Optical Metrology Quality Check

This note is about application (script) which allows to check quality of the optical metrology input during measurement.

Content

Introduction

Optical metrology measurements contains enough information for self check. Historically this quality check is done offline when entire detector or its quad is measured and entire file is available. Sometimes this file contains typo, which can be fixed using over-defined rectangular geometry of the detector segments. However, it could be much better to fix this problem during optical measurements with microscope. Simple application which can check partial optical metrology input is now available and described in this note.

Get application up and running

Direct usage

Optical metrology quality check (QC) application is implemented as a self consistent script which uses standard python features with numpy and matplotlib libraries. It can be downloaded from

https://github.com/lcls-psana/CalibManager/blob/master/app/optical_metrology_check

and used as is by the command

```
python optical_metrology_check <opt-met-file.txt>
```

Use from psana release

For development purpose it could be better to use it through psana-conda release system. Code is available since ana-1.2.8. Example:

Login to psana and set psana environment

```
# login to one of psana nodes
ssh -Y pslogin.slac.stanford.edu
ssh -Y psana.slac.stanford.edu

# set psana environment if it is missing in your .bash_profile or .bash_login
source /reg/g/psdm/etc/ana_env.sh
```

Setup conda environment, directory etc.

```
# setup conda environment
source conda_setup

# go to any directiory
mkdir my-test-dir
cd my-test-dir
```

Run script on optical metrology file

```
optical_metrology_check -h
optical_metrology_check <opt-met-file.txt>
```

Example

A few complete optical metrology files can be found under directory /reg/g/psdm/detector/alignment/cspad/, e.g. calib-xpp-2016-08-22-camera3/2016-08-22-CSPAD-XPP-Camera3-Metrology.txt

However, script can run on partial metrology file, e.d.: metrology_test.txt, which can be downloaded and used for test purpose:

```
optical_metrology_check metrology_test.txt
```

Output

Running script prints a few section of results, e.g.:

Command line and application input/default parameters

```
(ana-1.2.8) [dubrovin@psanagpu104:~/my-test-dir]$ optical_metrology_check metrology_test.txt
Command:
  /reg/g/psdm/sw/conda/inst/miniconda2-prod-rhel7/envs/ana-1.2.8/bin/optical_metrology_check metrology_test.txt
Argument list: ['metrology_test.txt']
Optional parameters:
  <key>      <value>              <default>
  psz        109.92               109.92
  vrb        15                   15
  ifn        ./optical_metrology.txt ./optical_metrology.txt
  plt        True                 True
  ofp        ./om                 ./om
------------------------------------------------------------
```

Input file parsing line-by-line

```
In read_optical_metrology_file: metrology_test.txt
EMPTY LINE IS IGNORED
IS RECOGNIZED QUAD: 1
EMPTY LINE IS IGNORED
COMMENT IS IGNORED : "# this is comment"
EMPTY LINE IS IGNORED
TITLE LINE:     Point    X      Y       Z
EMPTY LINE IS IGNORED
ACCEPT RECORD:   1       0       0     697
ACCEPT RECORD:   2     -15   20903     604
ACCEPT RECORD:   3   43529   20930     172
ACCEPT RECORD:   4   43542      23     297
EMPTY LINE IS IGNORED
ACCEPT RECORD:   9     159   46961     508
ACCEPT RECORD:  10      78   90506     321
ACCEPT RECORD:  11   20986   90547     156
ACCEPT RECORD:  12   21070   47003     343
EMPTY LINE IS IGNORED
ACCEPT RECORD:  13   23423   46973     341
ACCEPT RECORD:  14   23540   90519     116
ACCEPT RECORD:  15   44447   90457     -67
ACCEPT RECORD:  16   44342   46917      93
EMPTY LINE IS IGNORED
ACCEPT RECORD:  21   47105   69413      27
ACCEPT RECORD:  22   47103   90323     -40
ACCEPT RECORD:  23   90653   90322    -435
ACCEPT RECORD:  24   90651   69415    -365
EMPTY LINE IS IGNORED
ACCEPT RECORD:  25   44480     259     284
ACCEPT RECORD:  26   44381   43805     129
ACCEPT RECORD:  27   65305   43846     -50
ACCEPT RECORD:  28   65389     303     109
EMPTY LINE IS IGNORED
ACCEPT RECORD:  29   67741     149      98
ACCEPT RECORD:  30   67705   43731     -48
EMPTY LINE IS IGNORED
-------------------------------------------------------------
```

Point numeration check (consequtive 4 per segment)

```
check_points_numeration
WARNING - numeration of points in table is NOT sequential or started from non-x4 number
Measured segment  0  point numbers: (  1   2   3   4) OK - points in segment are sequential
Measured segment  1  point numbers: (  9  10  11  12) OK - points in segment are sequential
Measured segment  2  point numbers: ( 13  14  15  16) OK - points in segment are sequential
Measured segment  3  point numbers: ( 21  22  23  24) OK - points in segment are sequential
Measured segment  4  point numbers: ( 25  26  27  28) OK - points in segment are sequential
```

Per segment in-plane (X-Y) quality check

```
X-Y quality check for optical metrology measurements
-------------------------------------------------------------------------------------------------------------------
------------
segm:        S1      S2     dS1     dS2        L1      L2     dL1     dL2    angle(deg)   D1      D2      dD   d
(dS)   d(dL)
-------------------------------------------------------------------------------------------------------------------
------------
segm: 0   20903   20907      23      27     43542   43544     -15     -13    0.03290   48302   48304
-1      -4      -2
segm: 1   20911   20908     -81     -84     43545   43544      42      41    0.10855   48307   48302
4       3       1
segm: 2   20919   20907     117     105     43546   43540     -56     -62   -0.14606   48301   48310
-8      12       6
segm: 3   20910   20907       2      -1     43546   43550      -2       2    0.00066   48309   48308
1       3      -4
segm: 4   20909   20924     -99     -84     43546   43543      44      41    0.12040   48307   48309
-1     -15       3
-------------------------------------------------------------------------------------------------------------------
------------
```

Quality check in Z measurement

```
Z quality check for optical metrology measurements
-------------------------------------------------------------------------------------------------------------------
-------------------------
segm:        SA      LA   XSize   YSize    dZS1  dZS2  dZL1  dZL2    dZSA  dZLA  ddZS  ddZL     dZX   dZY
angXZ(deg) angYZ(deg) dz3(um)
-------------------------------------------------------------------------------------------------------------------
-------------------------
segm: 0   20905   43543   43543   20905     -93  -125  -400  -432    -109  -416    32    32    -416  -109
-0.54737   -0.29874    -31.962
segm: 1   20909   43544   20909   43544    -165  -165  -187  -187    -165  -187     0     0    -165  -187
-0.45212   -0.24605      0.028
segm: 2   20913   43543   20913   43543    -248  -183  -225  -160    -215  -192   -65   -65    -215  -192
-0.59039   -0.25330    -64.821
segm: 3   20908   43548   43548   20908     -67   -70  -392  -395     -68  -393     3     3    -393   -68
-0.51771   -0.18771     -2.973
segm: 4   20916   43544   20916   43544    -175  -179  -155  -159    -177  -157     4     4    -177  -157
-0.48484   -0.20658      3.885
-------------------------------------------------------------------------------------------------------------------
-------------------------
```

Parameters to check

See for detail CSPAD Geometry and Alignment

dD (um) - difference between diagonals

d(dS) (um) - difference between two short sides

d(dL) (um) - difference between two long sides

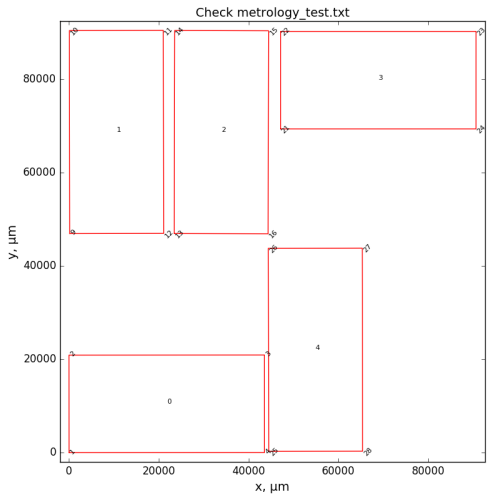
dz3 (um) - deviation one of the measured points from the plane of three other points

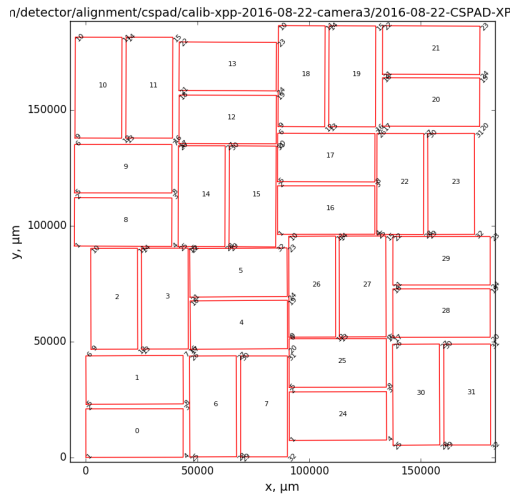
> ⚠ All these parameters should be about zero within fraction of the pixel size. If not... re-measurement is desirable.

Plots

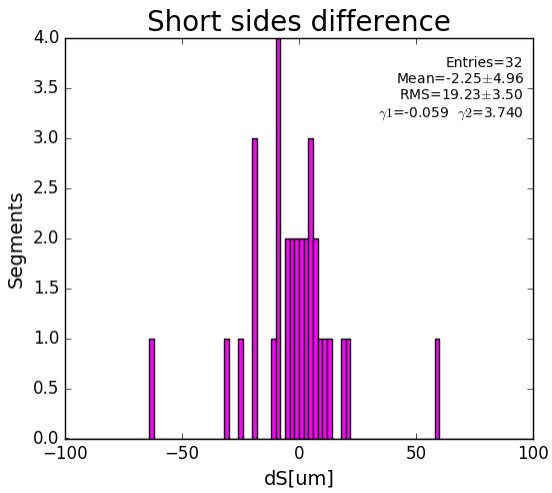
Application generates and saves in current directory a few useful plots;

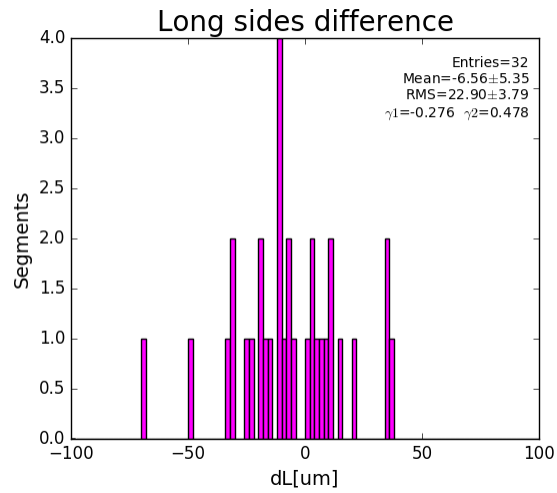
map of measured sensors for metrology_test.txt and 2016-08-22-CSPAD-XPP-Camera3-Metrology.txt metrology files:

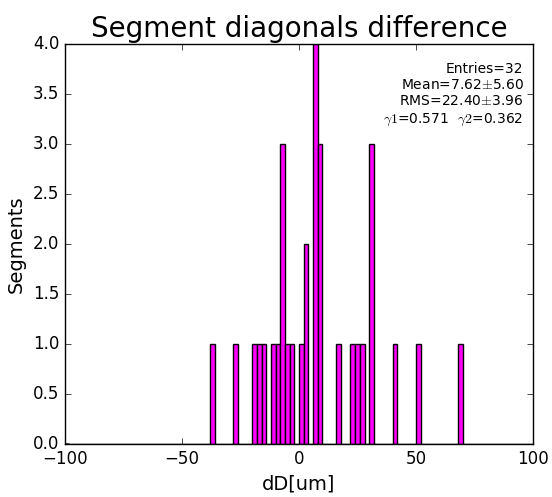


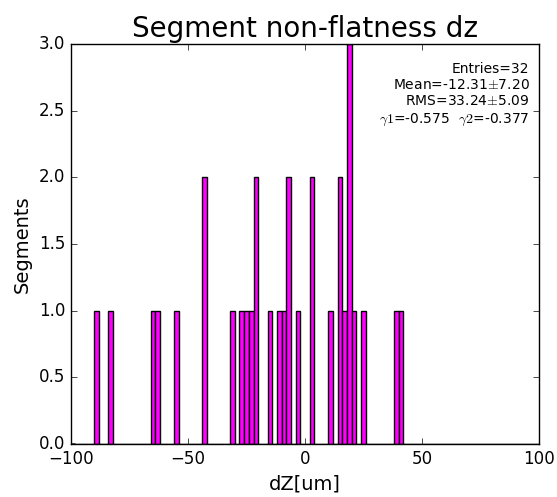


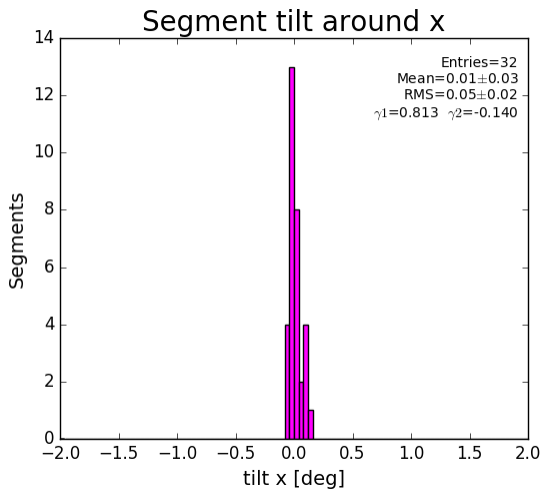
frequency distributions of a few important parameters, as shown for 2016-08-22-CSPAD-XPP-Camera3-Metrology.txt

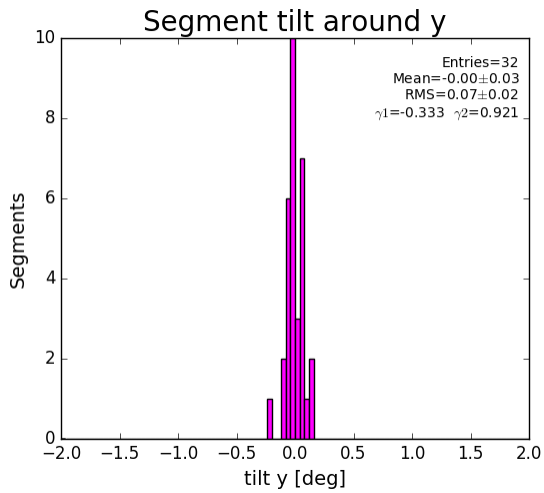


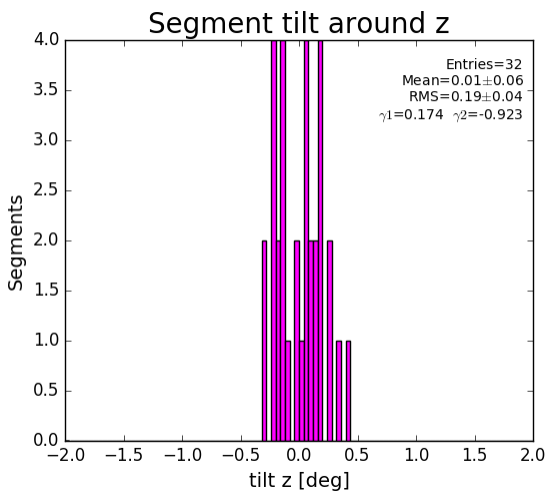












References

- CSPAD Geometry and Alignment
- CSPAD Alignment