

# Optical Metrology Quality Check

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

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## 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](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 directory
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 (consecutive 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 (dS)	S2 d(dL)	ds1	ds2	L1	L2	dL1	dL2	angle(deg)	D1	D2	dD	d
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 angXZ(deg)	LA angYZ(deg)	XSize dz3(um)	YSize	dzS1	dzS2	dzL1	dzL2	dzSA	dzLA	ddzS	ddzL	dzx	dzy
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

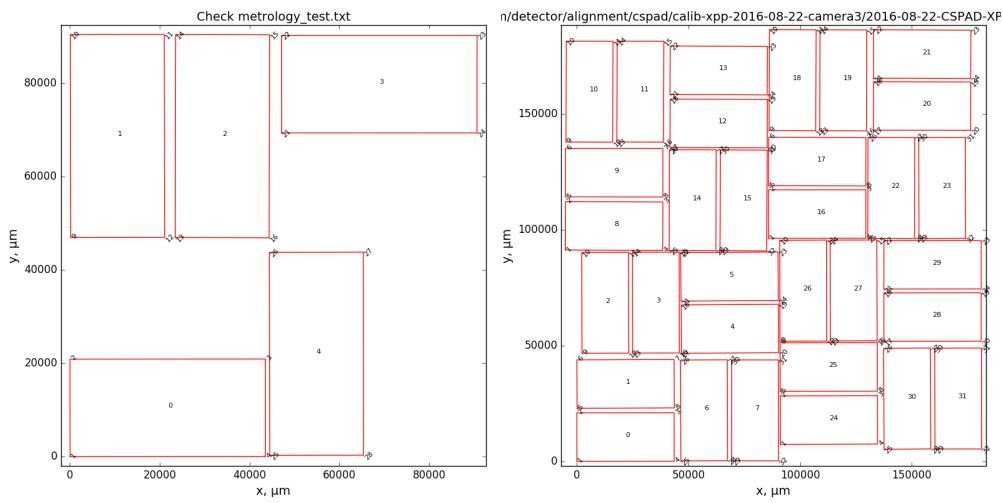


All these parameters should be about zero within fraction of the pixel size. If not... re-measurement is desirable.

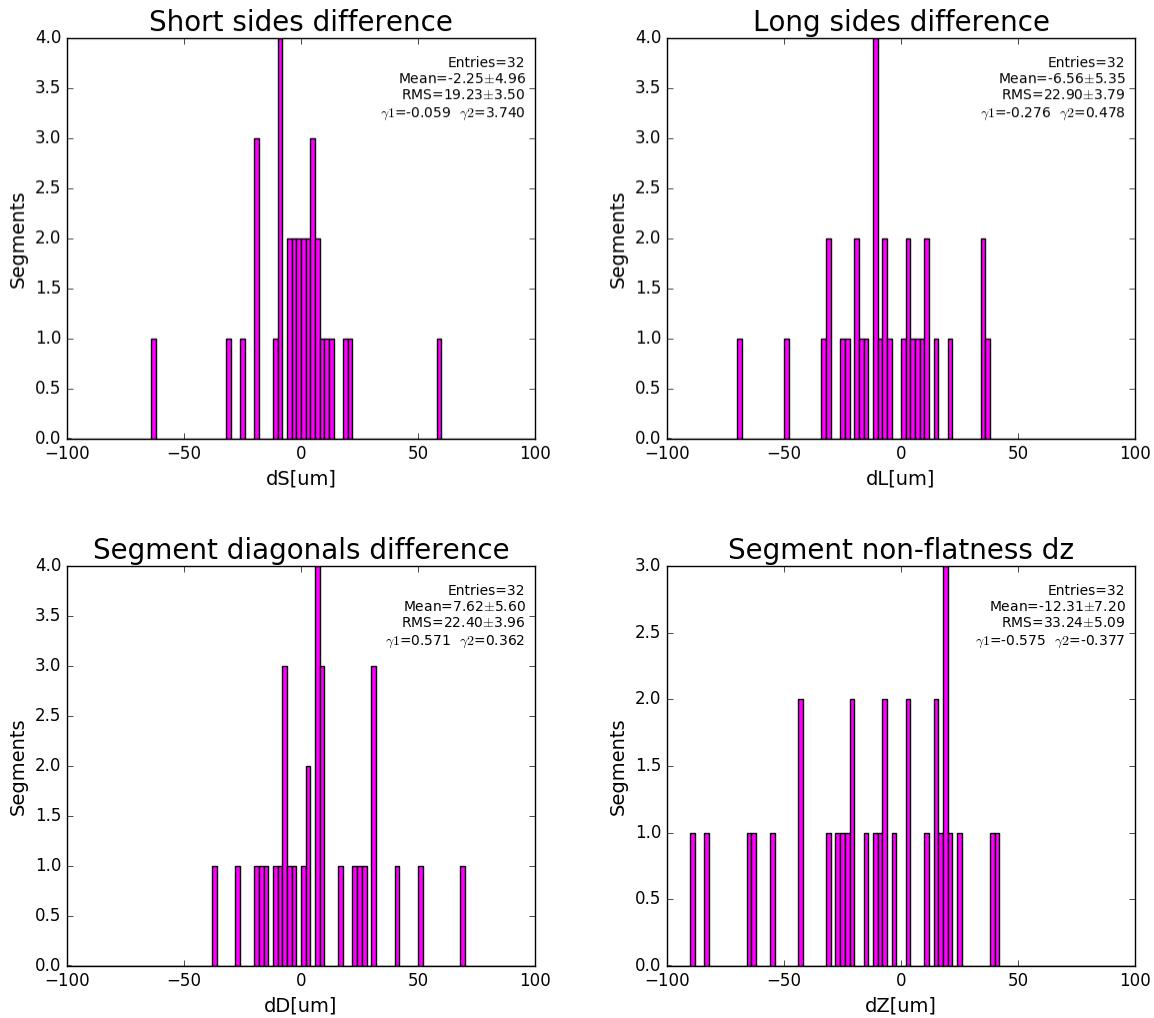
## Plots

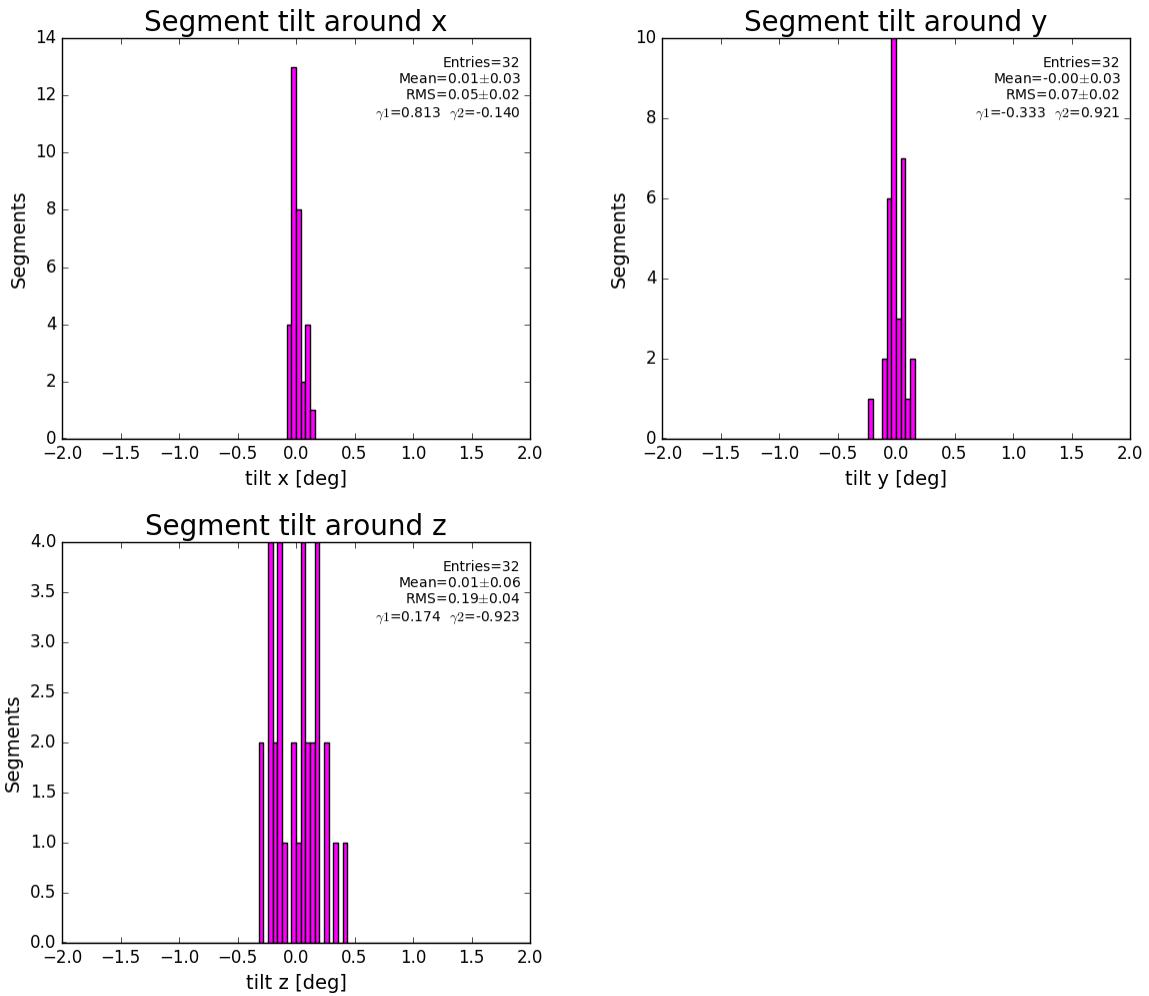
Application generates and saves in current directory a few useful plots;

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](#)