combimage

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Abstract

This task combines the various EPIC exposure images from a single observation, as well as images from multiple exposures into single count, exposure, model particle background, soft proton background, and SWCX images. This task was originally called *comb*, and was in the *esas* package prior to SAS-21.

1 Instruments/Modes

Instrument	Mode
EPIC	Imaging

2 Use

pipeline processing	no
interactive analysis	yes

3 Description

combimage combines the various EPIC exposure images from a single observation (ObsID), including images from multiple exposures, into single count, exposure, model particle background, soft proton background, and model solar wind charge exchange (SWCX) background images.

combimage 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 value 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 MOS2 medium filter versus the thin or thick, making the resultant image appropriate for the MOS2 medium filter.

Warning and requirements: *combimage* was part of the singular *esas* package integrated into 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 wrt to the names and structures of the input files. In particular, *combimage* assumes

that another tasks from the package, *mosspectra*, *pnspectra*, *mosback*, *pnback*, *rotdet2sky*, and possibly *proton* and *swcx* 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
prefixlist	yes	string		

List of EMOS and/or EPN prefixes (e.g., 1S001, S003).

withpartbkg	no	boolean	F	T/F

Apply particle background?

withspbkg	no	boolean	F	T/F

Apply soft proton background?

withswcxbkg	no	boolean	F	T/F

SWCX background flag, 'true' to apply.

withcheese	no	boolean	F	T/F

Select 'true' to apply a CHEESE mask. Mutually exclusive with WITHMASK.

cheesetype	no	string	t	multiple

Cheese mask type: s=soft h=hard t=total smsl=merged soft hmsl=merged hard tmsl=merged total (bands).

withmask	no	boolean	F	T/F

Select 'true' to apply a source mask. Mutually exclusive with WITHCHEESE.

elowlist	no	int	400 750	0 <= *elowlist* <= 11999

Energy low limit(s) (in eV) for the different bands.

ehighlist	no	int	750 1250	1 <= *ehighlist* <= 12000

Energy high limit(s) (in eV) for the different bands.

alpha	no	real	1.7	1.0 <= *alpha* <= 2.4

Assumed spectral index for the filter correction scaling [1.0-2.4]

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.

NoMaskANDCheese *(error)*
Can apply mask OR cheese but not both

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

eLowsGT2 *(error)*
elowlist has more than two

eHighsGT2 *(error)*
ehighlist has more than two

eLowsNEeHighs *(error)*
ehighlist nElems NE elowlist nElems

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

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

noINSTRUME *(error)*
Input file has no INSTRUME keyword

noFILTER *(error)*
Input file has no FILTER keyword

noSUBMODE *(error)*
Input file has no SUBMODE keyword (PN)

6 Input Files

For the full treatment images (products) from running *mosspectra* and *pnspectra*, *mosback* and *pnback*, *proton*, *swcx*, and *rotdet2sky* are needed. However, the combining of model particle background and soft proton images can be turned off by the `withpartbkg` and `withspbkg` parameters.

The user enters a list of prefixes, which are simply the expid prefaced by a detector indicator, e.g. 1S001 for a MOS1 expid, 2S002 for MOS2 expid, and S003 for a PN expid respectively.

Upon entering the prefix list, *combimage* will construct all of the input depending on the user's choices. At minimum, it will construct:

- *prefix*-fovimsky-elow-ehigh.fits (e.g. mos1S001-fovimsky-350-1100.fits) One for each prefix listed.
- *prefix*-bkgimsky-elow-ehigh.fits (One for each prefix listed)
- *prefix*-swcximsky-elow-ehigh.fits (One for each prefix listed)
- *prefix*-protimsky-elow-ehigh.fits (One for each prefix listed)
- *prefix*-cheese*cheesetype*.fits (If WITHCHEESE selected) (cheesetype can only be s,h,t,smsl,hmsl,tmsl, one for each prefix listed)
- *prefix*-maskim-elow-ehigh.fits (If WITHMASK selected) (One for each prefix listed)

7 Output Files

- `comb-fovimsky-`*elow-ehigh*`.fits` – The combined count image for the *prefix* exposure, selected energy band (`elow` and `ehigh`), and the selected region in sky coordinates.
- `comb-expimsky-`*elow-ehigh*`.fits` – The combined exposure image for the *prefix* exposure, selected energy band (`elow` and `ehigh`), and the selected region in sky coordinates.
- `comb-bkgimsky-`*elow-ehigh*`.fits` – The combined model particle background image for the *prefix* exposure, selected energy band (`elow` and `ehigh`), and the selected region in sky coordinates.
- `comb-protimsky-`*elow-ehigh*`.fits` – The combined model soft proton background image for the *prefix* exposure, selected energy band (`elow` and `ehigh`), and the selected region in sky coordinates.
- `comb-swcximsky-`*elow-ehigh*`.fits` – The combined model SWCX background image for the *prefix* exposure, selected energy band (`elow` and `ehigh`), and the selected region in sky coordinates.

Note: Only the comb-fovimsky* and comb-expimsky* will be created unless the users chooses any of withspbkg, withpartbkg, or withswcx, and then only the ones chosen will be created.

8 Algorithm

```
Read in parameters
Create input and output filenames based on parameters chosen.
Loop through prefixes and bands:
 Accumulate a total outImage
 Apply a mask or cheese mask if selected to eliminate point sources.
 Apply PN OOT if necessary
 call writeMap to write image to FITS.
End Loops
Repeat Loop for BKG image if withpart selected
Repeat Loop for PROT image if withprot selected
Repeat Loop for SWCX image if withswcx selected
Repeat Loop for EXP image and also apply scalefactor CCFs
```

9 Comments

The original code for this task appeared in the *esas* task 2009-2021 as the perl subtask *cheese*. It was converted to f95, removed from the task *esas*, and modularized as a single task for SAS-21. The *esas* task was removed in SAS-21.

References