Non-Standard AORs for PACS photometer spatial calibration

Author:
D.Lutz, V.Doublier

This note captures requirements on and the implementation of non-standard AORs for use in PACS spatial calibration, as set by the PACS calibration document and discussed between VD and DL on Oct 20, 2008. Three groups were identified:

1. A chopped/nodded AOR with more flexibility on chop throw, nod throw and direction, and positioning of the chop/nod pattern on the array.
2. A triple-chopped observation for linking chopper throw and displacement on sky
3. Line scans and staring rasters with the chopper at arbitrary (fixed) position

These are currently implemented as four modes of the PacsCal_Phot_PSF_FieldDistort generic AOR. **Warning:** The implementation descriptions below are a best attempt at the time of writing. In case of severe doubt, consult the current CUS code.
Document Change Log

<table>
<thead>
<tr>
<th>Document Title</th>
<th>Non-Standard AORs for PACS photometer spatial calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference No:</td>
<td>PICC-ME-TN-028</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Issue</th>
<th>Revision</th>
<th>Date</th>
<th>Reason for change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft</td>
<td>0.0</td>
<td>20 Oct 2008</td>
<td>Didn’t exist before</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>27 Oct 2008</td>
<td>PacsCal_Phot_PSF_FieldDistort</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
<td>30 Oct 2008</td>
<td>Chop clarifications/corrections</td>
</tr>
<tr>
<td></td>
<td>0.9</td>
<td>13 Nov 2008</td>
<td>All four modes</td>
</tr>
</tbody>
</table>

Applicable and Reference Documents

RD-1:

AD-1: PCD Pacs Calibration Document PACS-MA-GS-001
1 Flexible Chopped/Nodded AOR

1.1 Requested by
PCD 3.1.2 Relation between Chopper Position and Angular Displacement on Sky
PCD 3.1.4 Photometer Point Spread Function
PCD 2.6.2 Relative Pointing Error

1.2 Description
This is in principle a standard chopped and nodded AOR, but with freedom to flexibly define its spatial parameters and various durations. PSF determination for example prefers a clean beam with the chop and nod off beams well separated from the main beam to outside the FOV. The request for flexibility on the length of the nod cycle is driven by Req. 2.6.2 RPE where one wants a long chopping time that is not interrupted by a nod, over a longer period than provided by the standard point-source AOR.

After usual setup and calblock do a chopped/nodded observation optionally embedded in an outer spatial raster loop. No chopper dither of point-source AOR style is needed. No sensitivity calculations.

[Note previous work, Diego Cesarsky email to DL, TM, VD Feb 18, 2008]

1.3 Needed Calling parameters
Filter on blue side
Target Position or SSO ID (execution on SSOs shall be possible!)
Chopper throw (arcsec)
Nod throws (arcsec), for the two coordinates of the Array system, or as throw/direction
Offsets of positive beam from array center (arcsec) in the two coordinates of the Array system
Length of nodcycle (seconds) or equivalent
Number of nod cycles = repetition factor (perhaps not needed??)
Number of raster points per line
Number of raster lines
Raster point step (arcsec)
Raster line step (arcsec)

1.4 Implementation in PacsCal_Phot_PSF_FieldDistort
This generic AOR implements in its ‘flexible’ mode a chopped/nodded AOR inside a raster loop. For quick PSF characterization near the centers of each matrix, a 2*2 raster around the chop/nod combines speed with some redundancy wrt bad pixels etc. and matrix gap filling. For a more fine sampling around a given position, a larger finely sampled raster can be used.

Chop pattern: For xoffset=yoffset=nodthrow=0 (a setting not actually recommended), this mode would perform a square chop centered on the array, with chopthrow=c the elongation would be +c/2 -c/2 +c/2 –c/2 +c/2 –c/2…..

Example input parameters. Color code: Red = input to be set for each observation. Green = in principal to be set, but don’t touch the defaults Blue: Not applicable for this method.
Herschel

Non-Standard AORs for photometer spatial cal

Doc. Ref: PICC-ME-TN-028
Issue: 0.9
Date: 2008-11-13
Page: 4 of 10

Fltw position: POS B  (B=blue, A=green)

<psfMeth>: flexible
Mandatory for this mode!

BOLC gain: HIGH

<nrepeat>: 1
(loop number around the entire procedure)

Compression mode : 0  (blue)
(Compression mode : 0  (red)
Number of raw pixels : 3  (blue)
Number of raw pixels : 3  (red)

Nb of SRC-REF1-SRC-REF2 cycles : 16  (chopper cycles!)
Nb rdouts/plateau (4*nn - 1) : 15  (determines length of chop plateau, 40Hz)

Outermost DMC loop: 1
Loop on CSs : 0

RA (returned by xHSPOT pop-up window)
DEC (ditto)
yoffiset [arcsec] used as is in PntReq: 64
zoffiset [arcsec] used as is in PntReq: 26
naifid (returned by xHSPOT pop-up window, for SSOs)

Number of raster points (flexible): 2
Number of raster lines (flexible): 2

Raster point step [arcsec] (flexible): 8.5
Raster line separation [arcsec] (flexible): 8.5

Raster in S/C (false) or SKY coordinates : false

Nod throw [arcsec] : 180
Chop throw [arcsec]: 180

Chopper fixed position (ONLY fieldDist method): 664

Scan rate: high
Scan leg [arcmin]: 30

Number of scan legs: 2

<mapScanAngleRef>: inst
<mapScanConstrFrom> : 0.0
<mapScanConstrTo> : 0.0
<mapScanAngle> : 0.0

Scan separation [arcsec]: 2.0

<mapScanHomCoverage>: false
<mapScanSquare> : false
dwell time for staring raster (sec): 10.0

Raster pattern orientation: 0.0

Nodding orientation (def: along y-axis): 180  (0=+z, 90=+y on sky)
Number of Aa aA ... nods: 1
start at off-nod B position: false
verbose: true
2 Triple-chopped AOR

2.1 Requested by
PCD 3.1.2 Relation between Chopper Position and Angular Displacement on Sky

2.2 Description
After usual setup and calblock, do a symmetric triple chop center-off1-center-off2... defined from the center between the two sources. During the first period of the nod cycle, the center of one of the inner blue matrices should point at:

- The centroid of the double source if chopper is in its optical zero position
- Source 1 if chopper is in off1, the double source position angle is the chopper position angle, and the adopted scales are correct
- Source 2 if chopper is in off2, the double source position angle is the chopper position angle, and the adopted scales are correct

Then nod by 1 blue matrix size orthogonal to chop direction to redo the exercise on the other side and provide the off-nod for subtraction.

It is the responsibility of calibration planning to make sure that position angles of double source and chop direction are similar, only then the procedure makes sense. There is no suggestion of an orientation constraint below, because of the 180deg symmetry of the problem - to be discussed. There is also no need for a SSO capability since such observations if involving SSOs need to be time constrained anyway.

No sensitivity calculations, default length of nod cycle would be ok for the 3.1.2 purpose, flexibility as now implemented helps for mis-use.

2.3 Needed Calling parameters
Filter on blue side
Position of CENTROID of double source
Separation between double source = total throw off2-off1 (arcsec)
Number of nod cycles = repetition factor

2.4 Implementation in PacsCal_Phot_PSF_FieldDistort
This generic AOR implements in its ‘triple Chop’ mode a chopped/nodded AOR with triple Chop. Unlike ‘flexible’, there is no raster loop.

Chop pattern: For xoffset=yoffset=nodthrow=0 (a setting not actually recommended), this mode would perform a triple chop centered on the array, with chophrow=c the elongation would be 0 +c/2 0 -c/2 0 +c/2 0 -c/2 0 +c/2 0 -c/2....

Example input parameters. Color code: Red = input to be set for each observation. Green = in princible to be set, but don’t touch the defaults Blue: Not applicable for this method.

Fltw position: POS B      (B=blue, A=green)
<psfMeth>: tripleChop   Mandatory for this mode!
BOLC gain: HIGH
<nrepeat>: 1  (loop number around the entire procedure)
Compression mode : 0  (blue)
Compression mode : 0  (red)
Number of raw pixels : 3  (blue)
Number of raw pixels : 3  (red)
Nb of SRC-REF1-SRC-REF2 cycles : 32  (chopper cycles!)
Nb rdouts/plateau (4*nn - 1) : 15  (determines length of chop plateau, 40Hz)
Outermost DMC loop: 1
Loop on CSs : 0
RA (returned by xHSPOT pop-up window)
DEC (ditto)
yoffiset [arcsec] used as is in PntReq: 26
zoffiset [arcsec] used as is in PntReq: 26
naifid (returned by xHSPOT pop-up window, for SSOs)
Number of raster points (flexible): 2
Number of raster lines (flexible): 1
Raster point step [arcsec] (flexible): 10
Raster line separation [arcsec] (flexible): 2
Raster in S/C (false) or SKY coordinates : false
Nod throw [arcsec] : 52
Chop throw [arcsec]: 117.6
Chopper fixed position (ONLY fieldDist method): 664
Scan rate: high
Scan leg [arcmin]: 30
Number of scan legs: 2
<mapScanAngleRef>: inst
<mapScanConstrFrom> : 0.0
<mapScanConstrTo> : 0.0
<mapScanAngle> : 0.0
Scan separation [arcsec]: 2.0
<mapScanHomCoverage>: false
<mapScanSquare> : false
dwell time for staring raster (sec): 10.0
Raster pattern orientation: 0.0
Nodding orientation (def: along y-axis): 180  (0=+z, 90=+y on sky)
Number of Aa aA ... nods: 2
start at off-nod B position: false
verbose: true
3 Scan maps at arbitrary fixed chopper position

3.1 Requested by
PCD 3.1.3 Photometer Field of View Distortion
PCD 3.1.5 Photometer Ghosts

3.2 Description
After usual photometer setup and calblock, set the chopper to a fixed position, and then do a scanmap centered on the FOV at that given chopper position.

No sensitivity calculations, angles only in the array system, not in the sky system.

3.3 Needed Calling parameters
Filter on blue side
Target position
Chopper position (TBD whether in CPR or in Angle units)
Repetition factor
Scan speed
Scan leg length (arcmin)
Cross scan step (arcsec)
Number of scan legs
Orientation angle in Array reference frame

3.4 Implementation in PacsCal_Phot_PSF_FieldDistort
This generic AOR implements in its ‘fieldDist_scan’ mode a line scan AOR with chopper set to a nonstandard position. Use yoffset/zoffset to properly center the pattern on the FOV shifted by the chopper.

Example input parameters. Color code: Red = input to be set for each observation. Green = in principle to be set, but don’t touch the defaults Blue: Not applicable for this method.

Fltw position: POS B (B=blue, A=green)
<psfMeth>: fieldDist_scan Mandatory for this mode!
BOLC gain: HIGH
<nrepeat>: 1 (loop number around the entire procedure)
Compression mode : 0 (blue)
Compression mode : 0 (red)
Number of raw pixels : 3 (blue)
Number of raw pixels : 3 (red)
Nb of SRC-REF1-SRC-REF2 cycles : 2
Nb rdouts/plateau (4*nn - 1) : 31
Outermost DMC loop: 1
Loop on CSs : 0
RA (returned by xHSPOT pop-up window)
DEC (ditto)
yoffset [arcsec] used as is in PntReq: -108.7
4 Staring rasters at arbitrary fixed chopper position

4.1 Requested by
PCD 3.1.3 Photometer Field of View Distortion

4.2 Description

After usual photometer setup and calblock, set the chopper to a fixed position, and then do a staring raster centered on the FOV at that given chopper position.

No sensitivity calculations, angles only in the array system, not in the sky system.

4.3 Needed Calling parameters

Filter on blue side
Target position
Chopper position (TBD whether in CPR or in Angle units)
Repetition factor
Dwell time on each point (sec)
Number of raster points per line
Number of raster lines
Raster point step (arcsec)
Raster line step (arcsec)
Orientation angle in Array reference frame

4.4 Implementation in PacsCal_Phot_PSF_FieldDistort

This generic AOR implements in its ‘fieldDist_rast’ mode a staring raster AOR with chopper set to a nonstandard position. Use yoffset/zoffset to properly center the pattern on the FOV shifted by the chopper.

Example input parameters. Color code: Red = input to be set for each observation. Green = in principle to be set, but don’t touch the defaults Blue: Not applicable for this method.

Fltw position: POS B      (B=blue, A=green)
<psfMeth>: fieldDist_rast       Mandatory for this mode!
BOLC gain: HIGH
<repeat>: 1                   (loop number around the entire procedure)
Compression mode : 0    (blue)
Compression mode : 0    (red)
Number of raw pixels : 3    (blue)
Number of raw pixels : 3    (red)
Nb of SRC-REF1-SRC-REF2 cycles : 2
Nb rdouts/plateau (4*nn - 1) : 31
Outermost DMC loop: 1
Loop on CSs : 0
RA (returned by xHSPOT pop-up window)
DEC (ditto)
yoffset [arcsec] used as is in PntReq: 0.0
zoffset [arcsec] used as is in PntReq: 0.0
naifid (returned by xHSPOT pop-up window, for SSOs)
Number of raster points (flexible): 32    (Maximum 32)
Number of raster lines (flexible): 32    (Maximum 32)
Raster point step [arcsec] (flexible): 7
Raster line separation [arcsec] (flexible): 3.5
Raster in S/C (false) or SKY coordinates : false
Nod throw [arcsec] : 30
Chop throw [arcsec]: 30
Chopper fixed position (ONLY fieldDist method): 664
Scan rate: high
Scan leg [arcmin]: 30
Number of scan legs: 2
<mapScanAngleRef>: inst
<mapScanConstrFrom> : 0.0
<mapScanConstrTo> : 0.0
<mapScanAngle> : 0.0
Scan separation [arcsec]: 2.0
<mapScanHomCoverage>: false
<mapScanSquare> : false
dwell time for staring raster (sec): 10.0           (Minimum 10.0)
<table>
<thead>
<tr>
<th>Herschel</th>
<th>PACS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Standard AORs for photometer spatial cal</td>
<td>Doc. Ref: PICC-ME-TN-028</td>
</tr>
<tr>
<td>Issue: 0.9</td>
<td>Date: 2008-11-13</td>
</tr>
<tr>
<td>Page: 10 of 10</td>
<td></td>
</tr>
</tbody>
</table>

Raster pattern orientation: 90.0
Nodding orientation (def: along y-axis): 270
Number of Aa aA ... nods: 1
start at off-nod B position: false
verbose: true