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
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: Peak radius

Entries=75077
Mean=440.69 ± 0.89
RMS=4.37 ± 0.63
\( \gamma_1 = 0.353 \), \( \gamma_2 = 0.075 \)

Arc: Peak azimuthal angle

Entries=25188
Mean=93.54 ± 0.95
RMS=16.62 ± 2.09
\( \gamma_1 = 0.057 \), \( \gamma_2 = 0.722 \)

Arc: Peak azimuthal angle

Entries=34290
Mean=91.11 ± 2.80
RMS=19.78 ± 1.90
\( \gamma_1 = 0.047 \), \( \gamma_2 = 0.537 \)
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: S/N - for all peak pixels

Entries: 5963
Mean: 15.13 ± 2.08
RMS: 4.50 ± 1.47
γ = 3.147, ψ = 15.417

Equ: S/N - for all peak pixels

Entries: 11677
Mean: 20.71 ± 2.95
RMS: 10.38 ± 1.45
γ = 2.364, ψ = 9.339

Equ: Number of pixels/peak

Entries: 5966
Mean: 33.24 ± 4.51
RMS: 19.60 ± 3.19
γ = 5.235, ψ = 56.821
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: fit parameter p1=beta"""

Entries=747
Mean=-17.86 ± 3.00
RMS=15.41 ± 2.12
\chi^2/n=0.849   \nu=307

"""Equ: fit parameter p1=beta"""

Entries=663
Mean=-18.57 ± 3.02
RMS=16.17 ± 2.13
\chi^2/n=0.689   \nu=307
References

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