Test of Peak Finders - V2

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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>Exp</th>
<th>Run</th>
<th>Date</th>
<th>Time</th>
<th>time(sec)</th>
<th>time(nsec)</th>
<th>fiduc</th>
<th>Evnum</th>
<th>Reg</th>
<th>Seg</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Row</td>
<td>Col</td>
<td>Npix</td>
<td>Amax</td>
<td>Atot</td>
<td>rcent</td>
<td>ccent</td>
<td>rsigma</td>
<td>csigma</td>
<td>bkgd</td>
</tr>
<tr>
<td></td>
<td>imrow</td>
<td>imcol</td>
<td>x[um]</td>
<td>y[um]</td>
<td>r[um]</td>
<td>phi[deg]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Peak list processing

For peak list processing we use script:

```
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; δ=1.083

Arc: Amax

Entries=32284
Mean=251.97 ± 41.12
RMS=196.34 ± 29.22
γ=1.668; δ=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)
    ...

Arc: Number of peaks selected

Equ: Amax
Equ: Peak azimuthal angle

Entries: 5988
Mean: 74.54 ± 18.38
RMS: 103.09 ± 13.00
γ₁=0.512, γ₂=0.656

Equ: Peak azimuthal angle

Entries: 11730
Mean: 72.33 ± 18.58
RMS: 103.56 ± 13.13
γ₁=0.484, γ₂=0.666

Equ: Peak radius

Entries: 5897
Mean: 269.83 ± 30.76
RMS: 94.92 ± 21.75
γ₁=0.188, γ₂=1.263
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
To fit peaks we use `funcy_l1_v0(x, phi_deg, bet_deg, DoR=433/sp.DETD, sgnrt=-1.)`
EQU region
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.
Equ: event fit angle phi error

Entries=1657
Mean=1.01 ± 0.20
rms=0.23 ± 0.14
τ=3.088 · ϕ=19.310

References

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