all of *mosspectra/ mosback/ swcx/ proton* comb-fovimsky-400-2000.fits
comb-expimsky-400-2000.fits
comb-bkgimsky-400-2000.fits
comb-swcximsky-400-2000.fits
comb-protimsky-400-2000.fits
comb-maskimsky-400-2000.fits (from *emask, et al*)

NOTE: typically, a mask produced by combimage will have the name style as above, but if you rename your files, simply set withmask=T and maskfile=yourmaskname to override the default

7   Output Files

If withsmoothing=T, binadapt creates an adaptively smoothed, exposure corrected, and background subtracted (any selected) image in SKY coords:

mos1S001-adaptimsky-350-1100.fits

A 900x900 Real32 image of the smoothing FWHM:

mos1S001-sizeimsky-350-1100.fits

Note: both of the above are also binned if withbinning=T

A QDP plot file of the radial profile of the data for the selected energy band (elow and ehigh) of the selected region:

mos1S001-radfilt-350-1100.qdp

A histogram of the smoothing FWHM:

mos1S001-size-350-1100.qdp

If withsmoothing=F, only these binned, exposure corrected, and background subtracted (any selected) images are created:

The binned count rate uncertainty image for the selected energy band (elow and ehigh) of the selected region in SKY coordinates:

mos1S001-sigimsky-350-1100.fits

and the binned count rate image for the selected energy band (elow and ehigh) of the selected region in sky coordinates:

mos1S001-rateimsky-350-1100.fits

A QDP plot file of the radial profile of the data for the selected energy band (elow and ehigh) of the selected region:

mos1S001-radfilt-350-1100.qdp

8 Algorithm

```
Read parameters.
Create appropriate filenames.
Open all the files:
 Input image, e.g. mos1S001-fovimsky-350-1100.fits
 Input PN OOT image if applicable
 Input Exposure Map
 Input Mask if applicable
 Input QPB, SP, SWCX Maps if applicable
 Determine counts for each input image
 bin the data (withbinning=T)
 adaptively smooth the data (withsmoothing=T)
 Plot radial profile and size in QDP
 Open two new output files
 If withsmoothing=T then
  Write adapted and size arrays to output files
 else
  Write rate and sigma arrays to output files
 endif
 Add coord keywords
 Close output files.
```

9 Comments

The original code for this task appeared in the *esas* task 2009-2021 as subtasks *adapt* and *binimage*. They were merged, removed from the task *esas*, and modularized as a single task for SAS-21. The *esas* task was removed in SAS-21.

References