

Make ndarray for ROI mask

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Application for ROI mask construction / conversion

Application which works with ROI mask is implemented in `CalibManager/app/roicon`. All work with mask is split for 3 stages:

1. Produce file with 2-d image or image-mask for sensors.
2. Use mask editor to draw ROI on the top of the image.
3. Convert ROI mask to ndarray with mask shaped as data.



- Stages 1 and 3 should use the same geometry file in the option `-g`. This will guarantee that image production and mask conversion algorithms work on the same pixel maps.
- Stage 2 may be omitted if the mask for geometry-dependent bad pixels (edge, central column, non-bound pixels) is needed only. Then command for Stage 3 should have appropriate name for input mask file.
- Since ana-0.13.14 all `roicon` procedures work with numpy (*.npy) files to I/O ndarrays (see examples in command `roicon -h`).

Launching this app with `-h` option gives enough information about its functionality. In this note we demonstrate graphical content of the files generate in examples for this procedure.

Command

```
roicon -h
```

print help message with detailed description of three commands, brief command examples, and the list of optional parameters:

Usage: roicon [options]

Examples:

1) Construct 2-d image (or mask-of-segments) from ndarray with image shaped as data using appropriate geometry file

```
roicon -p1 -g <geometry-file> [-a <ndarray-with-image-(input)file>] [-i <image-(output)file>] [-c
<control-bitword>]
ex1: roicon -p1 -g /reg/d/psdm/CXI/cxitut13/calib/CsPad::CalibV1/CxiDs1.0:Cspad.0/geometry/0-end.data
ex2: roicon -p1 -g /reg/d/psdm/CXI/cxitut13/calib/CsPad::CalibV1/CxiDs1.0:Cspad.0/geometry/0-end.data -a
/reg/neh/home1/dubrovin/LCLS/CSPadAlignment-v01/calib-cxi-ds1-2014-03-19/cspad-ndarr-ave-cxii0114-r0227.dat
ex3: roicon -p1 -g /reg/d/psdm/CXI/cxitut13/calib/CsPad::CalibV1/CxiDs1.0:Cspad.0/geometry/0-end.data -a
/reg/neh/home1/dubrovin/LCLS/CSPadAlignment-v01/calib-cxi-ds1-2014-05-15/cspad-arr-cxid2714-r0023-lysozyme-
rings.npy -i image.npy
```

2) Create ROI mask using mask editor "med" (DO NOT FORGET to save mask in file!)

```
roicon -p2 [-i <image-(input)file>] [-m <roi-mask-(output)file>]
ex1,2: roicon -p2
ex3: roicon -p2 -i image.npy -m roi-mask.npy
```

3) Convert ROI mask to ndarray with mask shaped as data

```
roicon -p3 -g <geometry-file> [-m <roi-mask-(input)file>] [-n ndarray-with-mask-(output)-file] [-c
<control-bitword>]
ex1,2: roicon -p3 -g /reg/d/psdm/CXI/cxitut13/calib/CsPad::CalibV1/CxiDs1.0:Cspad.0/geometry/0-end.data
ex3: roicon -p3 -g /reg/d/psdm/CXI/cxitut13/calib/CsPad::CalibV1/CxiDs1.0:Cspad.0/geometry/0-end.data -m
roi-mask.npy -n ndarray-mask.npy
```

Optional input parameters.

Options:

```
-h, --help          show this help message and exit
-g GFNAME, --gfname=GFNAME
                    geometry file name, default = /reg/d/psdm/CXI/cxitut13
                    /calib/CsPad::CalibV1/CxiDs1.0:Cspad.0/geometry/0-end.
                    data
-a AFNAME, --afname=AFNAME
                    input ndarray file name, default = None
-i IFNAME, --ifname=IFNAME
                    image file name, default = mask-img.txt
-m MFNAME, --mfname=MFNAME
                    ROI mask file name, default = mask-roi.txt
-n NFNAME, --nfname=NFNAME
                    ndarray mask file name, default = mask-nda.txt
-c CBITS, --cbits=CBITS
                    mask control bits, =0-none, +1-edges, +2-middle,
                    etc..., default = 65535
-p PROC, --proc=PROC
                    process number: 1-construct image, 2-run mask editor
                    on image, 3-convert image mask to ndarray; default = 1
-v, --verb          verbosity, default = False
```

Produce file with 2-d image

Commands

```
roicon -p1 -g /reg/d/psdm/CXI/cxitut13/calib/CsPad::CalibV1/CxiDs1.0:Cspad.0/geometry/0-end.data
```

or

```
roicon -p1 -g /reg/d/psdm/CXI/cxitut13/calib/CsPad::CalibV1/CxiDs1.0:Cspad.0/geometry/0-end.data -a /reg/neh/home1/dubrovin
/LCLS/CSPadAlignment-v01/calib-cxi-ds1-2014-03-19/cspad-ndarr-ave-cxii0114-r0227.dat
```

with default options produce 2-d image from ndarray of sensors' data and save it in the file mask - img . txt, Fig.1. In the 1st command the ndarray file name (option -a) is omitted and the mask of sensors is created. Option -c sets the bit control word to remove edge, central, non-bound, etc. pixels in the mask.

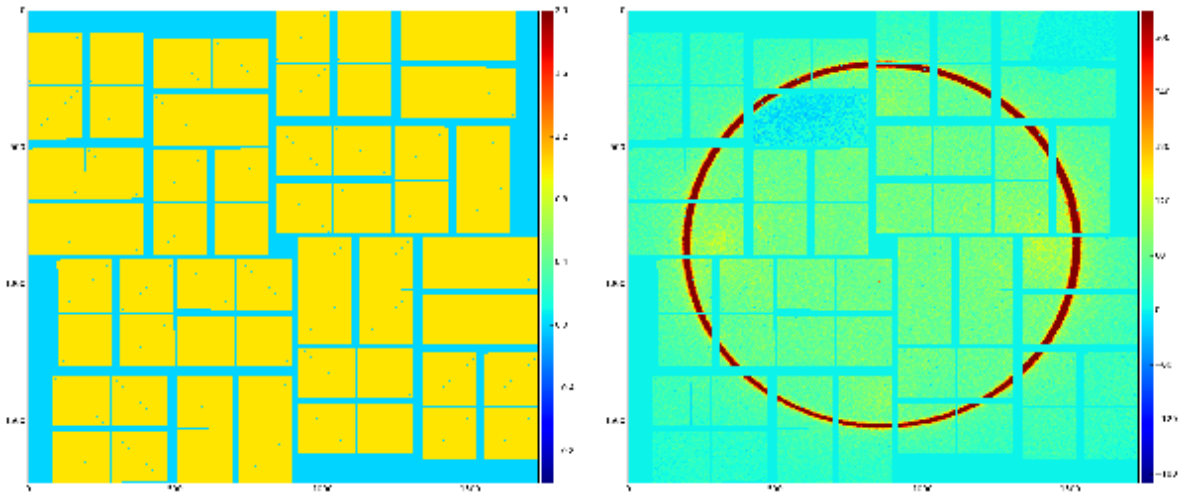


Fig.1: Graphical content of the file *mask-img.txt* for the 1st and 2nd command, respectively.

Use mask editor to draw ROI

Command

```
roicon -p2
```

invokes the mask editor *med* with default input file *mask-img.txt* and open GUI, as shown in Fig.2.

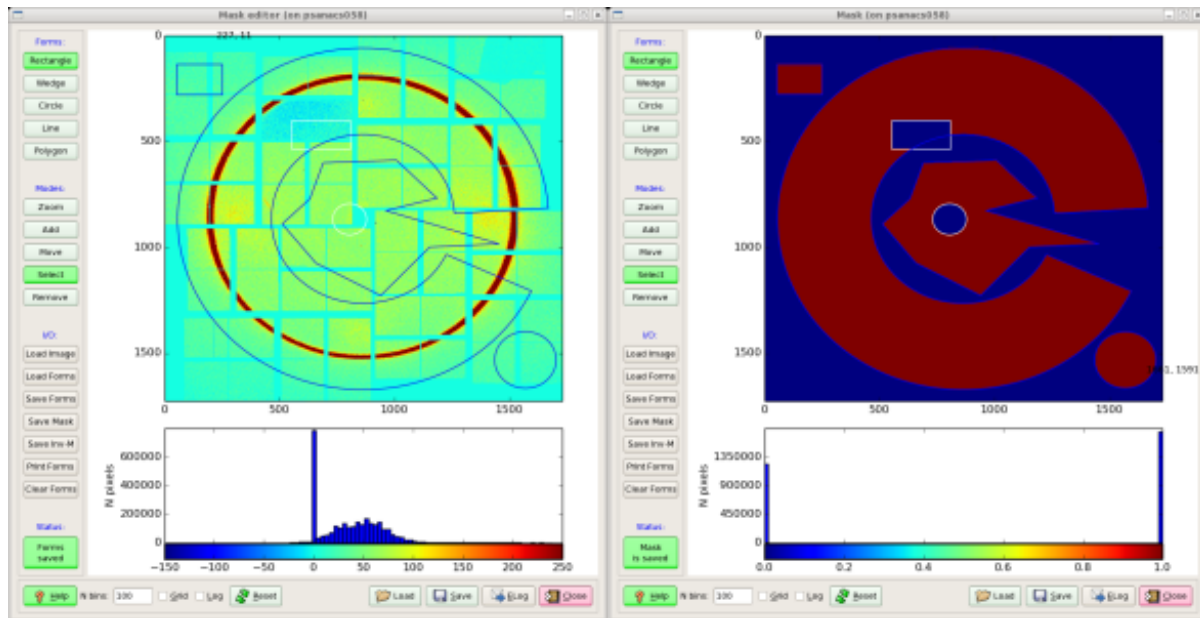


Fig.2: Mask editor GUI for drawing the ROI (left) and when the mask is saved (right).

Then, use mouse and buttons to draw the mask and, when it is ready, click the button "Save Mask". By default the file *mask-roi.txt* is saved with content shown in Fig.2 (right).

Convert ROI mask to ndarray with mask shaped as data

Command

```
roicon -p3 -g /reg/d/psdm/CXI/cxitut13/calib/CsPad::CalibV1/CxiDs1.0:Cspad.0/geometry/0-end.data
```

by default converts the file *mask-roi.txt* to *mask-nda.txt*.

Algorithm loops over pixel index ndarrays *iX* and *iY* and saves the mask-image status in the output ndarrys:

```
mask_nda = np.array( [mask_roi[r,c] for r,c in zip(iX, iY)] )
```

ROI mask content saved in the ndarray is presented in Fig.4 (right) in specific for CSPAD shape.

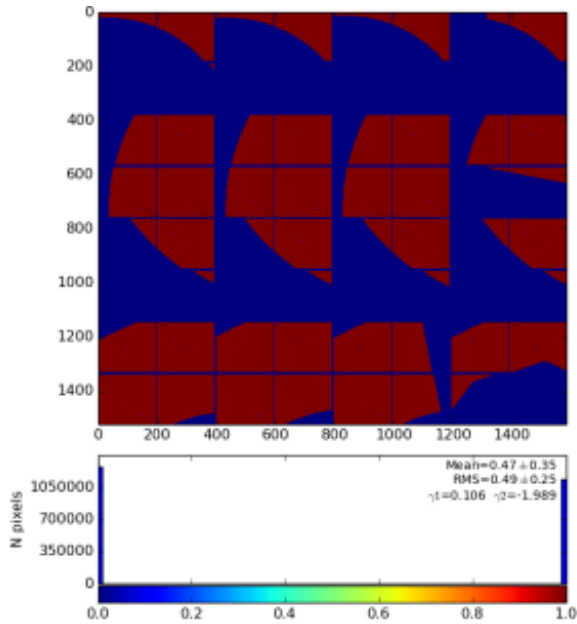


Fig.3: Mask on the top of enumerated (color-coded) pixels (left) and result of the mask conversion to the ndarray (right).

As a cross-check this ndarray can be converted back to the image using geometry file, as shown in Fig.4.

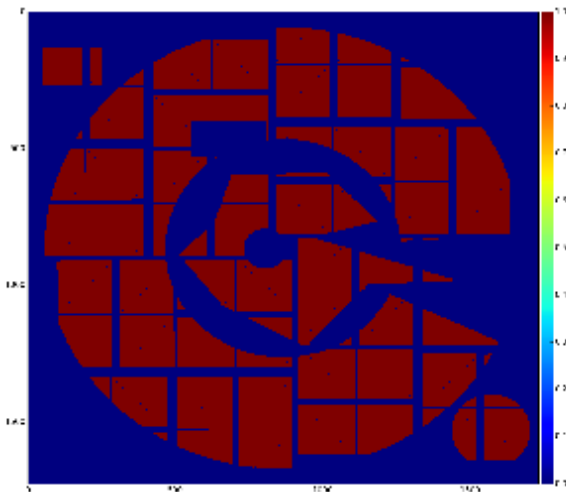


Fig.4: Cross-check: ndarray with mask is converted to the image using geometry file.

Usage of ndarray with ROI mask

Our particular goal was to make this mask for module `ImgAlgos::NDArrCalib`, which can be included in the psana configuration file:

```
[ImgAlgos.NDArrCalib]
source = DetInfo(:Cspad.0)
...
do_mask    = yes
fname_mask = mask-nda.txt
```

ROI mask for ndarray (or numpy array) can also be used in any stand-alone application, for example in python code. To apply the mask in python code the data numpy array should be multiplied by the mask numpy array.

Examples

Mask for CSPAD2x2

Let us to produce mask for CSPAD2x2 with discarded edge, middle columns, unbounded pixels:

```
cd <some-directory>
cp /reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-01-2013-02-13/calib/CsPad2x2::CalibV1
/MecTargetChamber.0:Cspad2x2.1/geometry/0-end.data geo2x2.data
roicon -p1 -g geo2x2.data -c 15 -i mask-img.npy
roicon -p3 -g geo2x2.data -m mask-img.npy -n mask-nda.txt
```

Popping up monitoring images should be closed by pressing on  in the right window corner. This lets script to run until the end. Resulting file with CSPAD2x2 mask array in text format will be in the file mask-nda.txt (with 0/1 ordered the same way like in data of size 185*388*2). To check content use command:

```
plims -v mask-nda.txt
```

where plims converts CSPAD2x2 (185,388,2) ndarray in naturally looking 2-d image adding extra-columns and rows in the middle.

Implementation of the ROI mask conversion algorithms in calibman

The same algorithms are implemented in the [Calibration Management Tool](#) as a GUI under the tab "ROI". The files with ndarray and geometry constants should be selected as input parameters. The names of other intermediate output files are optional. Three procedures for image reconstruction, mask editor, and mask conversion can be performed sequentially by clicking on relevant buttons. All files and images can be "Plot"-ted and "View"-ed. For now, mask file is saved in the work directory and is not deployed. In stead, its path could be used in the `ImgAlgos.NDArrCalib` module.

References

- [Mask Editor](#)
- [Calibration Management Tool](#)
- [Detector Geometry](#)
- [CSPAD Alignment](#)
- [CSPAD2x2 Alignment](#)
- [Module `ImgAlgos::NDArrCalib`](#)