mosaicmerge

April 16, 2023

Abstract

This task combines the images produced for individual observations into larger field mosaics. This includes the event and exposure images (output from *mosspectra* and *pnspectra*), QPB background images (output from *mosback* and *pnback*, both processed by *rotdet2sky*), the soft proton images (output from *proton* processed by *rotdet2sky*), and the solar wind charge exchange background (output from *swcx*, also processed by *rotdet2sky*), plus Swiss cheese maps from *cheese* and *makemaskmerge*. Pixel size, image size, coordinate system, and central coordinates are all user selected. This task was originally a subtask of the SAS *esas* task named *merge_comp_xmm* prior to SAS-21 and retains all of its functionality.

1 Instruments/Modes

Instrument	Mode
EPIC	Imaging

2 Use

pipeline processing	no
interactive analysis	yes

3 Description

This task combines the images produced for individual observations into larger field mosaics. This includes the event and exposure images (output from `mosspectra`), QPB background images (output from *mosback* processed by *rotdet2sky*), and the soft proton images (output from `proton` also processed by *rotdet2sky*). Pixel size, coordinate system, and central coordinates are all user selected. The output images are 2000 × 2000 pixels.

mosaicmerge compensates for the inclusion of observations with different filters in the mosaic. It uses the results of PIMMS with the assumption of a power-law spectrum with photon indices (alpha) of 2.4, 1.7, and 1.0, and absorption of $N_H = 2{\times}10^{20}$ H I cm^{-2}. The user enters a vlaue for alpha between 1.0 and 2.4 where 1.0 will select the hard spectrum, 1.7 selects the medium spectrum, and 2.4 selects the soft spectrum. Intermediate values will produce a linear scaling between the two nearest spectra. The

exposure image is then scaled by the ratio of the model count rates for the medium filter versus the thin or thick, making the resultant image appropriate for the medium filter.

Warning and requirements: *mosaicmerge* was part of the package *esas*, integrated into SAS, but (still) limited to work within *esas* data reduction schema. This is especially true wrt input files structure and names. In particular, *mosaicmerge* assumes that other tasks from the package, *mosspectra* / *pnspectra*, *proton* and *rotdet2sky* 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
dirfile	no	string	dir.list	

File containing the list of exposures, including the directory string, for data to be merged. For instance, if the merging processing is being done in the directory */DATA/merge* and the individual observations are located in the parallel directories */DATA/obs1/proc* and */DATA/obs2/proc*, the file *dirlist* could have entries such as:

```
/DATA/obs1/proc/mos1S001
/DATA/obs1/proc/mos2S002
/DATA/obs1/proc/pnS003
/DATA/obs2/proc/mos1S001
/DATA/obs2/proc/mos2S002
/DATA/obs2/proc/pnS003
```

type	no	int	1	

Type of file to mosaic (1=fovim, 2=expim, 3=bkgim, 4=protim, 5=swcxim, 6=cheese, 7=mslcheese)

cheesemosaictype	no	string	t	

Type of cheese masks to be mosaicked (s (soft), h (hard), t (total), smsl, hmsl, tmsl (merged))

coordsys	no	int	1	

Selects which coordinate system should be used, 1/equ, 2/gal, 3/ecl

crvaln1	yes	real		

Central longitude of the projection.

crvaln2	yes	real		

Central latitude of the projection.

pixelsize	no	real	0.03	

Pixel size of the projection in decimal degrees.

alpha	no	real	1.7	

Assumed spectral index for the filter correction scaling.

elow	no	int	350	1 <= *elow* <= 11999

Energy low limit (in eV) for the band.

ehigh	no	int	1100	2 <= *ehigh* <= 12000

Energy high limit (in eV) for the band.

xdim	no	int	2000	

X dimension of the output image

ydim	no	int	2000	

Y dimension of the output image

withmask	no	boolean	no	

Apply ordinary mask?

withcheese	no	boolean	no	

Apply cheese mask?

cheesemasktype	no	string	t	

Cheese type (s (soft), h (hard), t (total), smsl, hmsl, tmsl (merged))

NOTE1: It is possible to both create a mosaic using cheese masks AND apply an additional cheese mask to the final output mosaic.
NOTE2: It is NOT possible to apply both a cheese mask AND an ordinary mask.
NOTE3: If mosaicking cheese masks, the default cheesemosaictype is *t* (total band). If that is NOT desired, simply set the parameter cheesemosaictype to one of the other allowed options (i.e., s/h/smsl/hmsl/tmsl)

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.

badCoordsys *(error)*
Coordsys param must be (1 or equ), (2 or gal), (3 or ecl)

NoMaskANDCheese *(error)*
Mosaicmerge can apply an ordinary mask OR cheese mask but not both

badCheeseMaskType *(error)*
Value can only be s/h/t/smsl/hmsl/tmsl

badCheeseMosaicType *(error)*
Value can only be s/h/t/smsl/hmsl/tmsl

noDirfile *(error)*
Input dirfile does not exist

wrongArrayDims *(error)*
Input array must be 900x900

noPrefixes *(error)*
None of your dirfile prefixes exist

invalidMask *(error)*
Mask must be exp, cheese, or msl

cheeseCheese *(warning)*
You are attempting to apply a cheese mask to mosaicked cheese masks
corrective action: Task just continues

noCurFile *(warning)*
Current input file does not exist, skipping
corrective action: Skips prefix

badInFile *(warning)*
Current input file cannot be opened or read, skipping
corrective action: Skips prefix

noOOTInfile *(warning)*
Current input OOT file cannot be opened or read, skipping
corrective action: Skips OOT file

badMask *(warning)*
Current input MASK file cannot be opened or read, skipping
corrective action: Skips mask

6 Input Files

FOV and exposure images, products from running *mosspectra/ pnspectra*, QPB background images (from *mosback / pnback* processed by *rotdet2sky*), soft proton images (output from *proton* also processed by *rotdet2sky*), SWCX images (output from *swcx* also processed by *rotdet2sky*), Swiss cheese maps (output from *cheese*, merged Swiss cheese maps from *combimage* or *makemaskmerge*).

7 Output Files

For the different values of `comp`, the output files are:

- 1: mosaic-fovimsky-*elow*-*ehigh*.fits The FOV count image
- 2: mosaic-bkgimsky-*elow*-*ehigh*.fits The background image
- 3: mosaic-expimsky-*elow*-*ehigh*.fits The exposure image
- 4: mosaic-protimsky-*elow*-*ehigh*.fits The soft proton image
- 5: mosaic-swcsimsky-*elow*-*ehigh*.fits The SWCX image
- 6: mosaic-cheese(s/h/t) The Swiss cheese map
- 7: mosaic-cheese(s/h/t)msl The merged Swiss cheese map

8 Algorithm

```
Read in parameters
Create input and output filenames based on parameters chosen.
Loop through prefixes for each directory in dirfile:
 if (withmask or withcheese) then
  Apply a mask or cheese mask if selected to eliminate point sources.
 endif
 Apply PN OOT if necessary (but not for cheese maps)
 Accumulate a total outImage
 Calculate pixel bins to place incoming counts based on WCS coords.
End Loops
Write output mosaicked image to FITS and write new WCS keywords.
```

9 Comments

The original code for this task appeared in the *esas* task 2009-2021 as the subtask *merge_comp_xmm*. It was removed from the task *esas*, and modularized as a single task for SAS-21. The *esas* task was removed in SAS-21.

References