Hit Finders and Peak Finders (Advanced)

Documentation

- Hit and Peak Finding Algorithms
- auto-generated documentation for module Algos.PyAlgos

Example of hit/peak finders

Script ex_peak_finder_01.py

```
import psana
ds = psana.DataSource('exp=xpptut15:run=54:smd')
det = psana.Detector('cspad', ds.env())

##------------------------------
# peak-finder initialization
from ImgAlgos.PyAlgos import PyAlgos
import numpy as np

winds = [(s, 0, 185, 0, 388) for s in (0,1,7,8,9,15,16,17,23,24,25,31)]
mask = np.ones((32,185,388))

alg = PyAlgos(windows=winds, mask=mask, pbits=0)
alg.set_peak_selection_pars(npix_min=2, npix_max=50, amax_thr=10, atot_thr=20, son_min=5)

##------------------------------
hdr = 'Seg  Row  Col  Npix      Amax      Atot   rcent   ccent rsigma  csigma '+\
      'rmin rmax cmin cmax    bkgd     rms     son'
fmt = '%3d %4d %4d  %4d  %8.1f  %8.1f  %6.1f  %6.1f %6.2f  %6.2f %4d %4d %4d %4d  %6.2f  %6.2f  %6.2f'
##------------------------------

for nevent,evt in enumerate(ds.events()):
    if nevent>5 : break
    print(f"{80*'_':s}\nEvent {nevent:d}") # (80*'_', nevent)

    nda = det.calib(evt)
    print(f'Calibrated data shape:{nda.shape} {nda.dtype}') # (nda.shape, nda.dtype)

    # hit-finders
    thr = 20
    numpix = alg.number_of_pix_above_thr(nda, thr)
    totint = alg.intensity_of_pix_above_thr(nda, thr)
    print(f'{numpix:d} pixels have intensity above threshold = {thr:5.1f}') # (numpix, thr)
    print(f'{totint:.1f} is a total intensity in pixels above threshold ={thr:5.1f})' # (totint, thr)

    # get 2-d array of peak parameters
    peaks = alg.peak_finder_v1(nda, thr_low=5, thr_high=30, radius=5, dr=0.05)
    #peaks = alg.peak_finder_v2(nda, thr=12, r0=5.0, dr=0.05)
    #peaks = alg.peak_finder_v3(nda, rank=3, r0=5.0, dr=0.05)
    print('Array of peak parameters shape:%s dtype:%s' % (peaks.shape, nda.dtype))
    print(hdr)
    for peak in peaks :
        seg,row,col,npix,amax,atot,rcent,ccent,rsigma,csigma,\
        rmin,rmax,cmin,cmax,bkgd,rms,son = peak[0:17]

        print(fmt % (seg, row, col, npix, amax, atot, rcent, ccent, rsigma, csigma,\
                     rmin, rmax, cmin, cmax, bkgd, rms, son))
```

includes examples for two hit-finders

- `numpix = alg.number_of_pix_above_thr(nda, thr)`
- `totint = alg.intensity_of_pix_above_thr(nda, thr)`

and three peak-finders

- `peaks = alg.peak_finder_v1(nda, thr_low=5, thr_high=30, radius=5, dr=0.05)`
- `peaks = alg.peak_finder_v2(nda, thr=12, r0=5.0, dr=0.05)`
- `peaks = alg.peak_finder_v3(nda, rank=3, r0=5.0, dr=0.05)`

When run, it does necessary initialization, loops over events, finds peaks and prints them like:

```
Event 5
Calibrated data shape:(32, 185, 388) dtype:float32
31 pixels have intensity above threshold = 20.0
816.9 is a total intensity in pixels above threshold = 20.0
Array of peak parameters shape:(7, 17) dtype:float32
Seg  Row  Col  Npix      Amax      Atot   rcent   ccent rsigma  csigma rmin rmax cmin cmax    bkgd     rms
son
  7  184    5     8      45.0     107.5   183.4     5.0   1.06    2.70  179  185    0   11   -1.38    3.60
12.88
  8   44   10    19      40.2     177.1    43.9    10.0   2.80    2.87   39   50    5   16    1.23    4.89
7.97
  9  184  240    12      46.1     126.2   181.9   239.6   1.99    2.43  179  185  235  246    3.05    3.82
11.28
 17  184   35     3      32.1      44.5   183.4    35.7   1.66    1.42  179  185   30   41    0.27    4.15
7.66
 23  183   57     7      35.9      78.0   181.5    56.6   1.98    2.40  178  185   52   63   -1.89    4.02
9.39
 25  172  198    22      30.8     181.9   171.5   198.4   2.55    3.07  167  178  193  204    0.11    3.62
8.48
 31  117  106    11      38.8     120.8   116.4   106.4   2.29    2.68  112  123  101  112   -0.27    4.55
8.57
```