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.

```python
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
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

```python
from pyimgalgos.RadialBkgd import RadialBkgd, polarization_factor

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

mask_bkgd = nda_mask # * 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:
da_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_mask, winds=winds_bkgd, pbits=0)
    nda = rb.subtract_bkgd(nda.flatten() * pf)
    nda.shape = shape_cspad
    nda *= nda_mask
```

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:

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

## Peak pre-selection for histogramms

### ARC region

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

```python
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 region**
Peak selection for fit

**ARC region**

```python
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
γ=0.499, ζ=1.438

Arc: Distance between 2 peaks

Entries=1008
Mean=165.81 ± 17.37
RMS=105.34 ± 12.28
γ=0.420, ζ=1.560

Arc: Distance between 2 peaks

Entries=4961
Mean=152.66 ± 11.84
RMS=103.95 ± 8.37
γ=0.056, ζ=1.462
To fit peaks we use `funcy_l1_v0(x, phi_deg, bet_deg, DoR=433/sp.DETD, sgnrt=-1.)`
ARC: fit angle phi

Entries: 1330
Mean: 3.07 ± 1.33
RMS: 4.39 ± 0.94
$\gamma_1$: 0.108 $\gamma_2$: 7.613

Entries: 148
Mean: 3.25 ± 1.45
RMS: 4.95 ± 1.02
$\gamma_1$: 0.365 $\gamma_2$: 12.765

Entries: 1392
Mean: 2.81 ± 1.44
RMS: 4.84 ± 1.02
$\gamma_1$: 0.941 $\gamma_2$: 8.843
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_10 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