Test of Peak Finders - V2

Content

- Content
- Data
- V2 News
  - Peak selection parameters
  - Summary of peak selection parameters
  - Raw n-d array pre-processing before peak-finders
  - Peak list
- Peak list processing
  - Peak pre-selection for histogramms
    - ARC region
    - EQU region
  - Peak selection for fit
    - ARC region
    - EQU region
- References

Data

exp=cxif5315:run=169

V2 News

V2 is done for test of peak finders after revision r1.

See for details

- Hit/Peak Finding - description of algorithms
- ImgAlgos.PyAlgos - peak finders API
- PSAS-147 - details about revision 1

We work with peak finder versions v2r1, v3r1, v4r1.

Data processing and peak finding is done in cxif5315/proc-cxif5315-r0169-data-pfvn-2016-04-19.py

Peak selection parameters

- selection parameters were set with as minimal number of parameters as possible.
- selection parameters of different peak finders were adjusted to get about the same yield of peaks in the file.
from ImgAlgos.PyAlgos import PyAlgos

alg_arc = PyAlgos(windows=winds_arc, mask=mask_arc, pbits=2)
#alg_arc.set_peak_selection_pars(npix_min=0, npix_max=1e6, amax_thr=0, atot_thr=500, son_min=6)    # for pfv2r1
alg_arc.set_peak_selection_pars(npix_min=0, npix_max=1e6, amax_thr=0, atot_thr=0, son_min=6)       # for pfv3r1, pfv4r1

alg_equ = ...  # the same

    # in the event loop:

    # run peakfinders and get list of peak records for each region
    #peaks_arc = alg_arc.peak_finder_v2r1(nda, thr=30, r0=6, dr=0.5)
    peaks_arc = alg_arc.peak_finder_v3r1(nda, rank=5, r0=6, dr=0.5)
    #peaks_arc = alg_arc.peak_finder_v4r1(nda, thr_low=10, thr_high=150, rank=5, r0=6, dr=0.5)

    #peaks_equ = alg_equ.peak_finder_v2r1(...)  # The same

Summary of peak selection parameters

peak finder specific parameters for seed peak finding

- v2: thr=30
- v3: rank=5
- v4: thr_low=10, thr_high=150, rank=5

use the same parameters for S/N calculation

- r0=6, dr=0.5

peak selection in the list

- common: son_min=6
- v2: atot_thr=500  # to keep the same number of peaks in the list as for v3,v4

Raw n-d array pre-processing before peak-finders

- get raw data
- subtract pedestals
- subtract radial background to polarization corrected data
- apply status mask
from pyimgalgos.RadialBkgd import RadialBkgd, polarization_factor

nda_bkgd = det.bkgd(runnum) # pre-defined n-d array with averaged background from calib/.../pixel_bkgd/...
nda_smask = det.mask(runnum, calib=False, status=True, edges=True, central=True, unbond=True, unbondnbrs=True)

mask_bkgd = nda_smask # * mask_winds_tot
rb = RadialBkgd(Xarr, Yarr, mask=mask_bkgd, radedges=(5200, 80000), nradbins=200, nphibins=1)
pf = polarization_factor(rb.pixel_rad(), rb.pixel_phi(), DIST_STOD)

    # in the event loop:
    nda_data = det.raw(evt)
    if nda_data is not None :
        nda = np.array(nda_data, dtype=np.float32, copy=True)
        nda -= nda_peds

        #det.common_mode_apply(evt, nda, cmpars=(1,50,50,100))
        #nda = subtract_bkgd(nda, nda_bkgd, mask=nda_smask, winds=winds_bkgd, pbits=0)

        nda = rb.subtract_bkgd(nda.flatten() * pf)
        nda.shape = shape_cspad

        nda *= nda_smask

Common mode correction was tested before and after background subtraction.
For unknown reason it makes image visually worse...

Peak list
In revision 1 four parameters col_min, col_max, row_min, row_max were discarded.
For each peak finder we created list of peak parameters, beginning as
<table>
<thead>
<tr>
<th>Row</th>
<th>Col</th>
<th>Npix</th>
<th>Amax</th>
<th>Atot</th>
<th>rcent</th>
<th>ccent</th>
<th>rsigma</th>
<th>csigma</th>
<th>bkgd</th>
<th>rms</th>
</tr>
</thead>
<tbody>
<tr>
<td>133</td>
<td>366</td>
<td>109</td>
<td>121.5</td>
<td>2327.8</td>
<td>134.6</td>
<td>365.6</td>
<td>2.71</td>
<td>2.93</td>
<td>-13.2</td>
<td>19.66</td>
</tr>
<tr>
<td>11.34</td>
<td>152</td>
<td>638</td>
<td>7357</td>
<td>46871</td>
<td>47445</td>
<td>81.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>170</td>
<td>91</td>
<td>133.1</td>
<td>1167.8</td>
<td>74.3</td>
<td>240.6</td>
<td>2.25</td>
<td>2.92</td>
<td>-9.00</td>
<td>20.34</td>
</tr>
<tr>
<td>7.80</td>
<td>149</td>
<td>434</td>
<td>-15104</td>
<td>47246</td>
<td>49601</td>
<td>119.31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>170</td>
<td>91</td>
<td>133.1</td>
<td>1167.8</td>
<td>74.3</td>
<td>240.6</td>
<td>2.25</td>
<td>2.92</td>
<td>-9.00</td>
<td>20.34</td>
</tr>
<tr>
<td>7.80</td>
<td>149</td>
<td>434</td>
<td>-15104</td>
<td>47246</td>
<td>49601</td>
<td>119.31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>170</td>
<td>91</td>
<td>133.1</td>
<td>1167.8</td>
<td>74.3</td>
<td>240.6</td>
<td>2.25</td>
<td>2.92</td>
<td>-9.00</td>
<td>20.34</td>
</tr>
<tr>
<td>7.80</td>
<td>149</td>
<td>434</td>
<td>-15104</td>
<td>47246</td>
<td>49601</td>
<td>119.31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Peak list processing

For peak list processing we use script:

```bash
cxif5315/proc-cxif5315-r0169-peaks-from-file-v6.py
```

Peak pre-selection for histogramms

ARC region
def procPeakDataArc(pk) :
    
    # Process peak for ARC region; accumulate peak statistics in histogram arrays.
    
    #===================
    # discard from all histograms except its own
    sp.lst_arc_atot.append(pk.atot)
    if pk.atot<2000 : return
    #===================
    sp.lst_arc_amax.append(pk.amax)
    sp.lst_arc_npix.append(pk.npix)
    sp.lst_arc_r   .append(pk.r)
    ...

---

Arc: Amax

Entries=23113
Mean=351.08 ± 28.36
RMS=194.45 ± 20.06
γ=1.286, χ²=1.083

Arc: Amax

Entries=32284
Mean=251.97 ± 41.32
RMS=196.34 ± 29.22
γ=1.668, χ²=2.237
def procPeakDataEqu(pk) :
    """ Process peak for EQU region; accumulate peak data ""
    #===================
    # discard from all histograms except its own
    sp.lst_equ_atot.append(pk.atot)
    if pk.atot<2000 : return
    sp.lst_equ_r_raw.append(pk.r)
    if pk.r<100     : return
    #===================
    sp.lst_equ_r.append(pk.r)
    sp.lst_equ_amax.append(pk.amax)
    sp.lst_equ_npix.append(pk.npix)
    ...

Equ: Amax

Entries=5489
Mean=373.37 ± 25.64
RMS=182.18 ± 18.13
χ²=1.201 υ=1.155
Peak selection for fit

ARC region

def peakIsSelectedArc(pk) :
    """Apply peak selection criteria to each peak from file"""
    if pk.son<9     : return False
    if pk.amax<150  : return False
    if pk.atot<2000 : return False
    if pk.npix>500  : return False
    if pk.r<435     : return False
    if pk.r>443     : return False
    if pk.rms>80    : return False
    if pk.bkgd<-20  : return False
    if pk.bkgd>50   : return False
    return True
Arc: Distance between 2 peaks

Entries: 2909
Mean: 169.01 ± 14.91
RMS: 101.42 ± 10.54
\( t = 0.499 \) \( \gamma = 1.438 \)

Arc: Distance between 2 peaks

Entries: 1008
Mean: 165.81 ± 17.37
RMS: 105.34 ± 12.28
\( t = 0.420 \) \( \gamma = 1.560 \)

Arc: Distance between 2 peaks

Entries: 4081
Mean: 152.66 ± 11.84
RMS: 103.95 ± 8.37
\( t = 0.066 \) \( \gamma = 1.462 \)
To fit peaks we use `funcy_l1_v0(x, phi_deg, bet_deg, DoR=433/sp.DETD, sgnrt=-1.)`
ARC: fit angle beta

Entries: 1332
Mean: 16.58 ± 0.83
MS: 2.49 ± 0.59
\(\chi^2 / \nu = 0.32\)
\(\nu = 0.942\)

Entries: 499
Mean: 16.83 ± 0.77
MS: 2.45 ± 0.55
\(\chi^2 / \nu = 0.72\)
\(\nu = 0.911\)

Entries: 1396
Mean: 16.80 ± 0.84
MS: 2.57 ± 0.59
\(\chi^2 / \nu = 0.67\)
\(\nu = 1.037\)
EQU region
```python
def peakIsSelectedEqu(pk):
    """Apply peak selection criteria to each peak from file
    """
    if pk.son<9    : return False
    if pk.amax<150 : return False
    if pk.atot<2000: return False
    if pk.npix>500 : return False
    if pk.r<100    : return False
    if pk.r>454    : return False
    if pk.rms>80   : return False
    if math.fabs(pk.bkgd)>20 : return False
    return True
```

To fit peaks we use `funcy_l0` which automatically select solution depending on sign of parameter B.
References

- Hit/Peak Finding Details - description of algorithms
- ImgAlgos.PyAlgos - interface methods
- PSAS-147 - details about revision 1
- Radial Background Subtraction Algorithm