

2013-10-09 CSPAD XPP alignment

Content

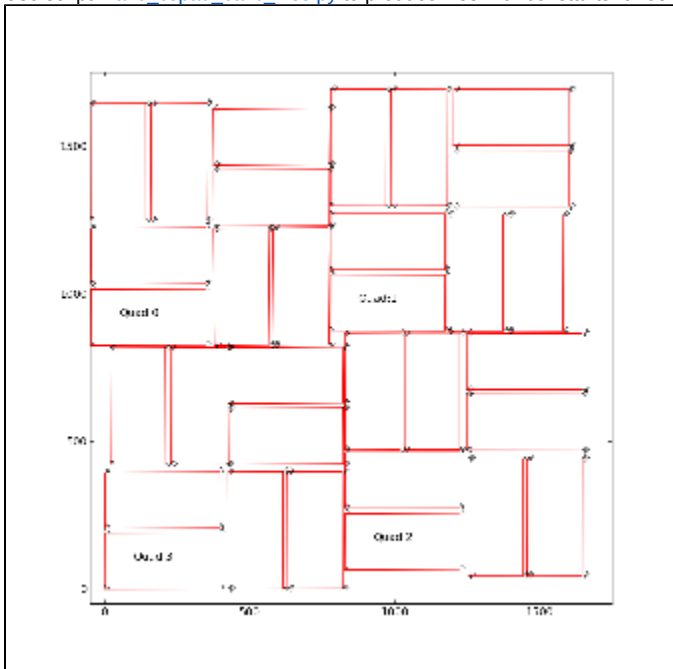
- [Content](#)
- [Optical measurement](#)
- [Procedure](#)
- [Quality check](#)
 - [Evaluated parameters](#)
 - [Quality check summary table](#)
- [Geometry parameters](#)
- [Test plot for XppGon.0:Cspad.0 using geo](#)
- [References](#)

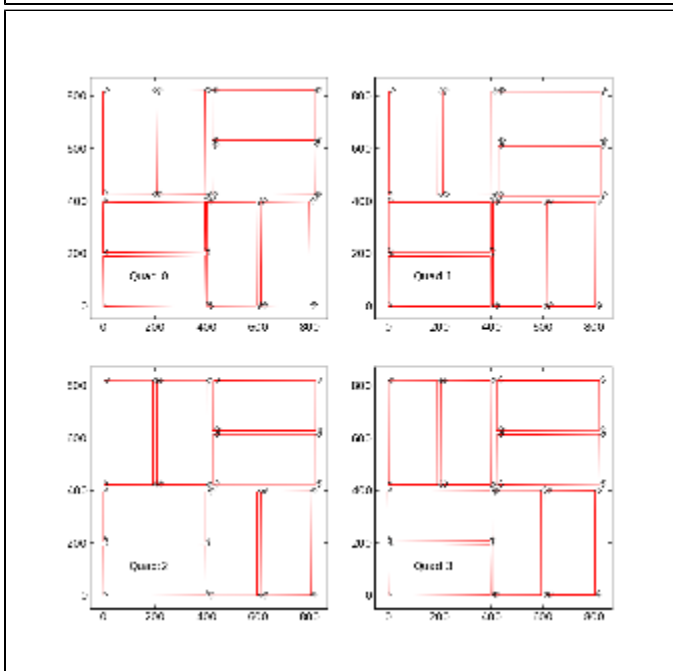
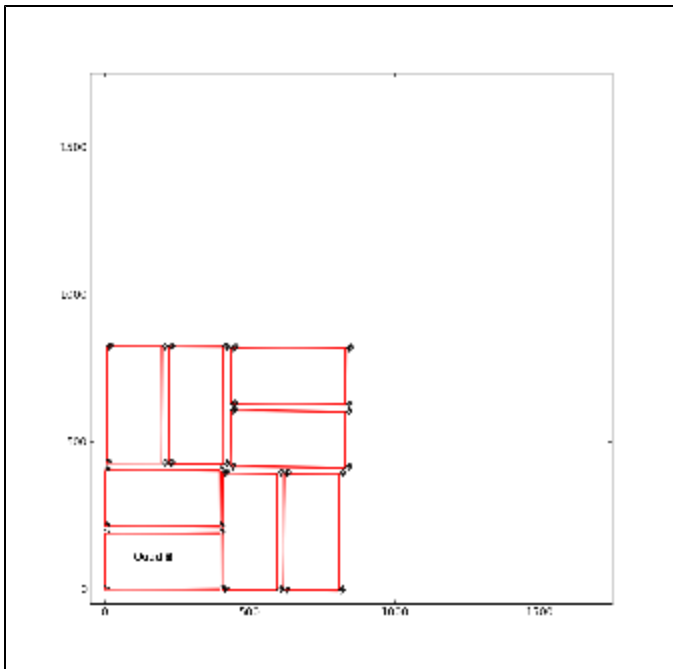
Optical measurement

- [2013-10-09-CSPAD-XPP-Metrology.xlsx](#) - file from Gabriel Blaj
- [2013-10-09-CSPAD-XPP-Metrology.txt](#) - text version of this file.

Procedure

- Use script [convertOpticalToStandard.py](#) to produce [2013-10-09-CSPAD-XPP-Metrology-standard.txt](#) and constants for **global_center**
- Use script [procOpticalAlignment.py](#) for quality check and to look at constants for **center** and **tilt**
- Use script [make_cspad_calib_files.py](#) to produce files with constants for **center** and **tilt**





Quality check

Evaluated parameters

We calculate

S1 - 1st short side length of 2x1

S2 - 2nd short side length of 2x1

L1 - 1st long side length of 2x1

L2 - 2nd long side length of 2x1

D1 - 1st diagonal of 2x1 between corners 1 and 3

D2 - 2nd diagonal of 2x1 between corners 2 and 4

dS and dL are the deviations of the 1st and 2nd corner along the short and long sides, respectively. The sign of all dS are chosen in order to provide correct sign for the tilt angle (the same direction for all 2x1 sensors).

<dS/L> - the tilt angle of 2x1 averaged over two sides in radians.

angle(deg) - the same angle in degrees.

dD = D1 - D2

d(dS) = dS1 - dS2

d(dL) = dL1 - dL2

dz3(um) - signed distance from 2x1 sensor plane and corner 3, where the 2x1 sensor plane contains the corner points p1, p2, and p4. This plane is defined by the vectors v21=p2-p1, v41=p4-p1, and their orthogonal vector

```
vort = [v21 x v41].
```

Scalar product with normalization defines the distance from point 3 to the 2x1 plane containing 3 other points:

```
dz3 = (v31 * vort) / |vort|.
```

S1=S2, L1=L2 - the 2x1 sides should have equal length and width,

D1=D2 - the 2x1 diagonals should be equal,

dS1 = dS2 (approximately)= (388/185)*dL1 = (388/185)*dL2 - tilt angle should provide consistent deviation for all corners,

dD=0, d(dS)=0, and d(dL)=0 - within precision of measurement.

dz3(um) = 0

Everything, excluding <dS/L> and angle(deg), are in micrometers.

Quality check summary table

pair:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1
D2	dD	d(dS)	d(dL)	dz3(um)							
Quad 0											
pair: 0	20897	20913	359	375	43542	43541	-177	-178	0.00843	0.48293	48300
48302	-2	-16	1	9.004							
pair: 1	20906	20909	370	373	43541	43539	-180	-182	0.00853	0.48887	48299
48303	-4	-3	2	19.004							
pair: 2	20908	20916	250	242	43539	43545	110	116	0.00565	0.32371	48299
48308	-9	8	-6	22.007							
pair: 3	20904	20902	114	116	43550	43551	52	53	0.00264	0.15130	48304
48309	-5	-2	-1	-0.012							
pair: 4	20901	20909	182	190	43539	43548	-102	-93	0.00427	0.24474	48294
48309	-15	-8	-9	-20.016							
pair: 5	20903	20910	42	49	43543	43545	-26	-24	0.00104	0.05987	48299
48305	-6	-7	-2	-36.013							
pair: 6	20896	20903	345	338	43536	43540	158	162	0.00784	0.44941	48292
48299	-7	7	-4	-12.004							
pair: 7	20905	20904	152	153	43542	43536	78	72	0.00350	0.20068	48299
48296	3	-1	6	2.003							
Quad 1											
pair: 0	20898	20900	9	11	43538	43538	-3	-3	0.00023	0.01316	48295
48292	3	-2	0	-17.000							
pair: 1	20905	20899	-118	-124	43538	43537	58	57	-0.00278	-0.15924	48294
48295	-1	6	1	-1.005							
pair: 2	20901	20912	91	80	43549	43552	44	47	0.00196	0.11249	48312
48304	8	11	-3	10.005							
pair: 3	20899	20903	-56	-60	43543	43542	-25	-26	-0.00133	-0.07632	48301
48297	4	4	1	-20.997							
pair: 4	20908	20906	-22	-24	43551	43547	15	11	-0.00053	-0.03026	48309
48305	4	2	4	-2.998							
pair: 5	20905	20905	-30	-30	43556	43548	18	10	-0.00069	-0.03947	48309
48309	0	0	8	26.995							
pair: 6	20911	20897	-140	-126	43542	43545	-65	-62	-0.00305	-0.17501	48301

48301	0	-14	-3	6.987							
pair: 7	20902	20904	1	-1	43540	43538	3	1	-0.00000	-0.00000	48298
48294	4	2	2	4.001							
Quad 2											
pair: 0	20906	20900	5	-1	43545	43542	2	-1	0.00005	0.00263	48302
48299	3	6	3	-49.991							
pair: 1	20908	20913	155	160	43542	43542	-78	-78	0.00362	0.20725	48300
48305	-5	-5	0	-5.998							
pair: 2	20909	20916	-38	-45	43540	43544	-23	-19	-0.00095	-0.05461	48302
48304	-2	7	-4	37.013							
pair: 3	20913	20909	-63	-59	43546	43542	-28	-32	-0.00140	-0.08026	48304
48305	-1	-4	4	-50.996							
pair: 4	20911	20915	22	26	43550	43547	-9	-12	0.00055	0.03158	48310
48308	2	-4	3	-20.002							
pair: 5	20919	20915	-58	-62	43560	43554	31	25	-0.00138	-0.07893	48318
48319	-1	4	6	16.005							
pair: 6	20909	20910	205	204	43542	43546	97	101	0.00470	0.26908	48305
48303	2	1	-4	12.003							
pair: 7	20912	20910	27	29	43533	43538	13	18	0.00064	0.03685	48298
48295	3	-2	-5	-26.998							
Quad 3											
pair: 0	20905	20906	211	212	43533	43538	-103	-98	0.00486	0.27835	48296
48294	2	-1	-5	-20.005							
pair: 1	20905	20902	286	283	43539	43537	-134	-136	0.00653	0.37440	48298
48295	3	3	2	-22.999							
pair: 2	20904	20904	137	137	43550	43550	69	69	0.00315	0.18024	48310
48304	6	0	0	25.000							
pair: 3	20905	20912	95	88	43541	43543	47	49	0.00210	0.12040	48305
48298	7	7	-2	-5.001							
pair: 4	20913	20903	212	202	43543	43536	-94	-101	0.00475	0.27240	48301
48298	3	10	7	-35.963							
pair: 5	20920	20905	82	67	43543	43528	-24	-39	0.00171	0.09805	48301
48293	8	15	15	8.024							
pair: 6	20916	20908	155	163	43546	43552	73	79	0.00365	0.20919	48309
48310	-1	-8	-6	-2.001							
pair: 7	20916	20915	69	70	43551	43549	34	32	0.00160	0.09144	48311
48312	-1	-1	2	-7.000							

- All X-Y measurements (see dD d(dS) d(dL)) are consistent within precision about 10um
- Tilt angles of 2x1 are in the range from -0.18 to +0.49 degree.
- Non-flatness: dz3 Mean and Standard deviation (over all 2x1) [um](#): -4.97 +- 21.39

Geometry parameters

✓ center_global/0-end.data (pixel)

469.62	674.75	148.89	149.34	252.78	44.08	570.94	572.06
974.33	974.04	1081.43	872.26	1400.15	1399.55	1484.25	1276.26
1127.23	921.42	1446.72	1446.72	1346.42	1550.25	1025.30	1024.75
622.71	621.29	517.82	723.23	197.03	197.85	112.42	320.66
1025.14	1027.17	1129.34	922.03	1448.63	1448.87	1534.12	1326.88
1178.07	970.70	1498.00	1497.74	1392.39	1599.72	1073.33	1072.93
670.72	670.48	565.89	772.24	244.24	244.32	161.46	369.23
518.70	725.08	199.83	200.16	301.30	95.42	620.05	620.91
1.39	1.23	0.97	1.68	1.12	0.96	1.20	1.25
1.50	1.38	1.38	1.30	1.44	1.27	1.42	1.39
1.21	1.18	1.29	1.24	0.96	0.87	0.88	0.91
1.08	1.09	0.63	0.61	0.66	0.25	0.88	0.81

or the same in um:

51621	74168	16366	16415	27786	4845	62758	62881
107098	107067	118871	95879	153905	153838	163149	140287
123905	101282	159023	159024	147998	170404	112701	112640
68448	68292	56919	79497	21658	21748	12357	35247
112683	112907	124137	101350	159233	159260	168631	145851
129494	106699	164660	164632	153051	175841	117980	117936
73726	73699	62203	84885	26847	26856	17748	40586
57015	79701	21965	22002	33119	10489	68156	68250
153	135	107	185	123	106	132	137
165	152	152	143	158	140	156	153
133	130	142	136	106	96	97	100
119	120	69	67	72	28	97	89

✓ center/0-end.data (pixel)

195.20	197.23	299.40	92.10	618.69	618.93	704.19	496.95
198.59	198.31	305.69	96.52	624.41	623.80	708.51	500.52
197.46	197.71	302.29	95.94	623.94	623.86	706.72	498.95
196.01	197.43	300.90	95.49	621.69	620.87	706.30	498.06
301.91	96.79	622.64	622.19	518.75	727.45	200.59	199.47
301.92	94.54	621.85	621.60	516.23	723.57	197.17	196.77
301.63	95.82	621.12	621.12	520.82	724.66	199.70	199.15
302.77	96.39	621.64	621.30	520.17	726.04	201.42	200.56
1.40	1.23	0.97	1.69	1.12	0.97	1.20	1.25
1.51	1.39	1.38	1.30	1.44	1.28	1.42	1.39
1.21	1.19	1.29	1.24	0.96	0.87	0.89	0.92
1.09	1.09	0.63	0.62	0.66	0.25	0.88	0.82

✓ tilt/0-end.data (degree)

0.48293	0.48887	0.32371	0.15130	0.24474	0.05987	0.44941	0.20068
0.01316	-0.15924	0.11249	-0.07632	-0.03026	-0.03947	-0.17501	-0.00000
0.00263	0.20725	-0.05461	-0.08026	0.03158	-0.07893	0.26908	0.03685
0.27835	0.37440	0.18024	0.12040	0.27240	0.09805	0.20919	0.09144

✓ offset/0-end.data

0	0	820	820
0	820	820	0
0	0	0	0

✗ offset_corr/0-end.data

0	0	-3	-1
0	-3	-3	-1
0	0	0	0

✗ marg_gap_shift/0-end.data

15	40	0	22
15	40	0	22
0	0	0	0

✓ geometry/0-end.data

```

# TITLE      Geometry parameters of CSPAD-XPP
# DATE_TIME  2014-10-03 12:04:35 PDT
# METROLOGY  /reg/neh/home1/dubrovin/LCLS/CSPadMetrologyProc/2013-10-09-CSPAD-XPP-Metrology.txt
# AUTHOR     dubrovin
# EXPERIMENT Any
# DETECTOR   CSPAD-XPP
# CALIB_TYPE geometry
# COMMENT:01 Table contains the list of geometry parameters for alignment of 2x1 sensors, quads, CSPAD, etc
# COMMENT:02 All translation and rotation pars of the object are defined w.r.t. parent object Cartesian frame
# PARAM:01 PARENT      - name and version of the parent object
# PARAM:02 PARENT_IND  - index of the parent object
# PARAM:03 OBJECT      - name and version of the object
# PARAM:04 OBJECT_IND  - index of the new object
# PARAM:05 X0          - x-coordinate [um] of the object origin in the parent frame
# PARAM:06 Y0          - y-coordinate [um] of the object origin in the parent frame
# PARAM:07 Z0          - z-coordinate [um] of the object origin in the parent frame
# PARAM:08 ROT_Z       - object design rotation angle [deg] around Z axis of the parent frame
# PARAM:09 ROT_Y       - object design rotation angle [deg] around Y axis of the parent frame
# PARAM:10 ROT_X       - object design rotation angle [deg] around X axis of the parent frame
# PARAM:11 TILT_Z      - object tilt angle [deg] around Z axis of the parent frame
# PARAM:12 TILT_Y      - object tilt angle [deg] around Y axis of the parent frame
# PARAM:13 TILT_X      - object tilt angle [deg] around X axis of the parent frame

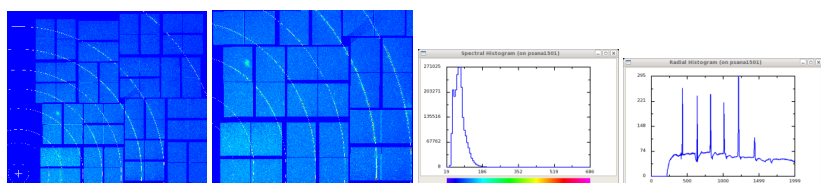
```

#	HDR	PARENT	IND	OBJECT	IND	X0[um]	Y0[um]	Z0[um]	ROT-Z	ROT-Y	ROT-X	TILT-Z	TILT-Y	TILT-X
CSPAD:V2		0	SENS2X1:V1	0	51621	112683	153	90	0	0	0.48292	0.00000	0.00263	
CSPAD:V2		0	SENS2X1:V1	1	74168	112907	135	90	0	0	0.48886	-0.05755	0.01316	
CSPAD:V2		0	SENS2X1:V1	2	16366	124137	107	0	0	0	0.32370	0.00395	-0.01096	
CSPAD:V2		0	SENS2X1:V1	3	16415	101350	185	0	0	0	0.15130	0.09867	-0.29055	
CSPAD:V2		0	SENS2X1:V1	4	27786	159233	123	270	0	0	0.24474	-0.03015	0.03948	
CSPAD:V2		0	SENS2X1:V1	5	4845	159260	106	270	0	0	0.05987	-0.04659	0.01053	
CSPAD:V2		0	SENS2X1:V1	6	62758	168631	132	0	0	0	0.44940	0.02895	-0.00548	
CSPAD:V2		0	SENS2X1:V1	7	62881	145851	137	0	0	0	0.20068	0.03553	-0.03015	
CSPAD:V2		0	SENS2X1:V1	8	107098	129494	165	0	0	0	0.01316	0.01184	-0.02742	
CSPAD:V2		0	SENS2X1:V1	9	107067	106699	152	0	0	0	-0.15924	-0.01316	-0.05208	
CSPAD:V2		0	SENS2X1:V1	10	118871	164660	152	270	0	0	0.11249	-0.02193	0.04078	
CSPAD:V2		0	SENS2X1:V1	11	95879	164632	143	270	0	0	-0.07632	-0.05757	0.03158	
CSPAD:V2		0	SENS2X1:V1	12	153905	153051	158	180	0	0	-0.03026	0.00000	-0.04385	
CSPAD:V2		0	SENS2X1:V1	13	153838	175841	140	180	0	0	-0.03947	-0.01973	-0.16719	
CSPAD:V2		0	SENS2X1:V1	14	163149	117980	156	270	0	0	-0.17500	-0.04385	-0.00526	
CSPAD:V2		0	SENS2X1:V1	15	140287	117936	153	270	0	0	0.00000	-0.02741	-0.00790	
CSPAD:V2		0	SENS2X1:V1	16	123905	73726	133	270	0	0	0.00263	-0.00548	-0.00921	
CSPAD:V2		0	SENS2X1:V1	17	101282	73699	130	270	0	0	0.20725	-0.02740	-0.03948	
CSPAD:V2		0	SENS2X1:V1	18	159023	62203	142	180	0	0	-0.05461	-0.00263	-0.03562	
CSPAD:V2		0	SENS2X1:V1	19	159024	84885	136	180	0	0	-0.08026	0.01579	-0.06576	
CSPAD:V2		0	SENS2X1:V1	20	147998	26847	106	90	0	0	0.03158	-0.08219	0.08947	
CSPAD:V2		0	SENS2X1:V1	21	170404	26856	96	90	0	0	-0.07893	-0.00822	0.06972	
CSPAD:V2		0	SENS2X1:V1	22	112701	17748	97	180	0	0	0.26908	-0.02500	-0.00548	
CSPAD:V2		0	SENS2X1:V1	23	112640	40586	100	180	0	0	0.03685	-0.01448	0.03836	
CSPAD:V2		0	SENS2X1:V1	24	68448	57015	119	180	0	0	0.27835	-0.02501	0.09319	
CSPAD:V2		0	SENS2X1:V1	25	68292	79701	120	180	0	0	0.37440	-0.03290	-0.04112	
CSPAD:V2		0	SENS2X1:V1	26	56919	21965	69	90	0	0	0.18024	-0.06578	0.07894	
CSPAD:V2		0	SENS2X1:V1	27	79497	22002	67	90	0	0	0.12040	-0.02740	0.09211	
CSPAD:V2		0	SENS2X1:V1	28	21658	33119	72	0	0	0	0.27240	0.03553	-0.12332	
CSPAD:V2		0	SENS2X1:V1	29	21748	10489	28	0	0	0	0.09805	0.03027	-0.07946	
CSPAD:V2		0	SENS2X1:V1	30	12357	68156	97	90	0	0	0.20919	0.03562	0.05789	
CSPAD:V2		0	SENS2X1:V1	31	35247	68250	89	90	0	0	0.09144	-0.04109	0.02368	

Test plot for XppGon.0:Cspad.0 using geo

exp=xpph6615:run=190

[info:ImgAlgos.Tahometer] Run=0190 Evt=001454 Time to process 001454 events is 109.308 sec, or 0.0751775 sec/event



References

- [CSPAD Alignment](#)
- [CSPAD Geometry and Alignment](#)
- [CSPAD Geometry Software \(depricated\)](#)
- [CSPAD2x2 Alignment](#)