emosaicproc

January 27, 2025

Abstract

`emosaicproc` is a task to perform coherently source detection on several more or less displaced exposures from the same or different observations, or "pseudo-exposures" as created by the task `emosaic_prep`, designed specifically for treating XMM-Newton observations in *emosaic* mode. A combination of real and "pseudo-exposures" (evtl. from different *emosaic* observations) is of course also possible.

1 Instruments/Modes

Instrument	Mode
EPIC	Imaging

2 Use

pipeline processing	no
interactive analysis	yes

3 Description

`emosaicproc` is a task to perform coherently source detection on several more or less displaced exposures from different observations, or "pseudo-exposures" as created by the task `emosaic_prep`, designed specifically for treating XMM-Newton observations in *emosaic* mode. A combination of real and "pseudo-exposures" (evtl. from different *emosaic* observations) is of course also possible. Spectral bands can be defined for maximizing the source detection.

Given the nature of this SAS task, it is possible to run out of memory if a large sky area is covered by the mosaic or the different ODFs. In this case, it is recommended to split the process in several runs.

Due to memory limitations od this task, usersmay find it necessary to work with subsets of different pointings We encorage user to be conservative when using `emosaicproc` and users have to be aware that RAM memory can be an issue.

When co-adding information for source detection from displaced exposures which cover more or less the same area, several factors act in different way for the images of the same source, eg. vignetting and PSF

changes within the FOV have to be taken into account. This is the reason why it is more accurate to treat the data basically pointing by pointing, instead of merging different pointings in the first place.

`emosaicproc` works on several individual (pseudo-)exposures. The reduced data (event files, as resulting from `e[m][p]proc` for pointing observations or pre-processed through `emosaic_prep` for EPIC mosaic observations, previously reduced) has to be prepared in a way, that each (pseudo)-exposure is contained in a separate directory, immediately above the working directory (eg. ../¡my-working-dir¿/prep_mosaic_001 ; ../¡my-working-dir¿/prep_mosaic_002 , etc). This is exactly the way data corresponding to different pointings in a mosaicking observation is left, after separating the data in pseudo-exposures by `emosaic_prep`. To avoid confusion and to keep the procedure simple, the names of the directories containing the (pseudo-)exposures are fixed (eg. "prep_mosaic_¡xxx¿", where ¡xxx¿ between 000 and 999 stands for each position. The numbering does not necessarily reflect any sequence - furthermore any combination of the (pseudo-)exposures can be taken for processing).

3.1 The data processing

The whole procedure is following explained. It is assumed that there are several directories above the working directory containing the event files of the exposures to be combined with the nomenclature *¡my-working-dir¿/prep_mosaic_¡xxx¿*. The only parameters allowed so far for the procedure are:

- a list of the PN or MOS event files to be processed,
- eventually a corresponding GTI file to be applied to them,
- the spectral bands to be taken for the procedure, individually chosen for each instrument

The processing comprises three logical steps:

3.1.1 Data preparation

The data preparation consists of:

- transforming the sky coordinates by every event file corresponding to the different instruments and pointings to a common image centre,
- extracting images per instrument, pointing and spectral selection, using common filtering and evtl. provided GTIs

3.1.2 Source detection steps on individual pointins

For each individual pointing and instrument, exposure maps, detection masks and background maps have to be created. The single steps performed are:

- creation of exposure maps (including vignetting) through `eexpmap`
- creation of exposure maps (without vignetting, needed for mask generation), also `eexpmap`
- creation of detection masks, via `emask`

- source detection (box method) using local background, using `eboxdetect`
- background maps creation using `esplinemap`, using the source information obtained in the former step

3.1.3 Final source detection steps using all images simultaneously

Final source detection is done through map mode box detection (`eboxdetect` in map mode) and maximum likelihood PSF fitting (`emldetect`) using simultaneously the input images of all pointings, cameras and energy bands. Note that the computer memory needed is proportional to the number of input images and the number of pixels in each input image. It is recommended therefore not to combine images which are not overlapping in this procedure.

Even a mosaicking observation with say 25 pointings is not necessarily processed in one step, but rather grouping overlapping exposures, and repeating the exercise even using same inputs partially in several runs.

4 Parameters

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

Parameter	Mand	Type	Default	Constraints
outdir	no	string	mosaic	

Name of output directory (relative to working directory) to contain the main products

pnevlist	no	dataset		

List of PN event files corresponding to the different pointings

pnPImin	no	int	300 1000 7500	

Lower energy boundaries of exposure images; units: eV

pnPImax	no	int	1000 7500 12000	

Higher energy boundaries of exposure images; units: eV

mos1evlist	no	dataset		

List of MOS1 event files corresponding to the different pointings

mos1PImin	no	int	200 1000 7500	

Lower energy boundaries of exposure images; units: eV

mos1PImax	no	int	1000 7500 12000	

Higher energy boundaries of exposure images; units: eV

mos2evlist	no	dataset		

List of MOS2 event files corresponding to the different pointings

mos2PImin	no	int	200 1000 7500	

Lower energy boundaries of exposure images; units: eV

mos2PImax	no	int	1000 7500 12000	

Higher energy boundaries of exposure images; units: eV

gtifile	no	dataset		

Global GTI file for all instruments and pointings

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.

label *(error)*
explanation

LowMemory *(warning)*
Expected memory allocation for `eboxdetect` larger than 2 GB
corrective action: Use less event files or increase RAM memory

6 Input Files

1. EPIC IMAGING mode event list per instrument (as obtained from SAS tasks `emproc`, `epproc` or from their incarnations in the official PPS)
2. EPIC MOSAIC mode event lists, preprocessed with `epproc` or `emproc` and then separated per pointing through `emosaic_prep`
3. GTI files

7 Output Files

The output is located in different directories. All the output corresponding specifically to a pointing is left at each input pointing directory, while the general output is under a general directory called by default *prep_mosaic* but changeable as it is an input parameter of `emosaicproc`. Therefore, if several runs using different input directories are started from the same working directory you have to be careful and avoid overwriting the output located in *prep_mosaic*. Optimally you will name this directory according to the combination of pointings you are using.

The main products of `emosaicproc` are:

1. exposure maps (from task `eexpmap`) per pointing, instrument and energy band
2. detector mask images (from task `emask`) per pointing, instrument and energy band

3. background maps (from task `esplinemap`) per pointing, instrument and energy band
4. mosaic `eboxdetect` source list
5. mosaic `emldetect` source list
6. `emosaic` obtained mosaic image of all instruments and pointings

8 Algorithm

9 Comments

•

References