ecoordconv

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Abstract

A routine to convert a position between coordinate systems

1 Instruments/Modes

Instrument	Mode
EPIC	IMAGING, TIMING

2 Use

pipeline processing	no
interactive analysis	yes

3 Description

This task converts a position in an image from one coordinate system into positions in other coordinate systems. For example the routine can be used to convert a celestial sky position (RA, DEC) into detector coordinatesi (DETX, DETY), chip coordinates (RAWX, RAWY), X/Y pixels and TelCoords (theta, phi). It also gives the numbers of the CCDs which are included within an input region.

Note that the conversion technique moves the input position to the centre of the image pixel containing that position. This gives the slightly strange result that the output coordinates, while being consistent with each other, are not exactly the same as the input position. Obviously the finer the binning of the input image the closer will be the correspondance between the input and the output values.

3.1 Input

3.1.1 Source image

The source image may be input in detector or sky (X/Y) coordinates. The task expects to find astrometry keywords in a certain part of the primary header and will exit with an error if the keywords are not found.

Table 1: **Output quantities**

Value	Units	Units
Theta	Off-axis angle	arc seconds
Phi	Azimuthal angle	Radians
X	X sky coord	0.05 arcsec pixel
Y	Y sky coord	0.05 arcsec pixel
DETX	Detector X coord	0.05 arcsec pixel
DETY	Detector Y coord	0.05 arcsec pixel
RA	Right ascension	degrees
DEC	Declination	degrees
RAWX	X chip coordinate	pixel
RAWY	Y chip coordinate	pixel
CCD(s)	CCD number(s) in region	-
Central CCD	CCD at region centre	-

Standard images produced by evselect and xmmselect and the pipeline will process ok. The background spline maps produced by the pipeline source detection chain and the exposure maps produced by eexpmap need to be pre-processed before they can be used within ecoordconv (see section 8).

3.1.2 Regions

Spatial regions may be entered in raw chip, detector, sky (X/Y) or celestial (RA, DEC, FK4 2000) coordinates. If raw coordinates are used the CCD must be given using the parameter `ccdno`. If the coordinates of the region are not the same as those of the image, e.g. a sky pixel region on a detector coordinate image, then the task will still function but will run more slowly. An error will result if the spatial region is not within the image. Any shape conforming to the **selectlib** rules may be used, except that RAW coordinates may currently only be entered using a circular selection (but see section **??**).

3.2 Output

The output text shown below is independent of the SAS_VERBOSITY setting. The strings shown may be searched for in a script and every effort will be made to keep them constant between versions of this task.

```
ecoordconv:-  Region Centre:
 Theta: Phi: 105.768 2.17488
 X: Y: -1239.05 1711.11
 DETX: DETY: -1239.05 1711.11
 RA: DEC: 275.547 64.3216
 RAWX: RAWY: 54 167
 CCD(s):  1 2 4 5 7 8 10 11 centred on CCD: 4
```

3.3 Examples

1. Convert a particular sky coordinate position

```
ecoordconv imageset=pnimagexy.ds x=27000 y=26900 coordtype=POS
```

```
ecoordconv:-  Region Centre:
 Theta: Phi: 18.4712 2.59867
 X: Y: 27010 26888
 DETX: DETY: -353.754 160.874
 RA: DEC: 275.505 64.3385
 RAWX: RAWY: 43 186
 CCD(s):  4 centred on CCD: 4
```

2. Convert a detector coordinate region

```
ecoordconv srcexp="(DETX,DETY) in CIRCLE(100,1000,7000)" imageset=pnimagexy.ds

ecoordconv:-  Region Centre:
 Theta: Phi: 50.5951 1.40977
 X: Y: 26280.112  27503.672
 DETX: DETY: 124.823 968.882
 RA: DEC: 275.498 64.3258
 RAWX: RAWY: 37 176
 CCD(s):  1 4 5 7 8 10 centred on CCD: 4
```

3. Convert a RAW coordinate

```
ecoordconv imageset=image.ds coordtype=raw x=32 y=191 ccdno=4

ecoordconv:-  Region Centre:
 Theta: Phi: 48.3652 3.84547
 X: Y: 27095.5 27965.5
 DETX: DETY: 546.171 -243.231
 RA: DEC: 114.952 -85.6571
 RAWX: RAWY: 32 191
 CCD(s):  4 centred on CCD: 4
```

4 Parameters

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

Parameter	Mand	Type	Default	Constraints
imageset	yes	string	image	

The name of the input image.

srcexp	no	string		

Expression for defining the source position and parameters

withcoords	no	boolean	false	none

If `true`, the source position must be specified via the parameters `coordtype`, `x`, `y`. Otherwise, the source position is taken from the centre of the source region defined in the `srcexp` parameter.

x	no	real		

The X coordinate of the position to convert

y	no	real		

The Y coordinate of the position to convert

coordtype	yes	string	eqpos	eqpos pos det raw

The coordinate system for which the source position, specified by the parameter `x` and `y`, is defined. If `coordtype` is set to `eqpos`, then `x, y` correspond to RA and DEC respectively in decimal degrees. If `coordtype` = `pos`, then `x,y` correspond to POS coordinates. (Note that the POS coordinates are defined relative to a nominal pointing position; this is taken from the global attributes `REFXCRVL` and `REFYCRVL` of the image dataset.) If `coordtype` = `det`, then `x, y` are the x and y positions of the source centre, in DET coordinates. Finally, if `coordtype` = `raw`, then `x, y` are the raw chip positions of the source centre. In this case the CCD number must be specified using the `ccdno` parameter.

withccd	no	boolean	false	none

If `true`, the ccd number must be specified via the parameter `ccdno`, `x`, `y`. This is mandatory if the position has been specified in raw chip coordinates.

ccdno	yes	int		

The CCD number on which the RAW chip position falls.

theta_out	no	double		

Output parameter that contains the off-axis angle, in units of arc seconds.

phi_out	no	double		

Output parameter that contains the azimuthal angle, in units of radians.

ra_out	no	double		

Output parameter that contains the right ascension.

dec_out	no	double		

Output parameter that contains the declination.

posx_out	no	double		

Output parameter that contains the POS, X position.

posy_out	no	double		

Output parameter that contains the POS, Y position.

detx_out	no	double		

Output parameter that contains the X position in detector coordinates

dety_out	no	double		

Output parameter that contains the Y position in detector coordinates

rawx_out	no	double		

Output parameter that contains the X position in raw, chip coordinates

rawy_out	no	double		

Output parameter that contains the Y position in raw, chip coordinates

ccd_out	no	int		

Output parameter that contains the number of the CCD which the input position falls on.

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.

InvalidExpression *(error)*
The input expression for this spatial region was not valid.

InvalidRegion *(error)*
The centre of the source or background region lies outside of the image

invalidArraySize *(error)*
The image is not two dimensional.

InvalidWCSType *(error)*
The image axes specified in the CTYPE1 and CTYPE2 keywords are not compatible.

invalidCoordType *(error)*
The input coordinate system is not recognised.

noCCDNumber *(error)*
A position has been given in RAW chip coordinates but no CCD number has been supplied. Use ccdno=nn on the command line.

UnknownModeString *(warning)*
If the spectrum contains an observing mode (in the keyword SUBMODE) which is not recognised then the software assumes that the common PrimeFullWindow mode was in use.
corrective action: PrimeFullWindow

NoInstrument *(warning)*
If the INSTRUME keyword is not set in the image header a warning is issued and the default of MOS-1 is taken. The instrument determines the PSF used and the position of the optical-axis.
corrective action:

InvalidPosWCSInfo *(warning)*
The REFerence keywords in the image header, e.g. REFXCRPX, REFXCRVL, REFXCDLT are incomplete. Defaults are chosen but there is likely to be a problem later.
corrective action:

6 Input Files

- an EPIC image produced by evselect or xmmselect or the pipeline.

7 Output Files

8 Algorithm

9 Comments

References