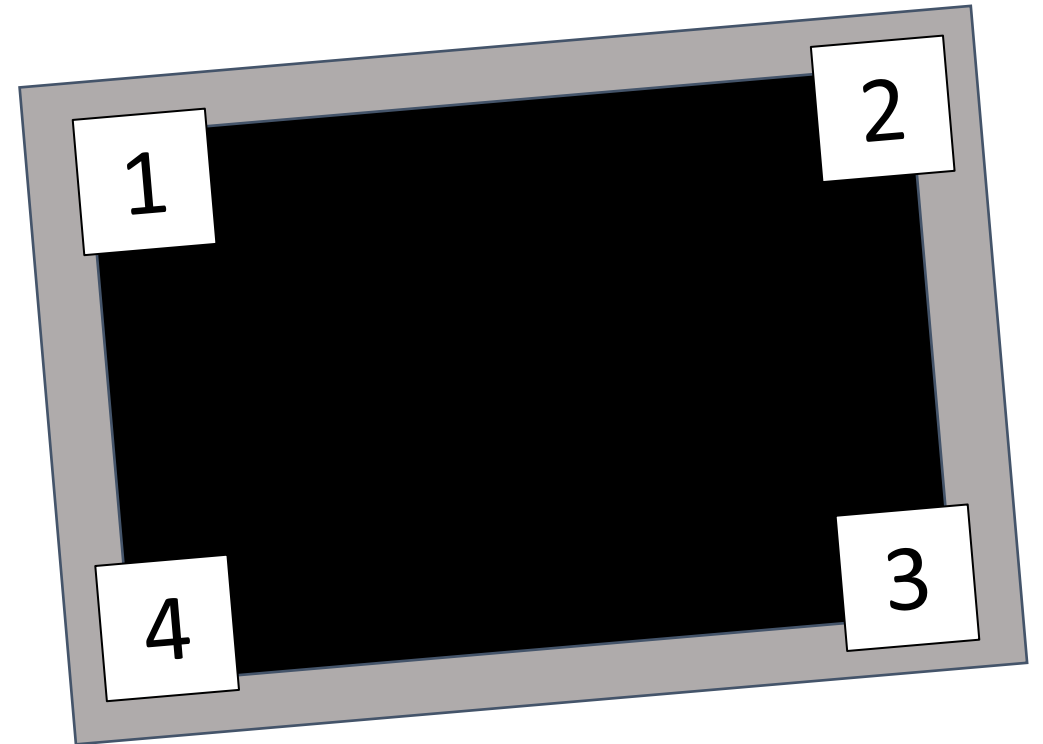
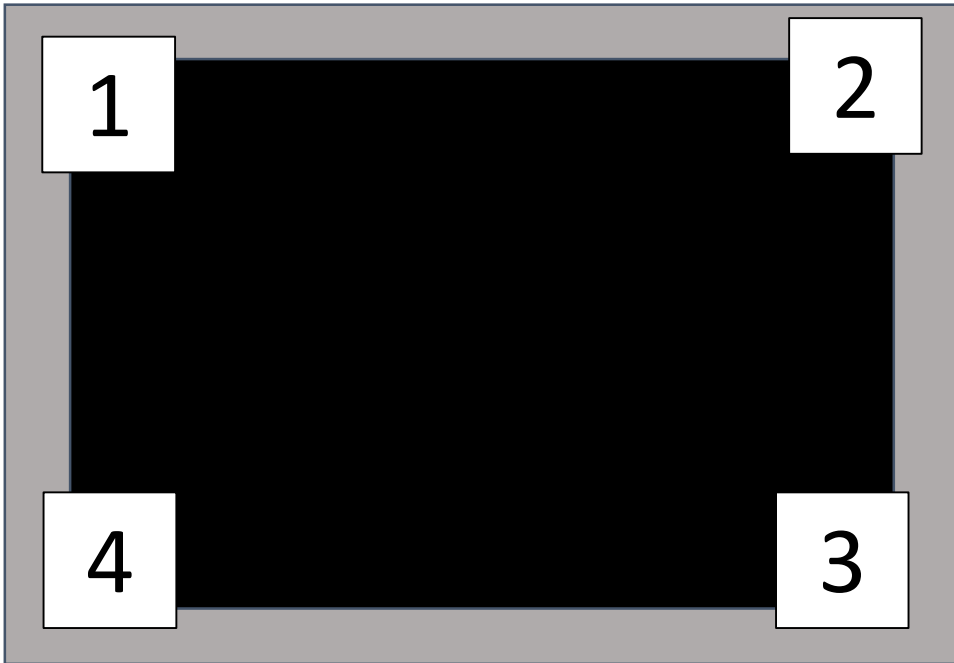
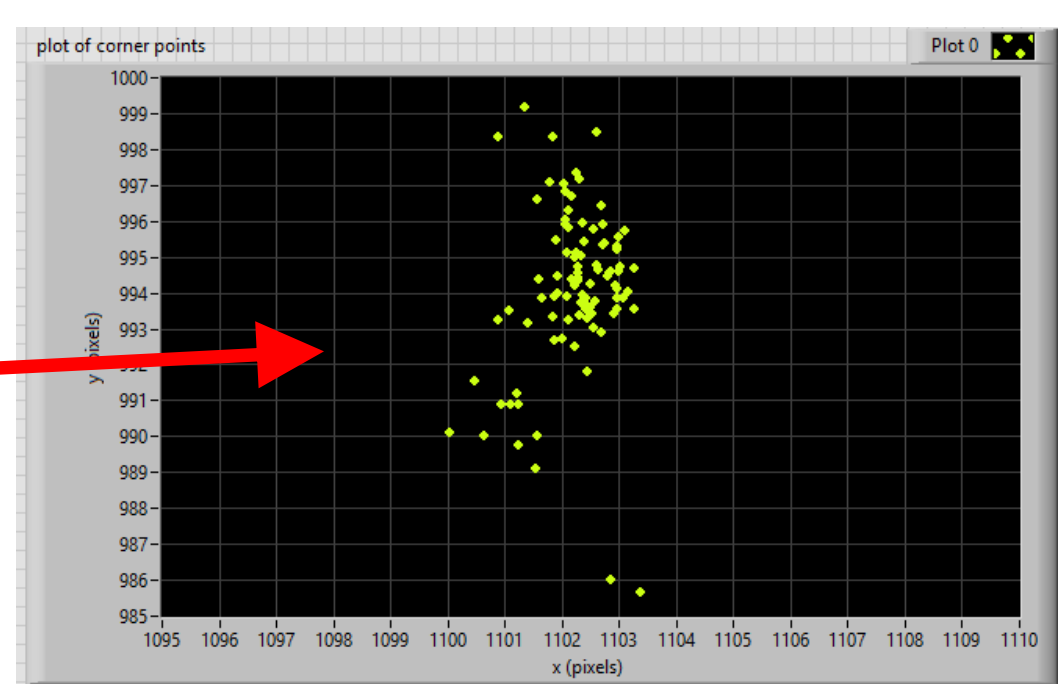
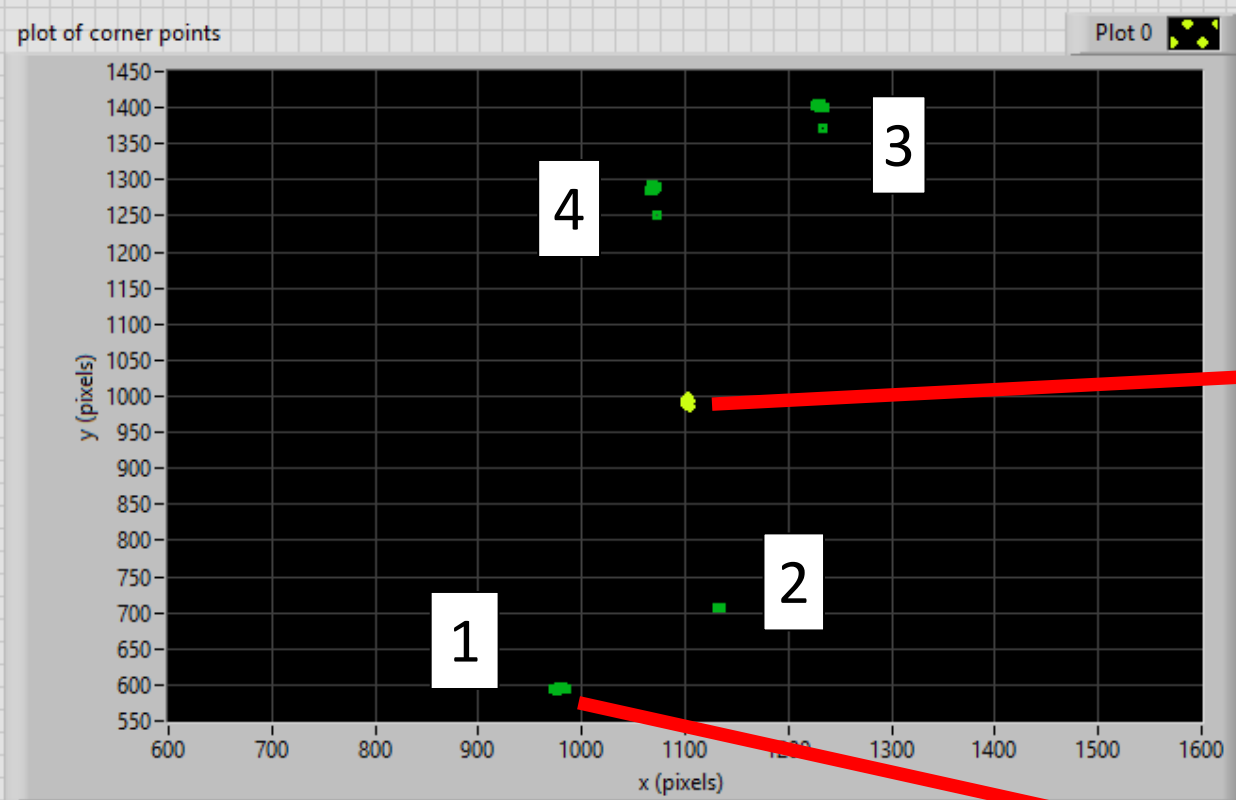


Locating module corners and testing precision

Laura Bergsten, Brandeis Univ.
10 February 2017

Module corner labelling and tilt

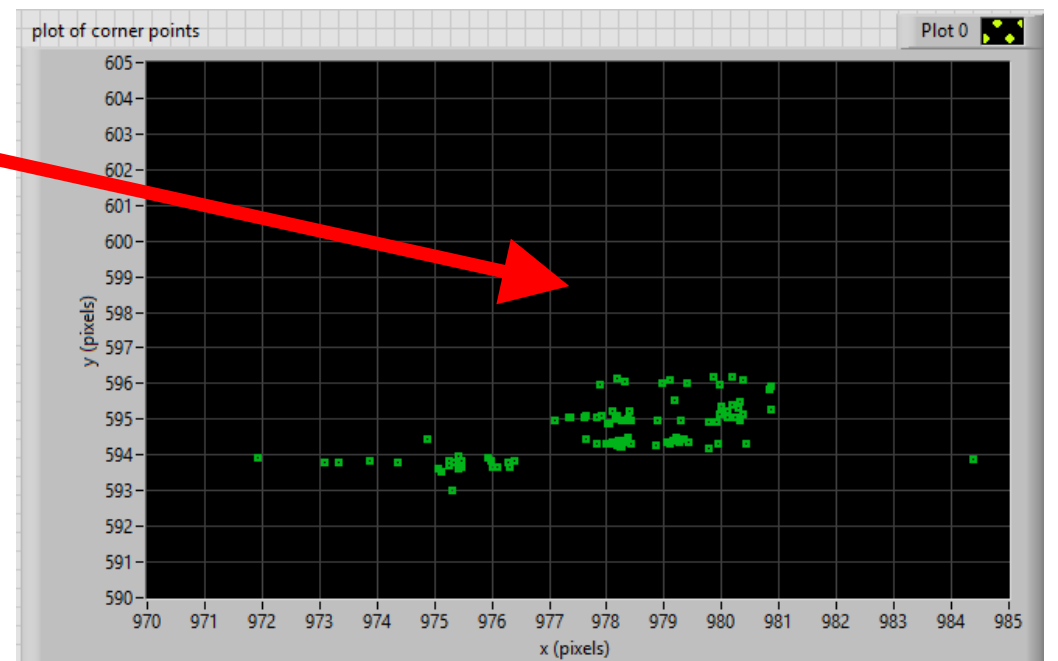


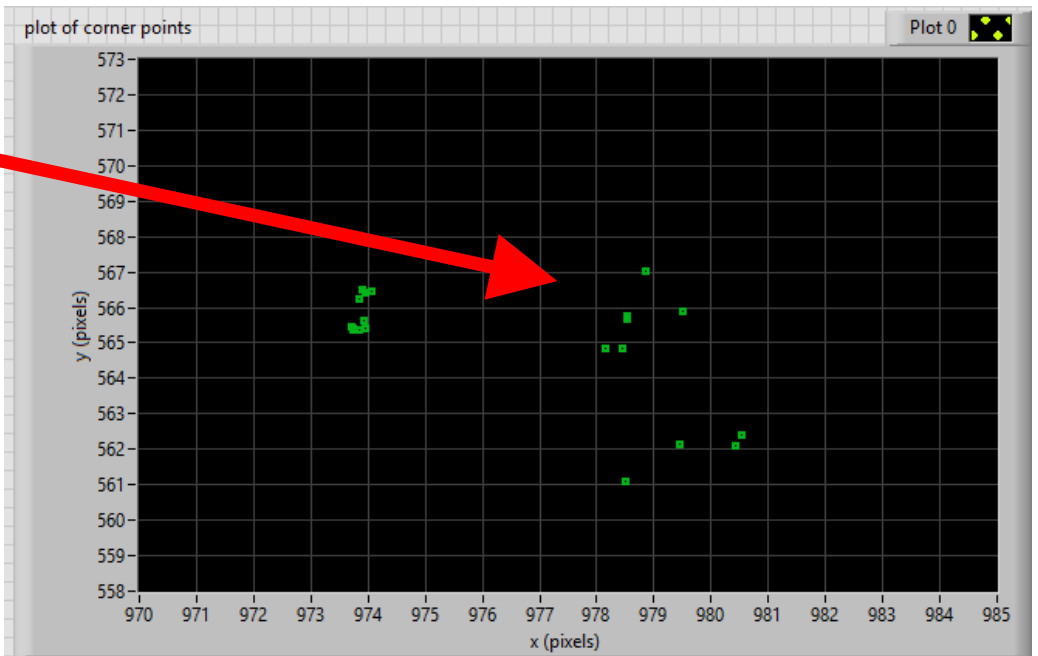
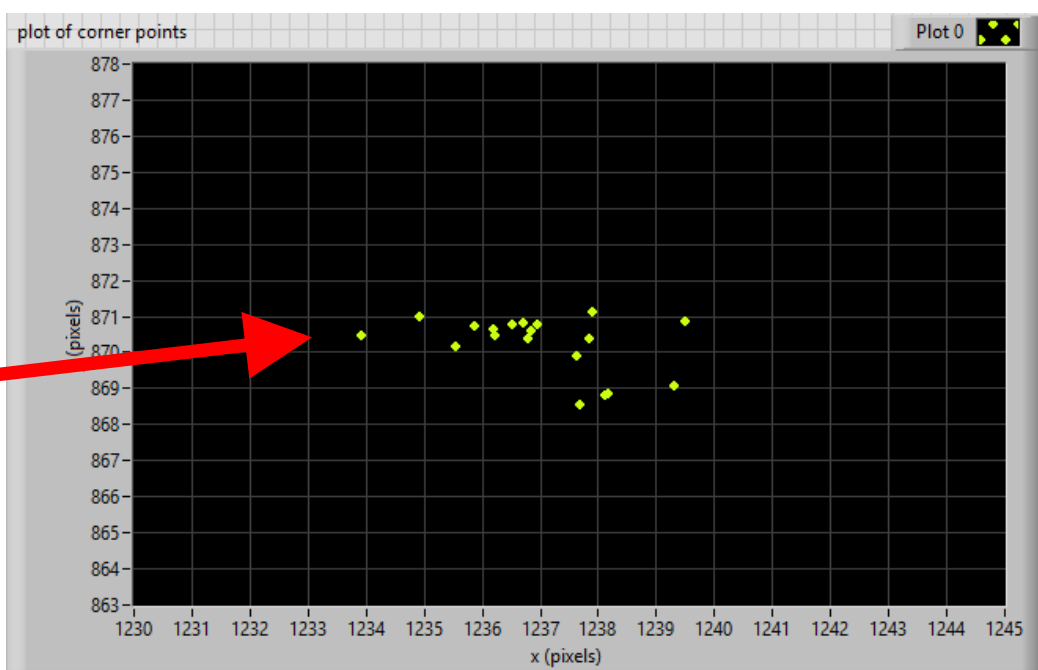
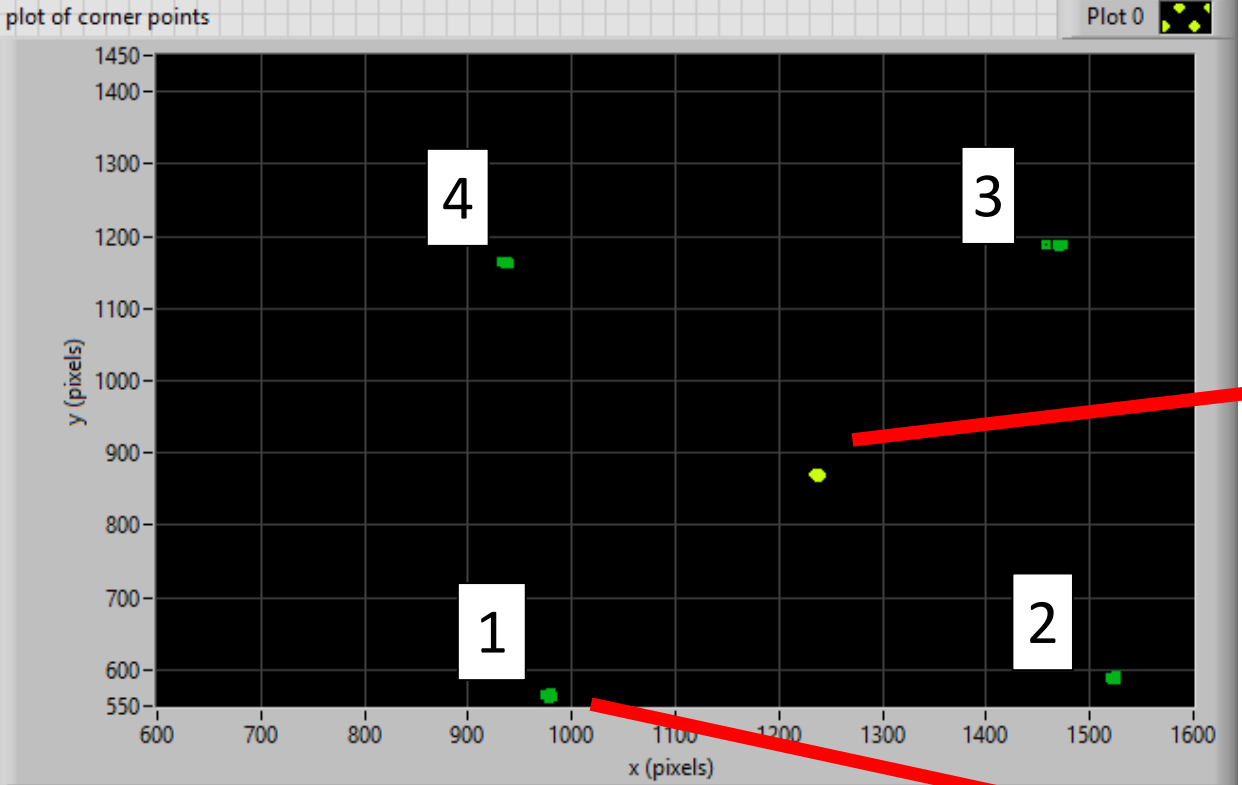


Here I plot in green the four corners found on the module in pixel space

In yellow, I plot the intersection point between module corners (center point). I zoom this below.

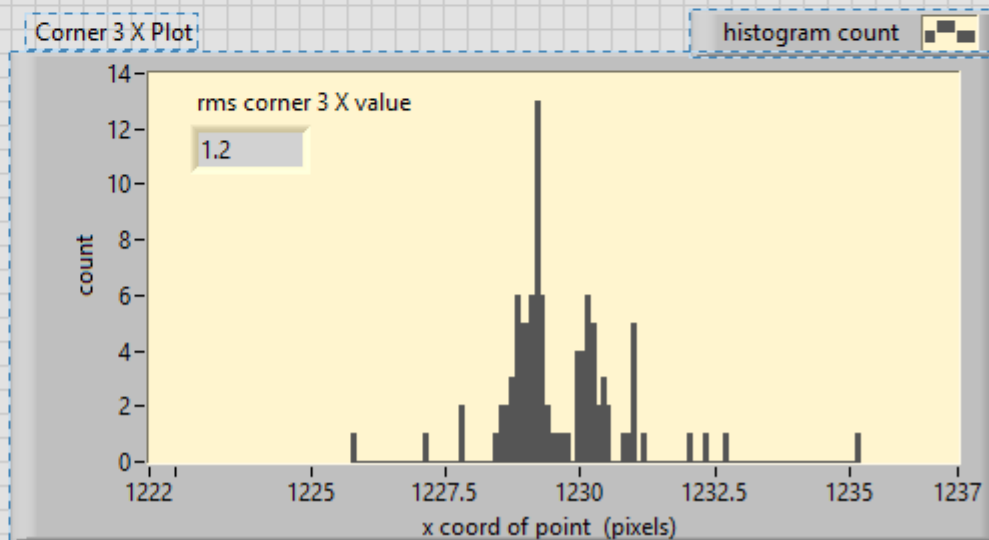
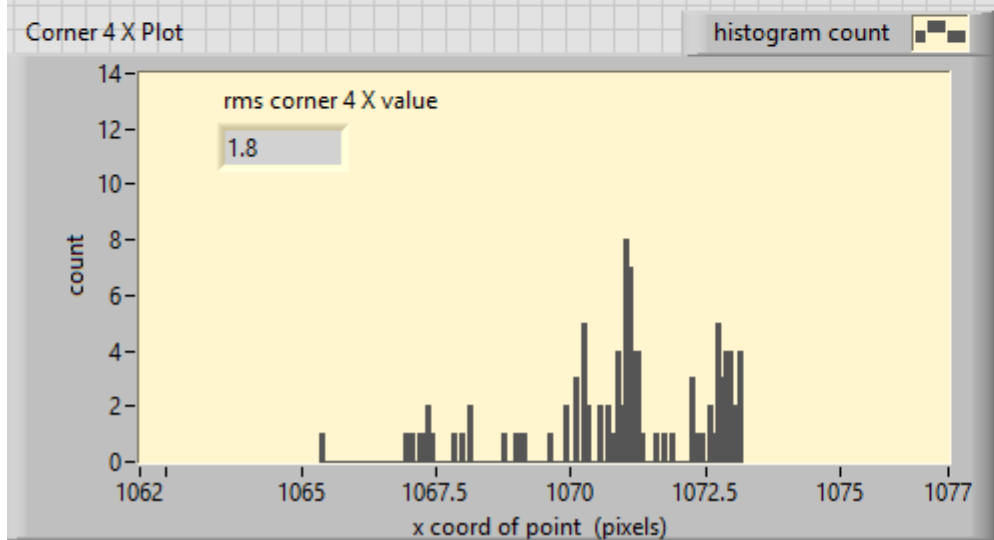
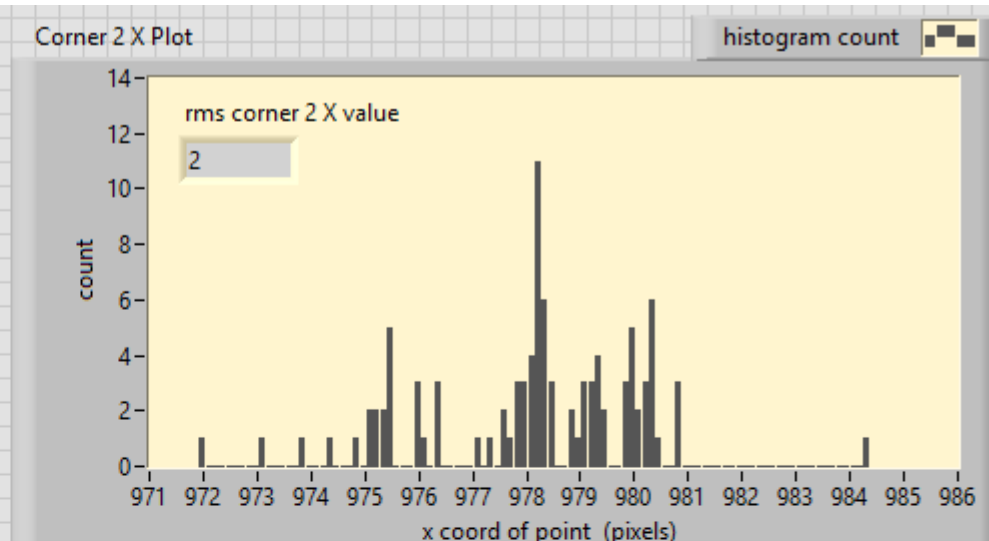
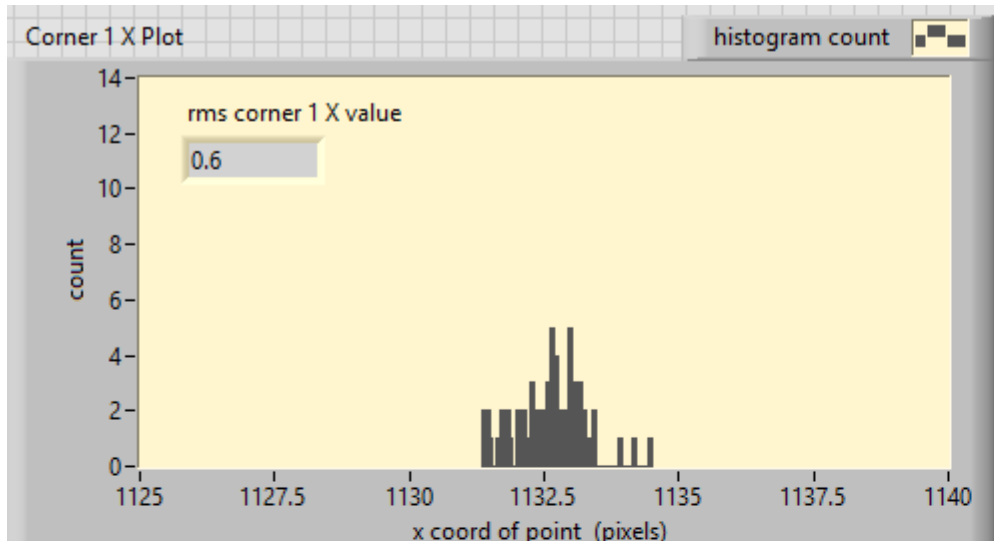
I also zoom in to a corner (corner 1)





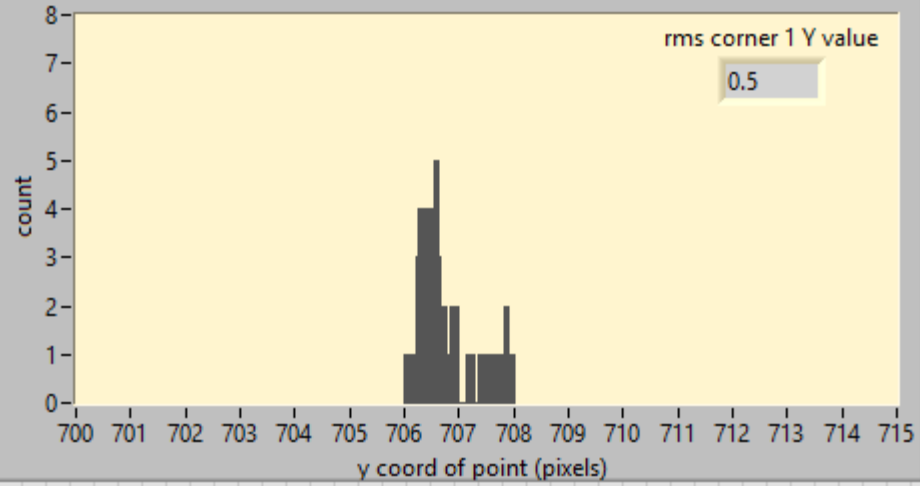
Here I show the same plots but using a better aligned sample- the most recent with 20 data points.

100 image dataset



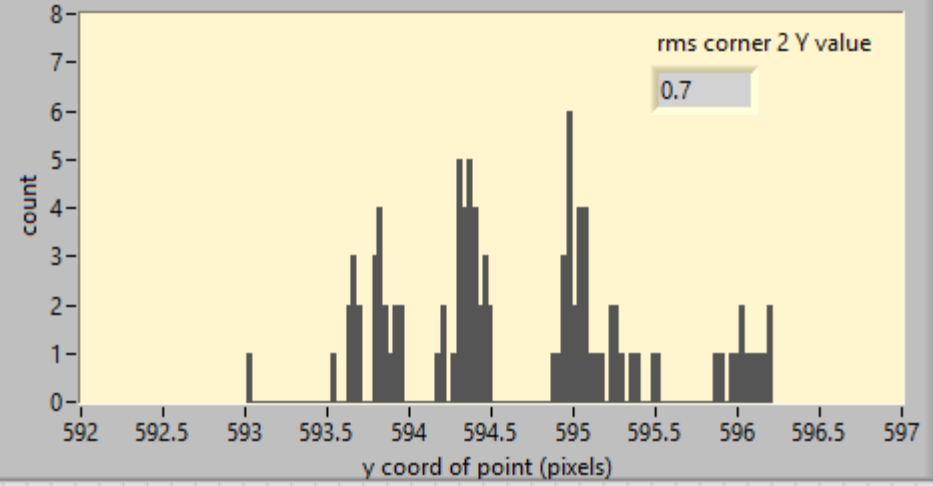
Corner 1 Y Plot

histogram count



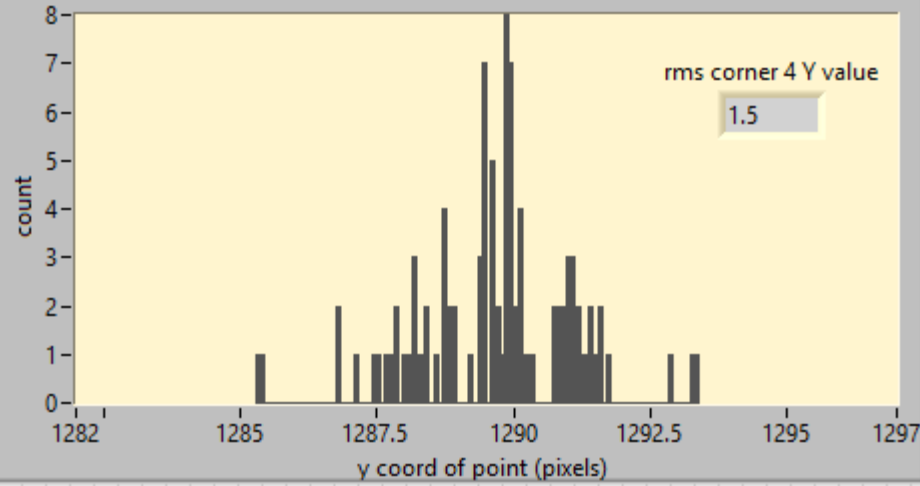
Corner 2 Y Plot

histogram count



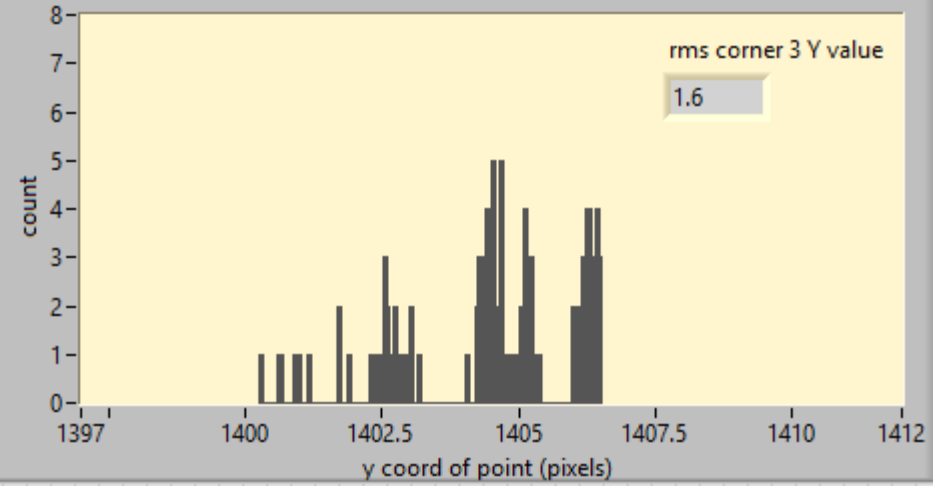
Corner 4 Y Plot

histogram count

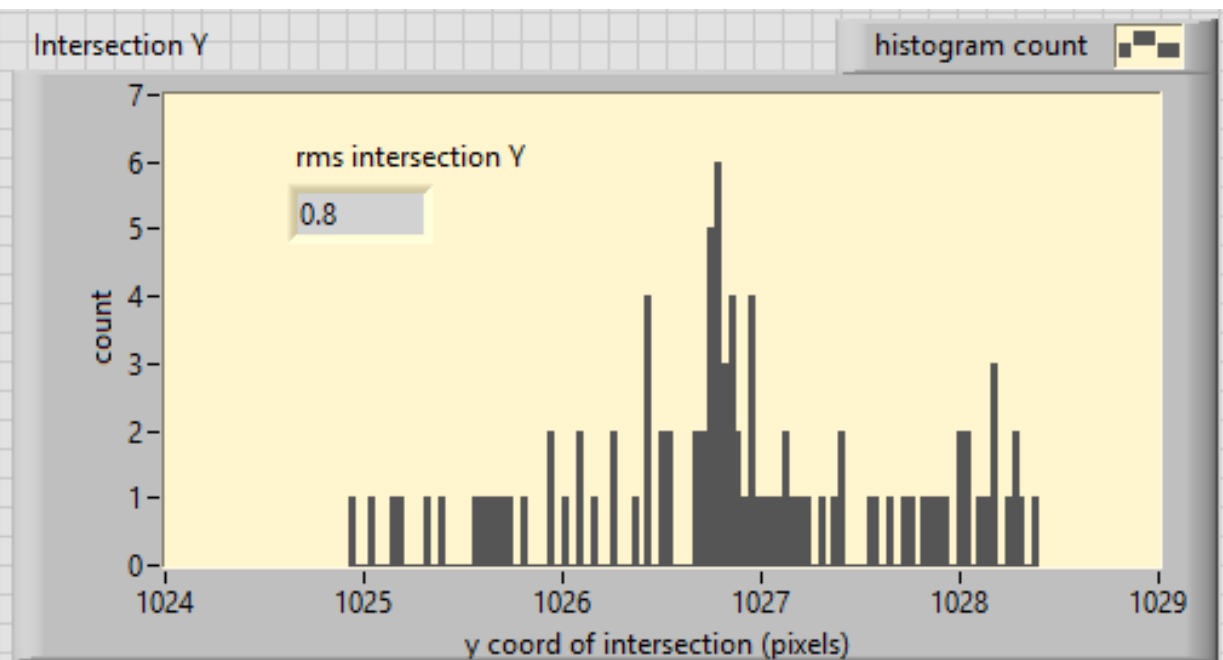
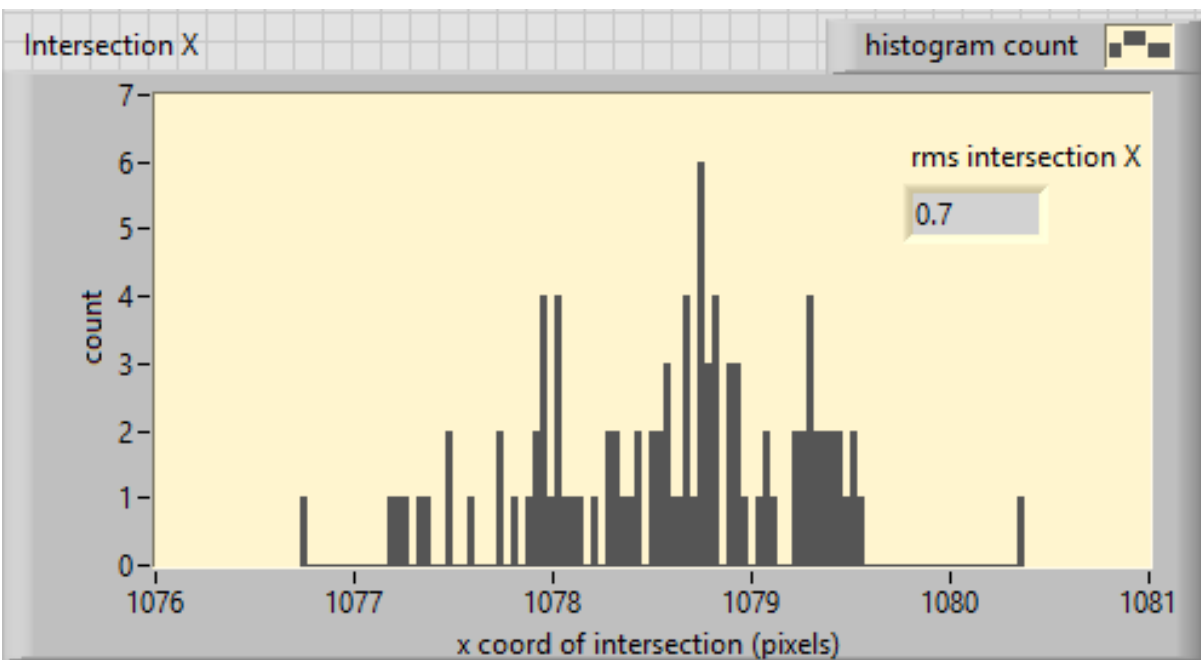


Corner 3 Y Plot

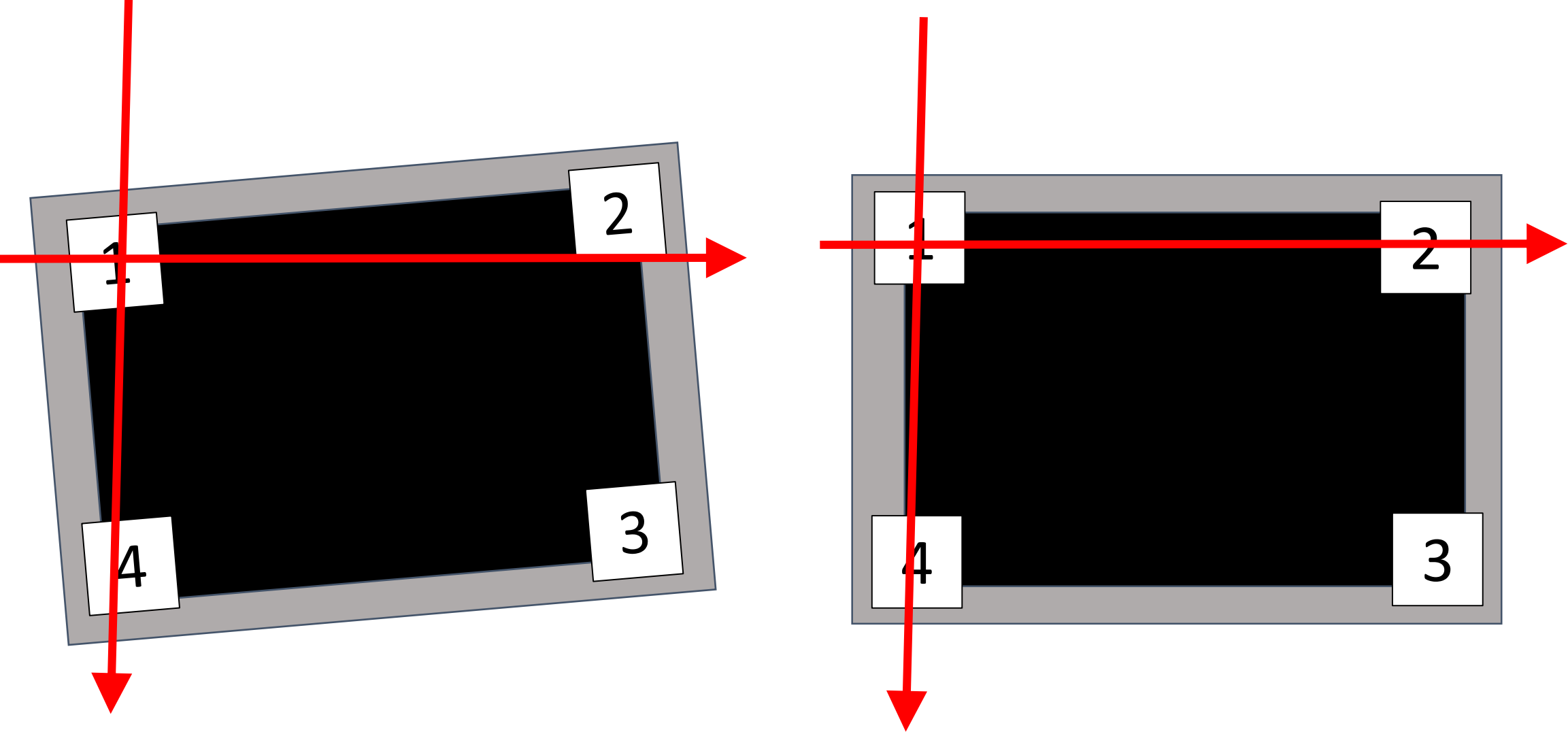
histogram count



Corrected intersection points



Correcting for rotations



Results across datasets

100 Count Dataset Corner						
Standard Deviations (pixels)			Standard Deviations (microns, 1.65/pixel)			
	x	y		x	y	
Corner 1		0.6	0.5	Corner 1	1.0	0.8
Corner 2		2	0.7	Corner 2	3.3	1.2
Corner 3		1.2	1.6	Corner 3	2.0	2.6
Corner 4		1.8	1.5	Corner 4	3.0	2.5
Intersection (using correction)			Intersection (using correction)			
		0.7	0.8		1.2	1.3

20 Count Dataset Corner						
Standard Deviations (pixels)			Standard Deviations (microns, 1.83/pixel)			
	x	y		x	y	
Corner 1		1.1	0.5	Corner 1	2.0	0.9
Corner 2		1.7	1.4	Corner 2	3.1	2.6
Corner 3		0.9	0.6	Corner 3	1.6	1.1
Corner 4		1	1.2	Corner 4	1.8	2.2
Intersection (using correction)			Intersection (using correction)			
		1	0.2		1.8	0.4

New 20 Count Dataset Corner						
Standard Deviations (pixels)			Standard Deviations (microns, 1.83/pixel)			
	x	y		x	y	
Corner 1		1.4	1	Corner 1	2.6	1.8
Corner 2		0.9	0.7	Corner 2	1.6	1.3
Corner 3		0.7	0.7	Corner 3	1.3	1.3
Corner 4		0.7	0.7	Corner 4	1.3	1.3
Intersection (using correction)			Intersection (using correction)			
		0.7	0.6		1.3	1.1

Comparing difference fiducial marks

100 Count Dataset Corner

Standard Deviations (pixels)

	x	y
Corner 1	0.6	0.5
Corner 2	2	0.7
Corner 3	1.2	1.6
Corner 4	1.8	1.5
Intersection (using correction)	0.7	0.8

Standard Deviations (microns, 1.65/pixel)

	x	y
Corner 1	1.0	0.8
Corner 2	3.3	1.2
Corner 3	2.0	2.6
Corner 4	3.0	2.5
Intersection (using correction)	1.2	1.3

100 Count Dataset Fiducial F

Standard Deviations (pixels)

	x	y
Corner 1	0.6	0.5
Corner 2	1.6	0.5
Corner 3	1	1.3
Corner 4	1.4	1.2
Intersection (using correction)	0.5	0.8

Standard Deviations (microns, 1.65/pixel)

	x	y
Corner 1	1.0	0.8
Corner 2	2.6	0.8
Corner 3	1.7	2.1
Corner 4	2.3	2.0
Intersection (using correction)	0.8	1.3

100 Count Dataset Fiducial Dots

Standard Deviations (pixels)

	x	y
Corner 1	0.7	0.9
Corner 2	1.6	0.5
Corner 3	1	1.5
Corner 4	1.3	1.2
Intersection (using correction)	0.6	0.9

Standard Deviations (microns, 1.65/pixel)

	x	y
Corner 1	1.2	1.5
Corner 2	2.6	0.8
Corner 3	1.7	2.5
Corner 4	2.1	2.0
Intersection (using correction)	1.0	1.5

Summary

- Reproducibility below 2 microns for all datasets
- Very sensitive to tilt in module placement but tilts and rotations can be corrected in data
- Little difference in use of different fiducial marks

Extra Slides

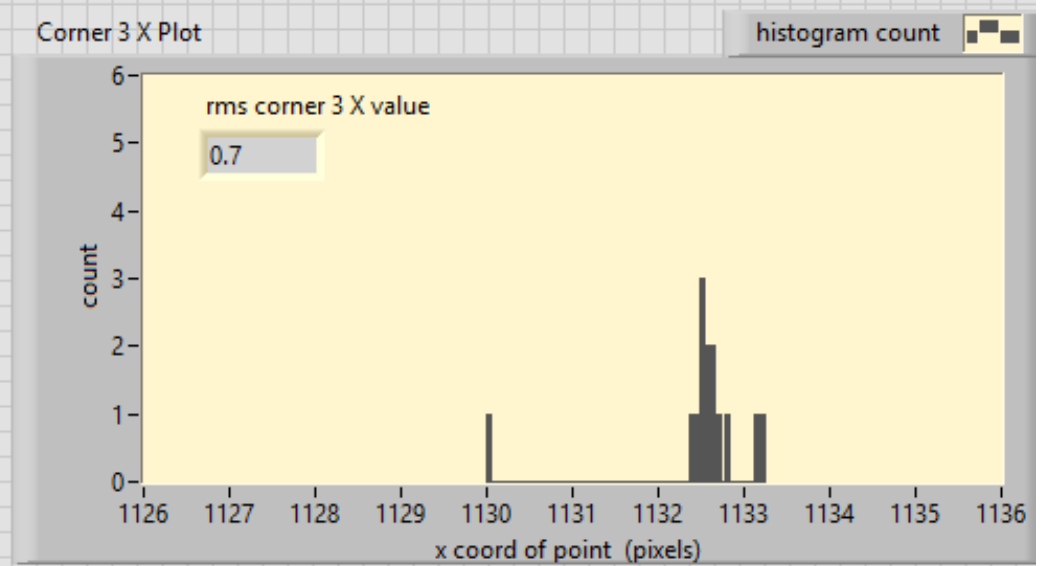
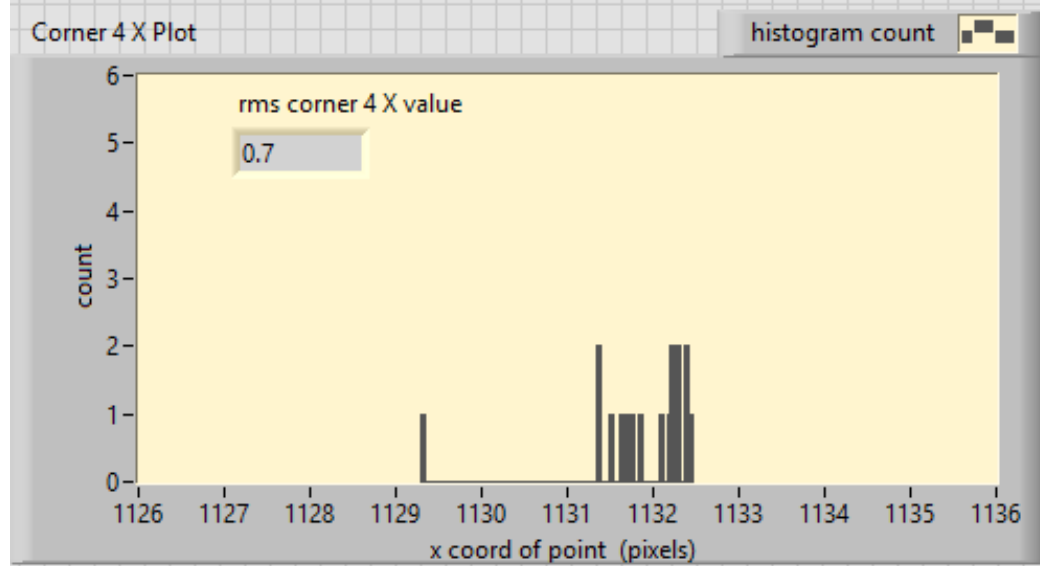
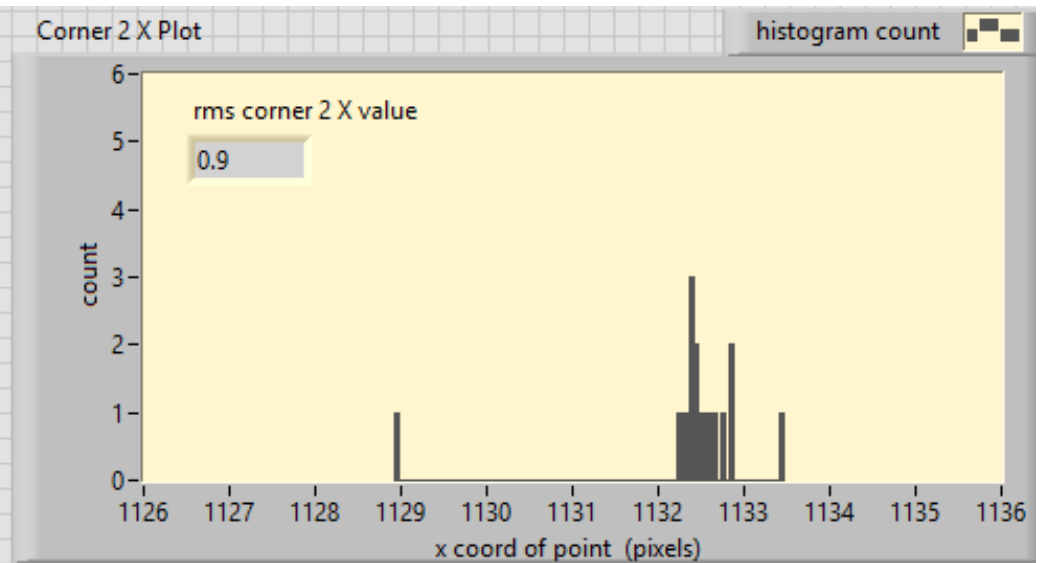
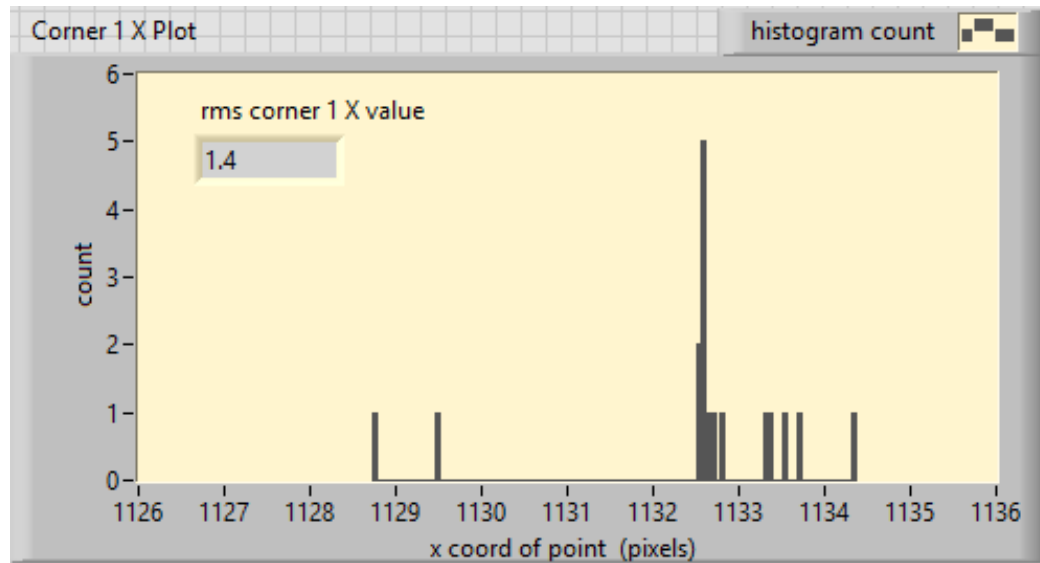
Comparing difference fiducial marks: old dataset

20 Count Dataset Corner					
Standard Deviations (pixels)			Standard Deviations (microns, 1.83/pixel)		
	x	y		x	y
Corner 1	1.1	0.5	Corner 1	2.0	0.9
Corner 2	1.7	1.4	Corner 2	3.1	2.6
Corner 3	0.9	0.6	Corner 3	1.6	1.1
Corner 4	1	1.2	Corner 4	1.8	2.2
Intersection (using correction)			Intersection (using correction)		
	1	0.2		1.8	0.4

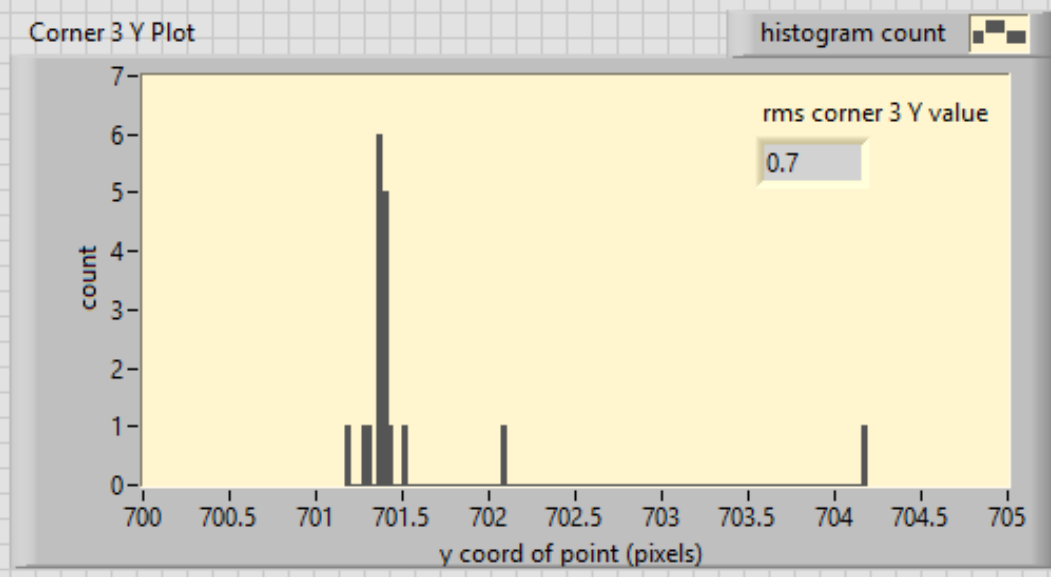
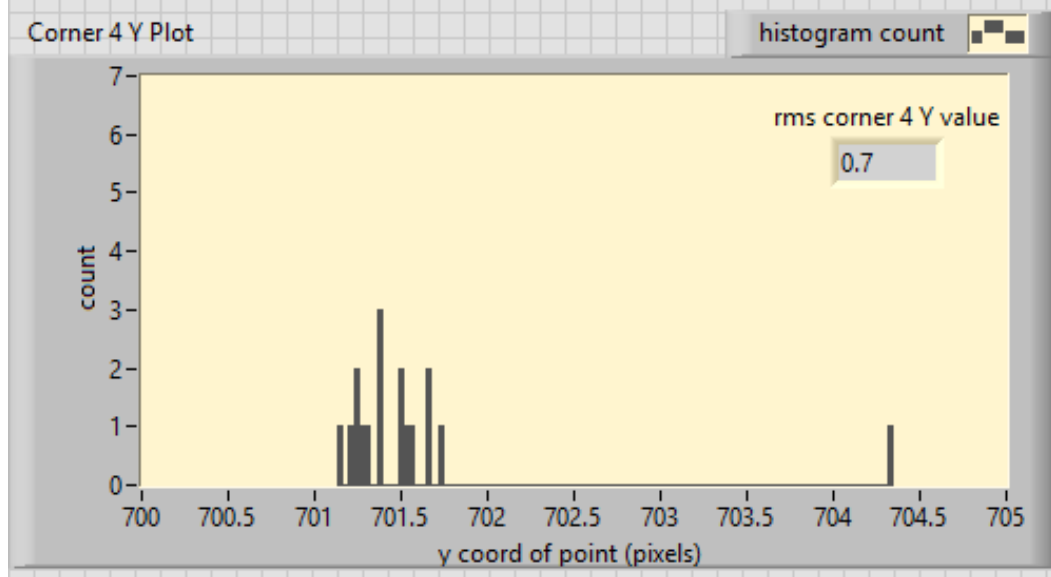
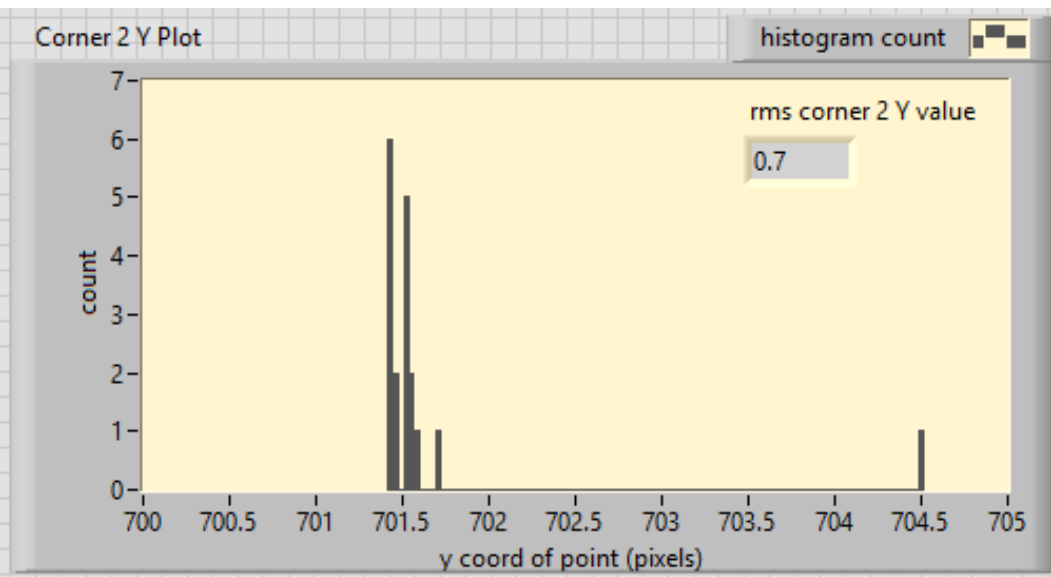
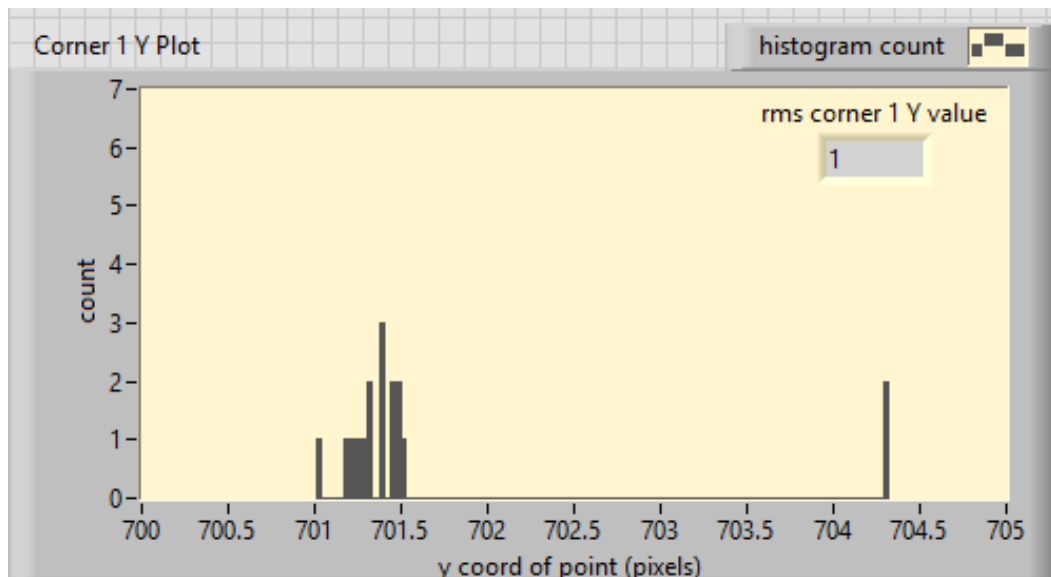
20 Count Dataset Fiducial F					
Standard Deviations (pixels)			Standard Deviations (microns, 1.83/pixel)		
	x	y		x	y
Corner 1	1.1	0.3	Corner 1	2.0	0.5
Corner 2	1.1	0.4	Corner 2	2.0	0.7
Corner 3	0.9	0.6	Corner 3	1.6	1.1
Corner 4	1	0.1	Corner 4	1.8	0.2
Intersection (using correction)			Intersection (using correction)		
	0.8	0.2		1.5	0.4

20 Count Dataset Fiducial Dots					
Standard Deviations (pixels)			Standard Deviations (microns, 1.83/pixel)		
	x	y		x	y
Corner 1	1	0.3	Corner 1	1.8	0.5
Corner 2	1.1	0.4	Corner 2	2.0	0.7
Corner 3	1.4	0.7	Corner 3	2.6	1.3
Corner 4	1	0.1	Corner 4	1.8	0.2
Intersection (using correction)			Intersection (using correction)		
	0.9	0.2		1.6	0.4

New 20 point dataset

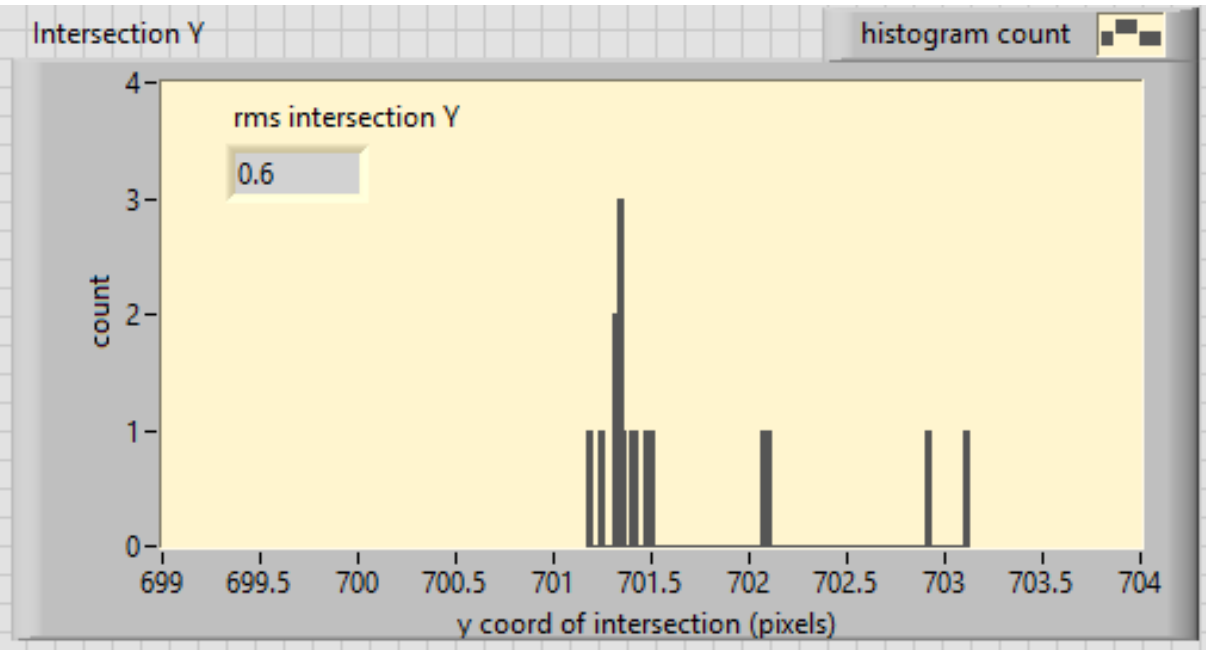
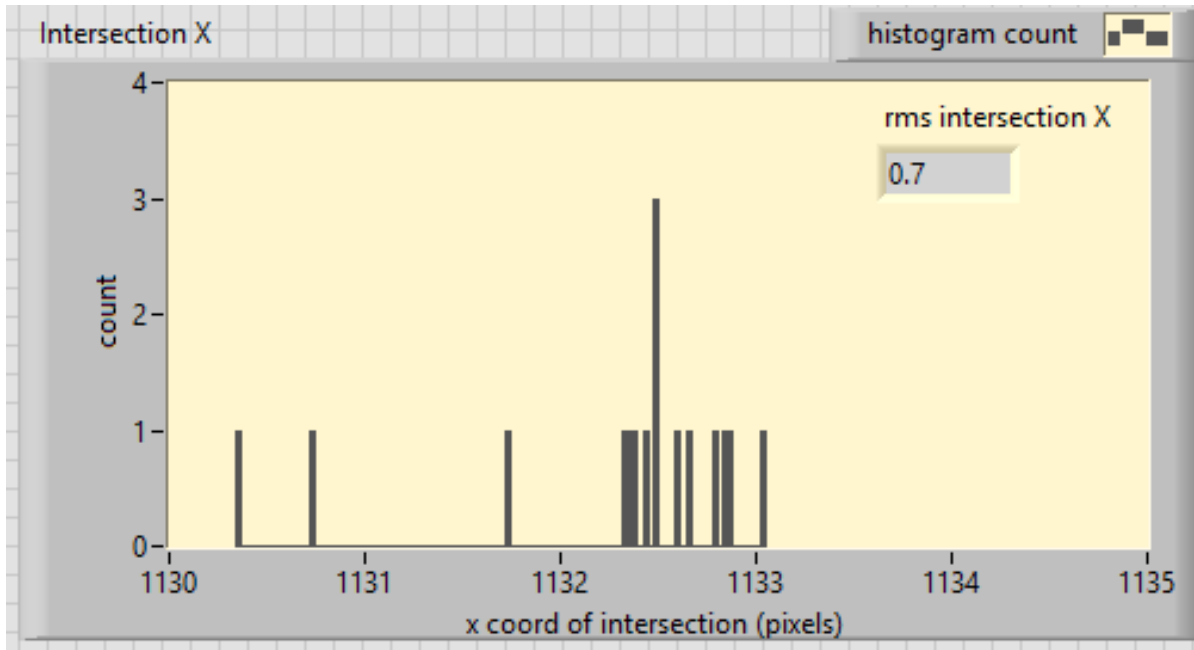


New 20 point dataset

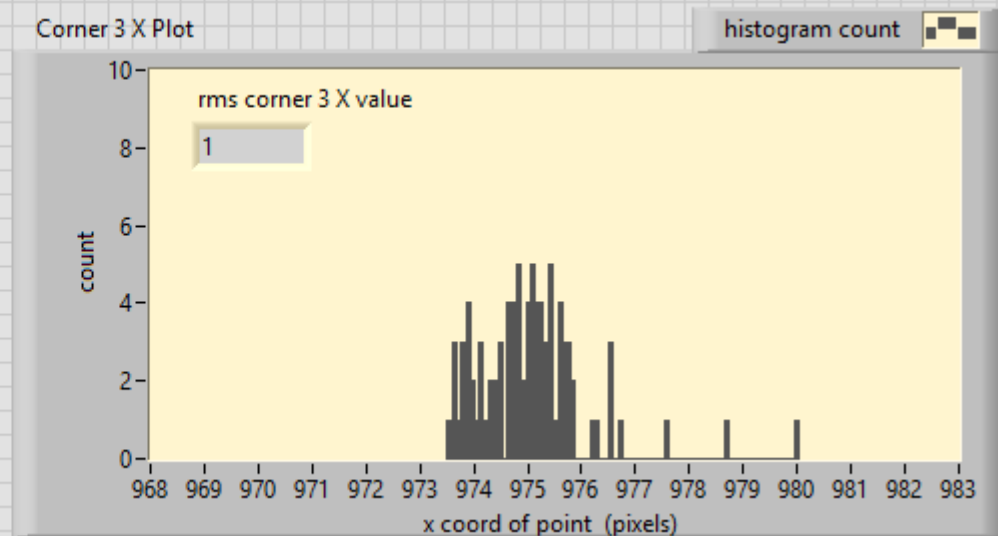
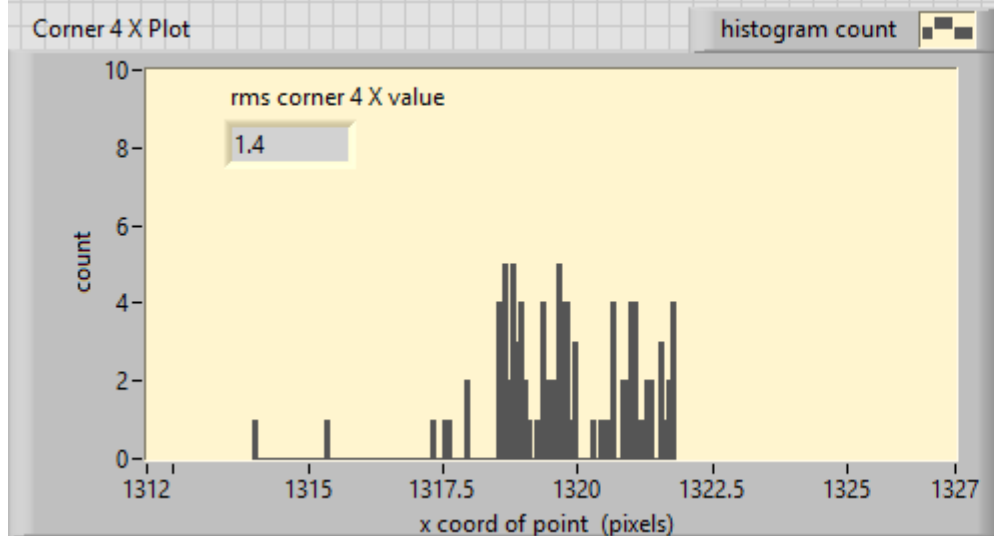
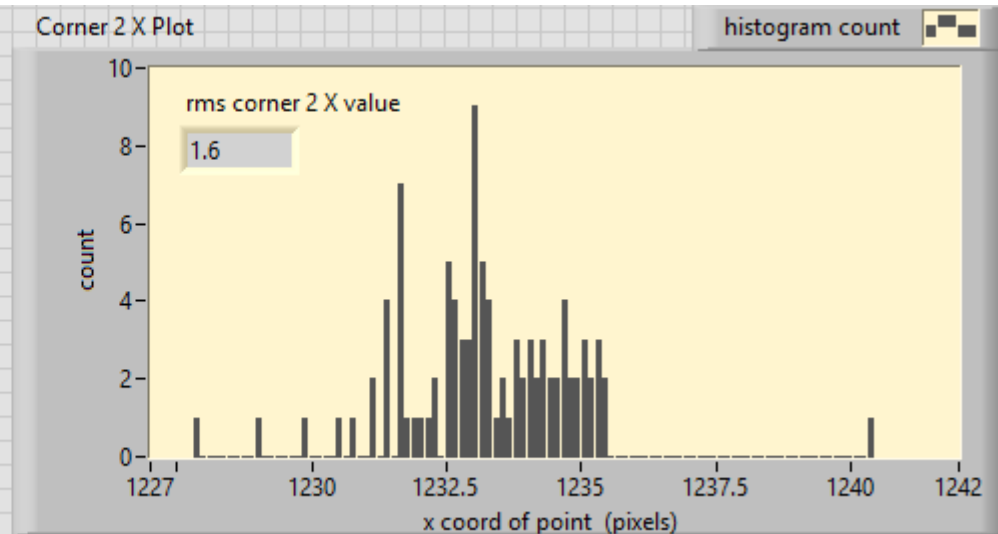
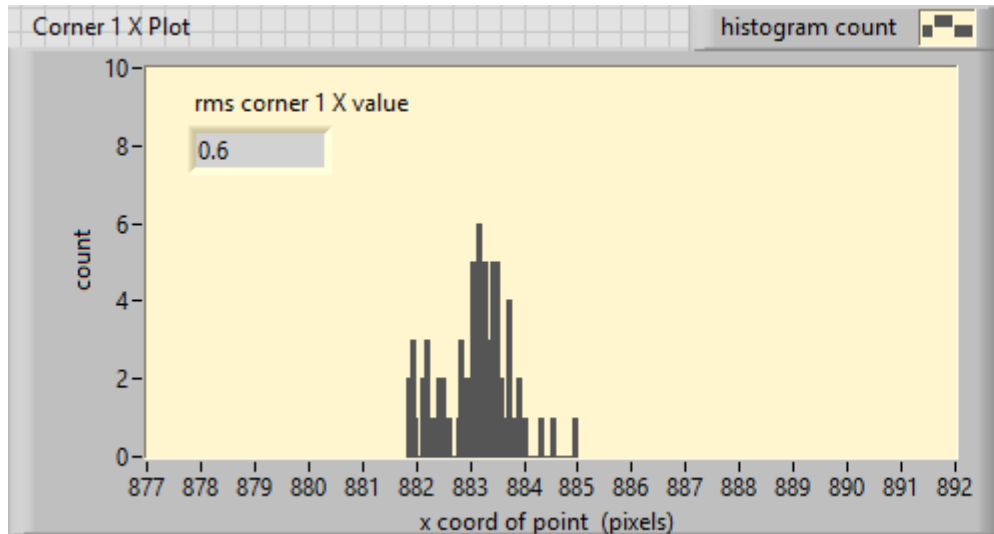


Corrected intersection values

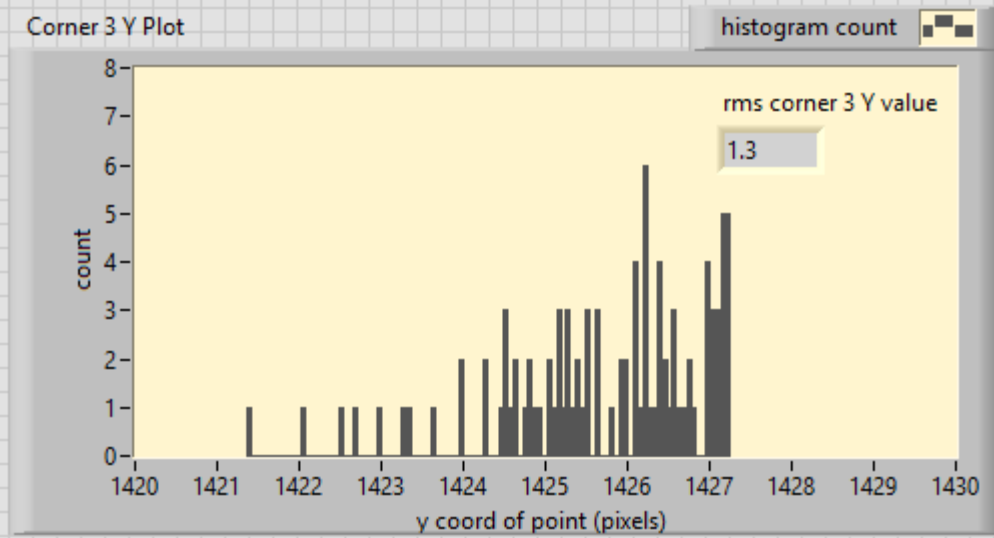
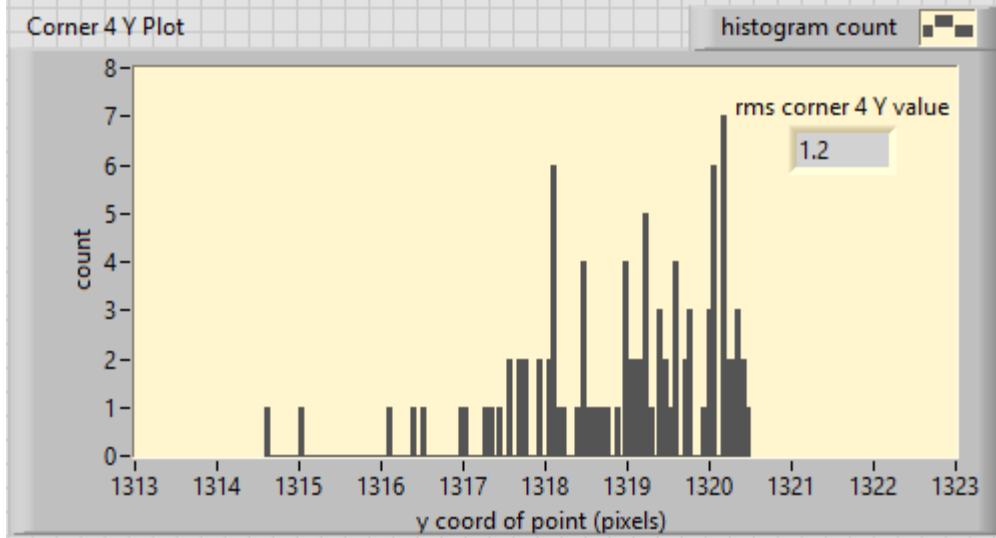
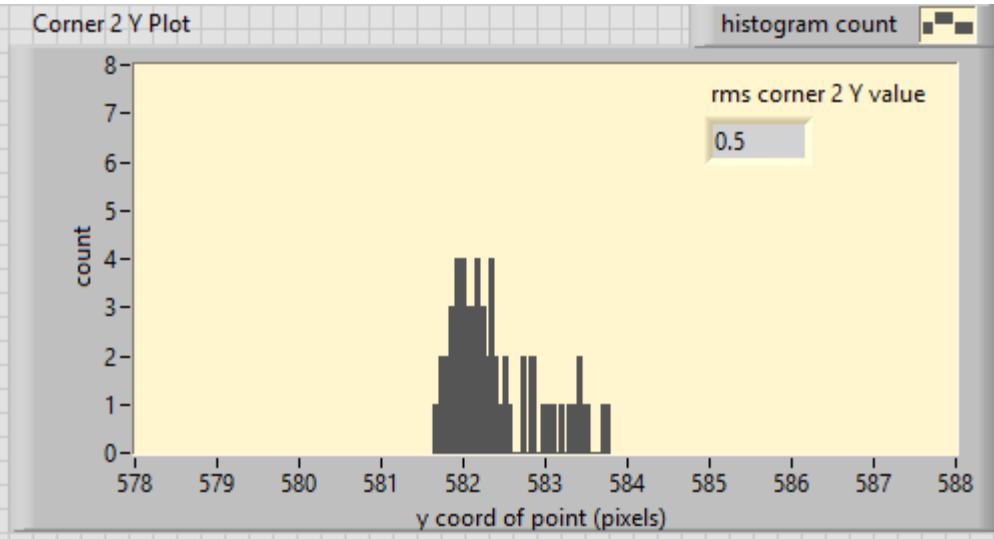
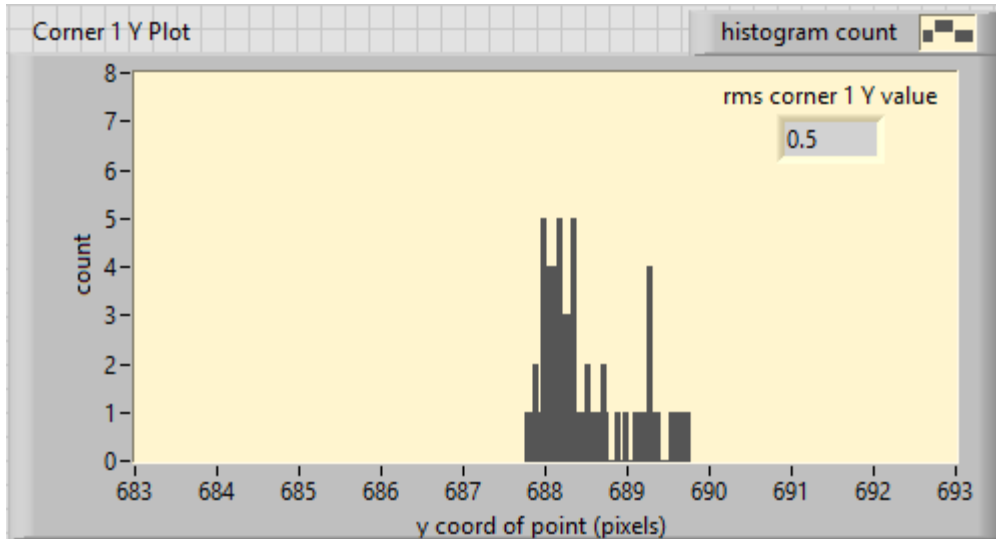
New 20 point dataset



100 point dataset fiducial "F"

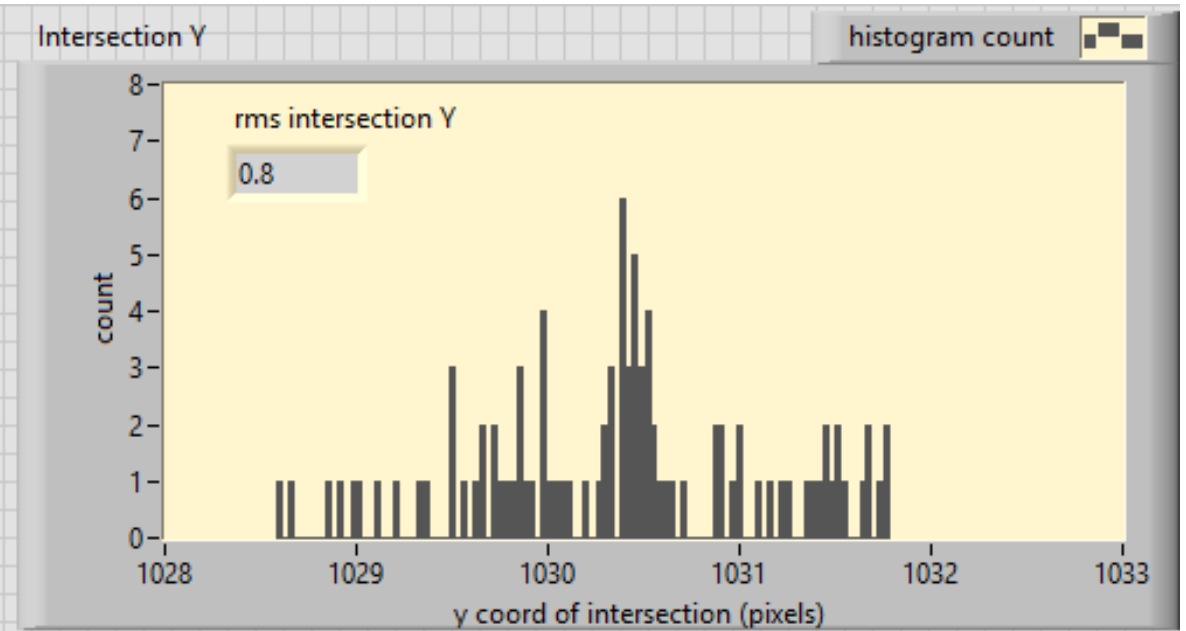
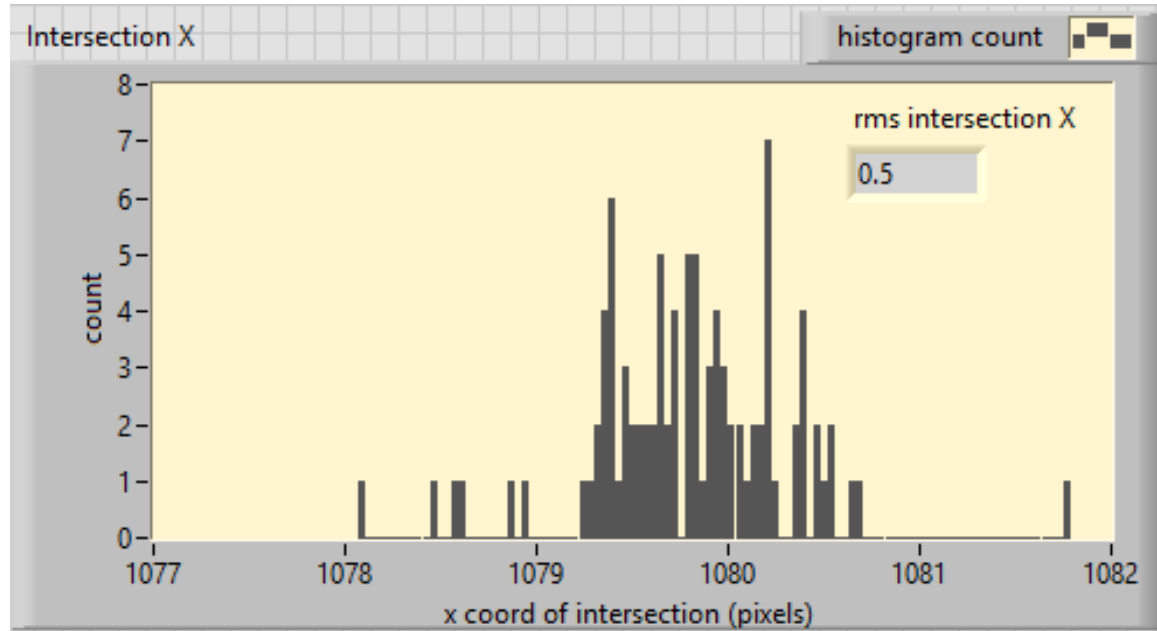


100 point dataset fiducial "F"

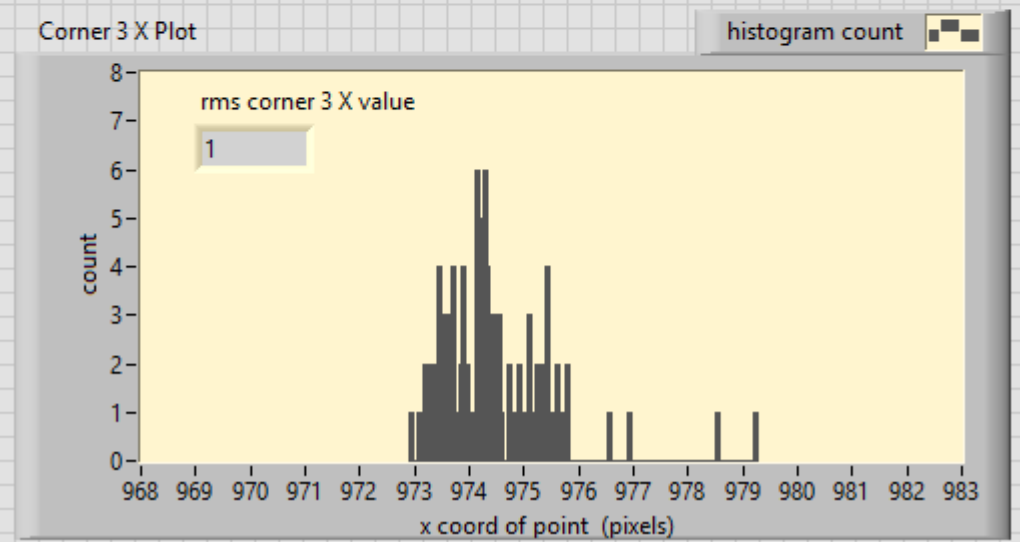
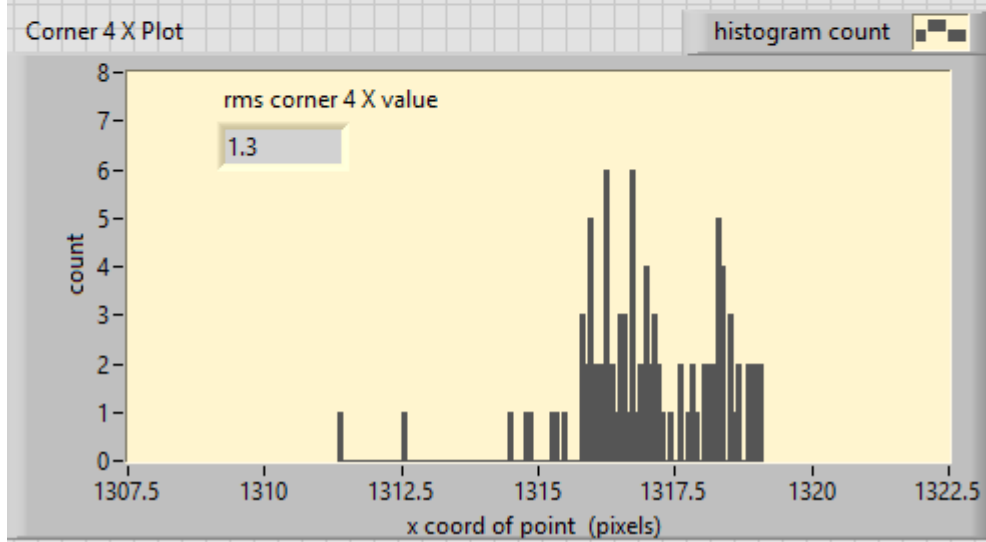
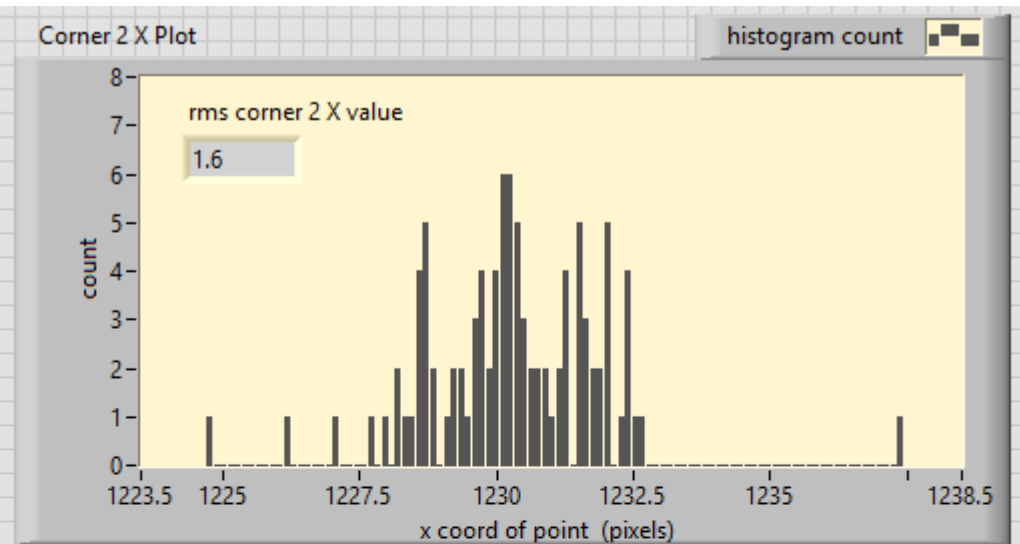
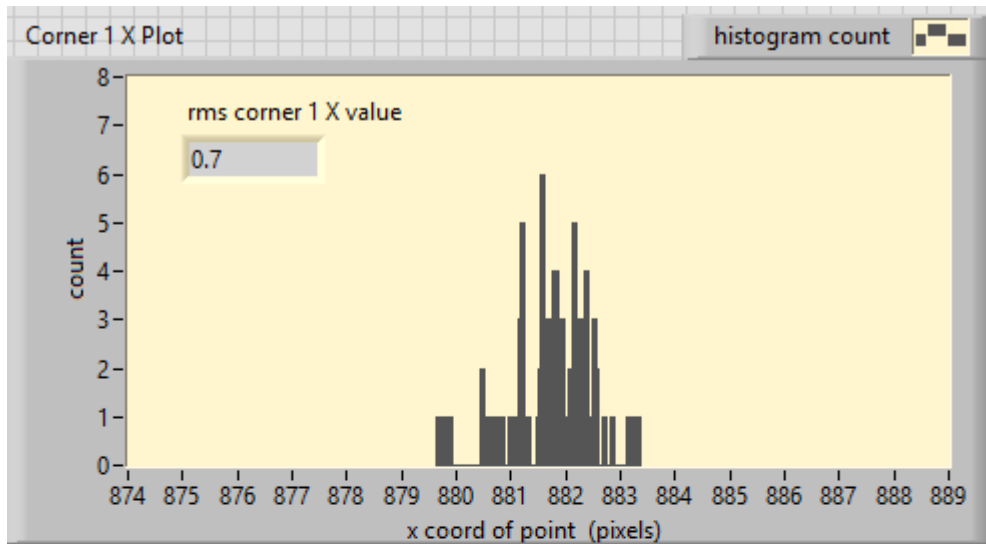


Corrected intersection values

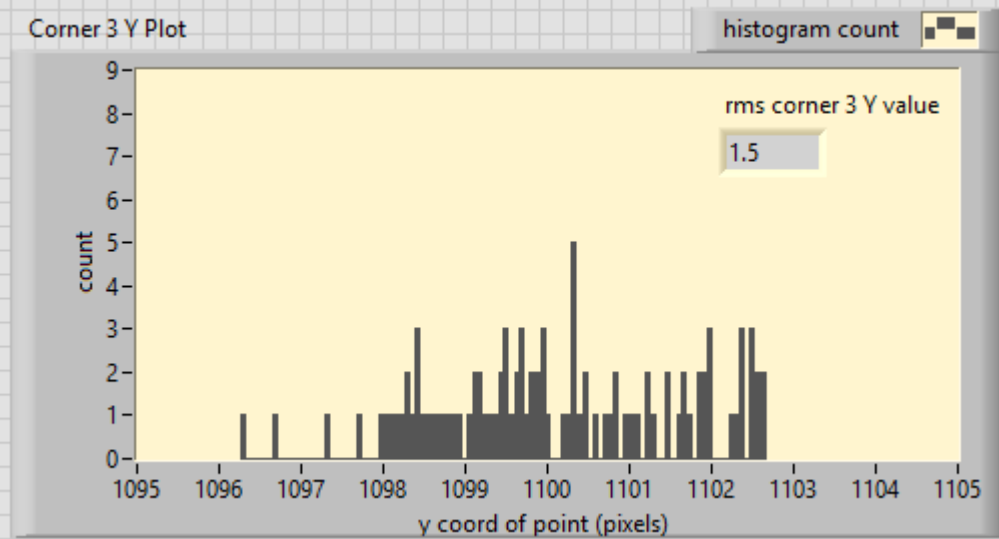
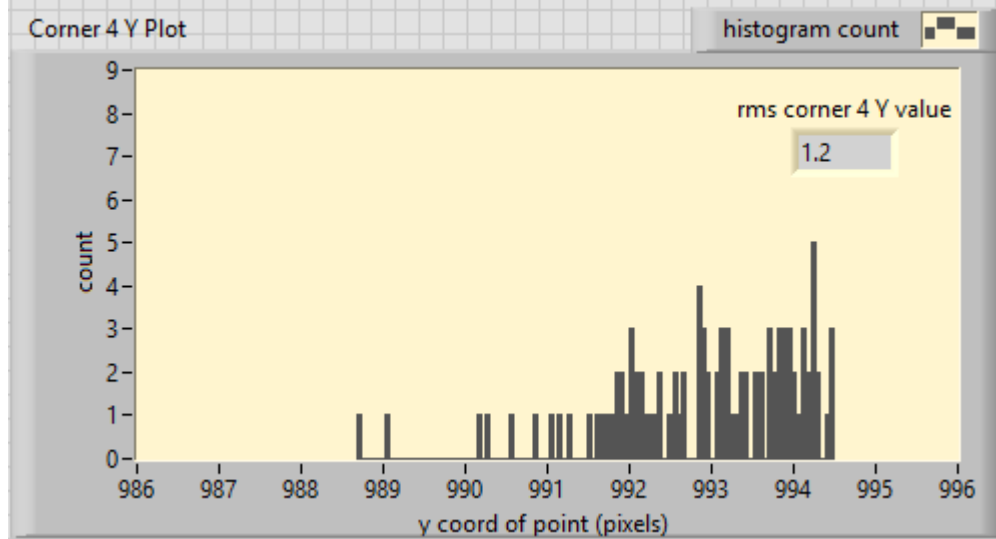
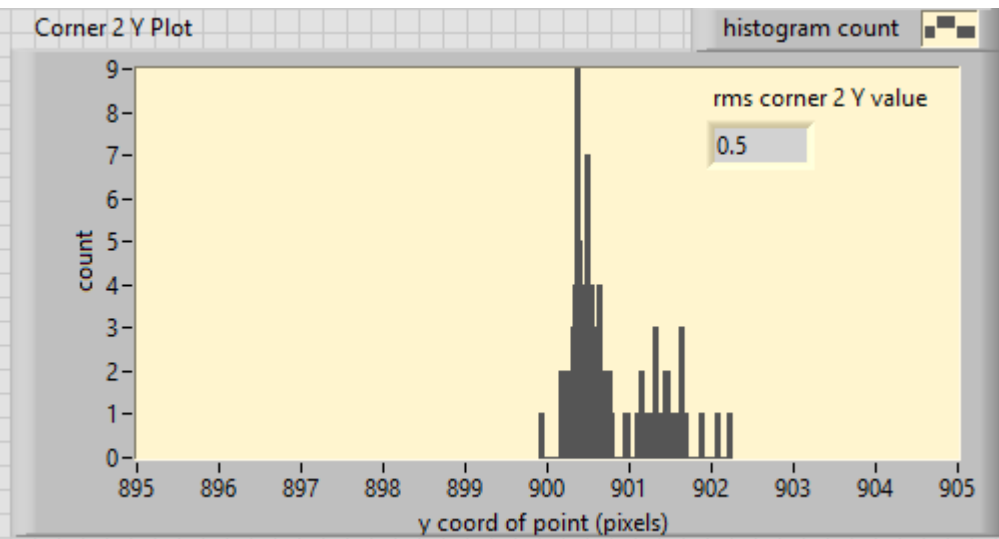
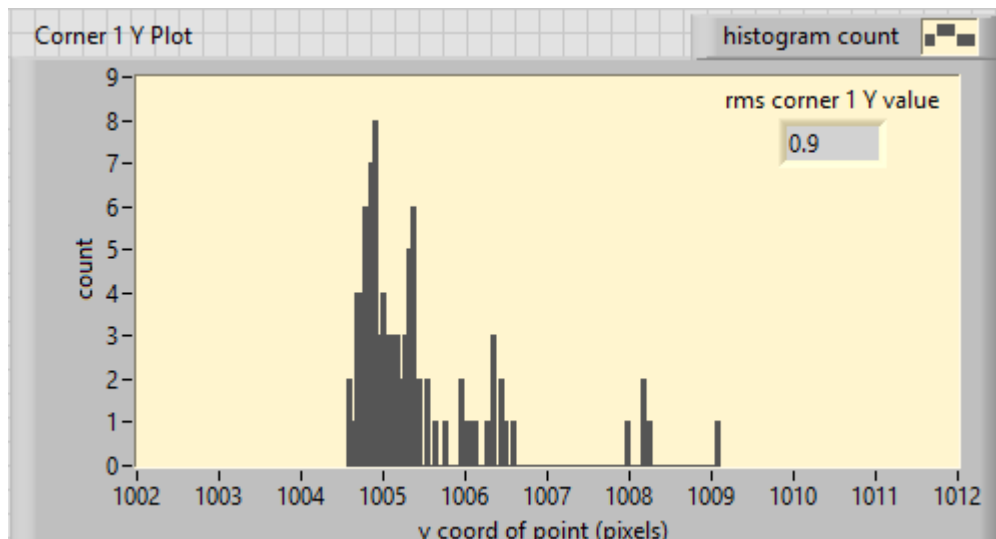
100 point dataset fiducial "F"



100 point dataset four dots

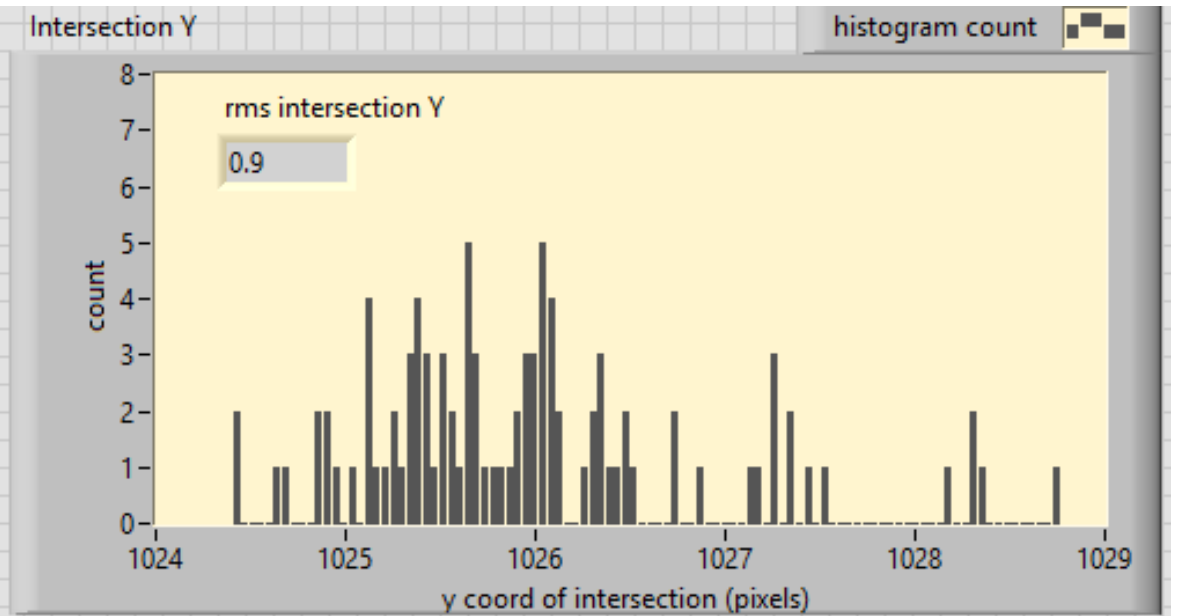
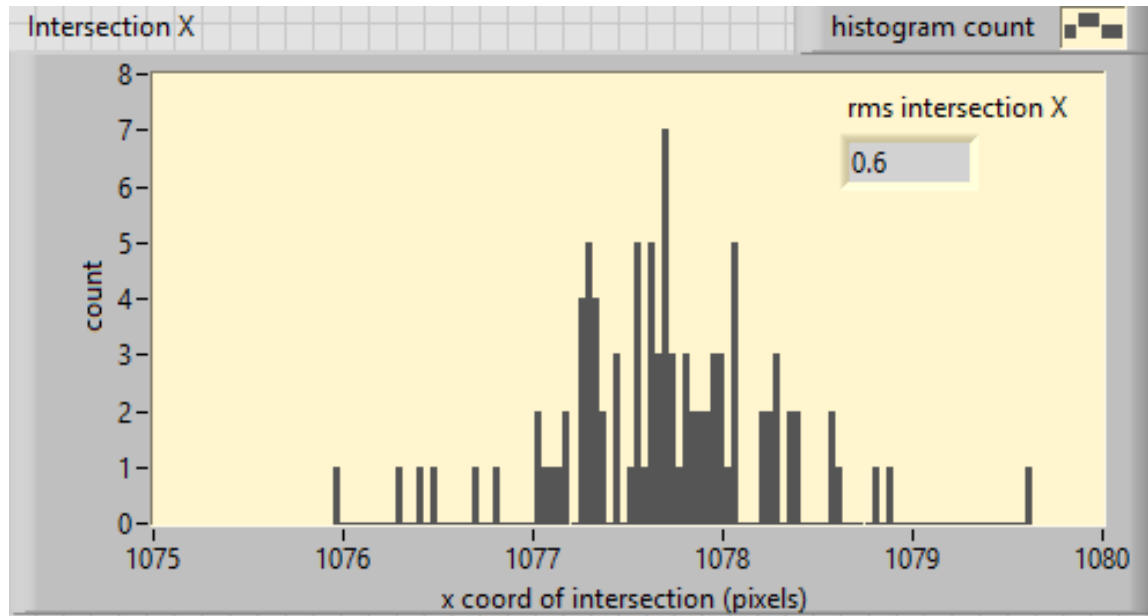


100 point dataset four dots

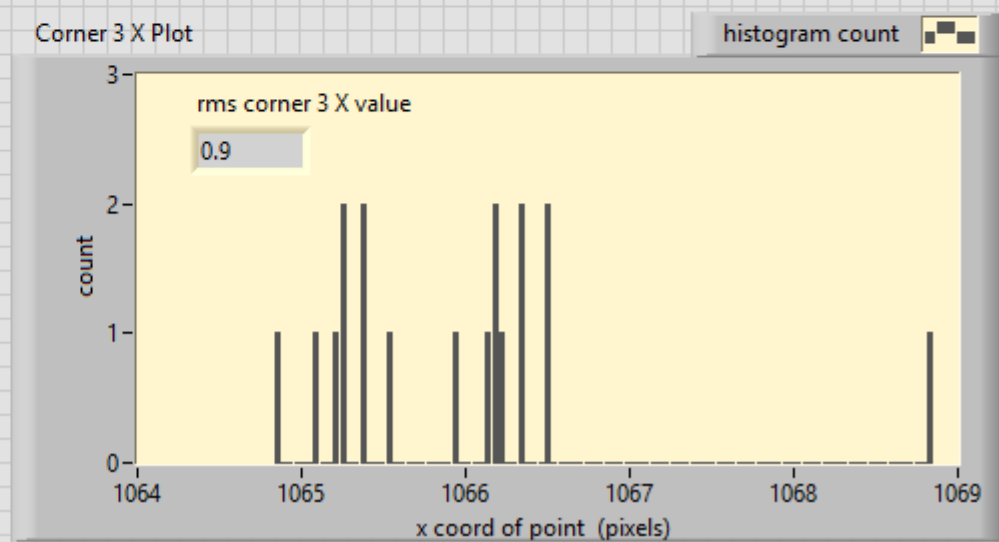
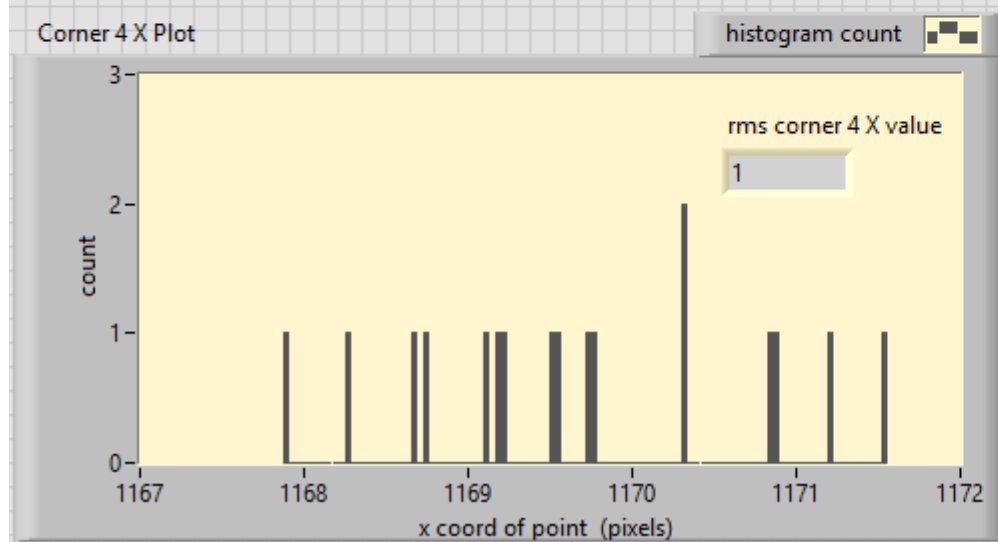
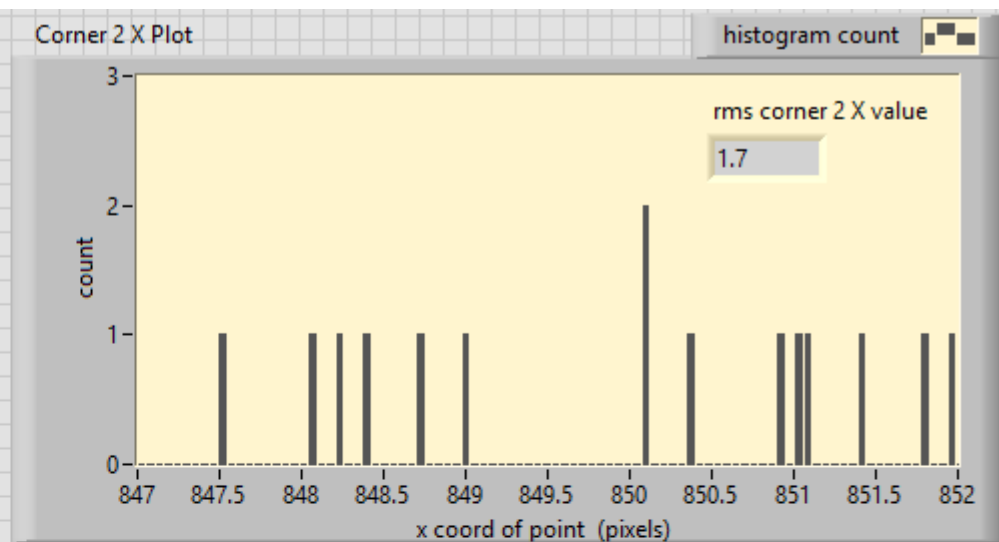
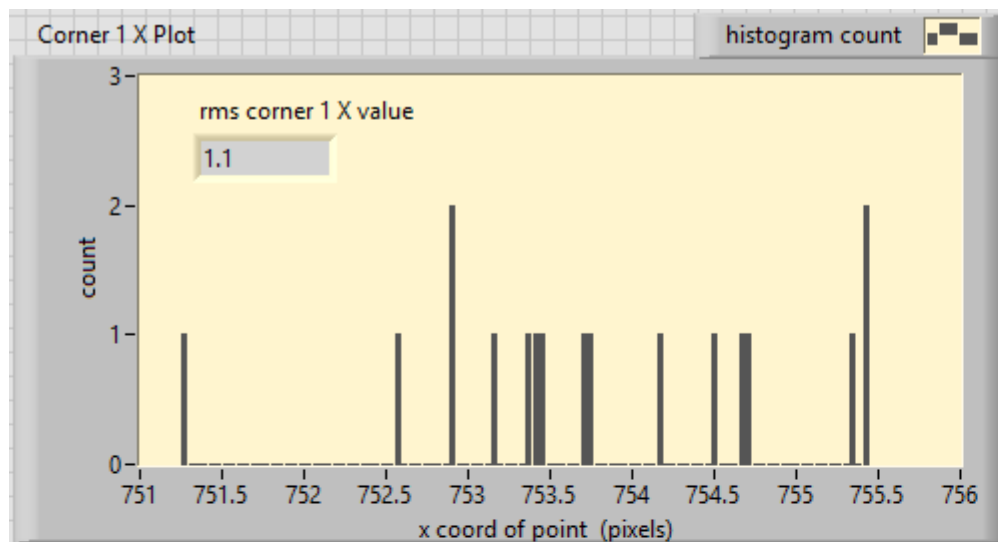


Corrected intersection values

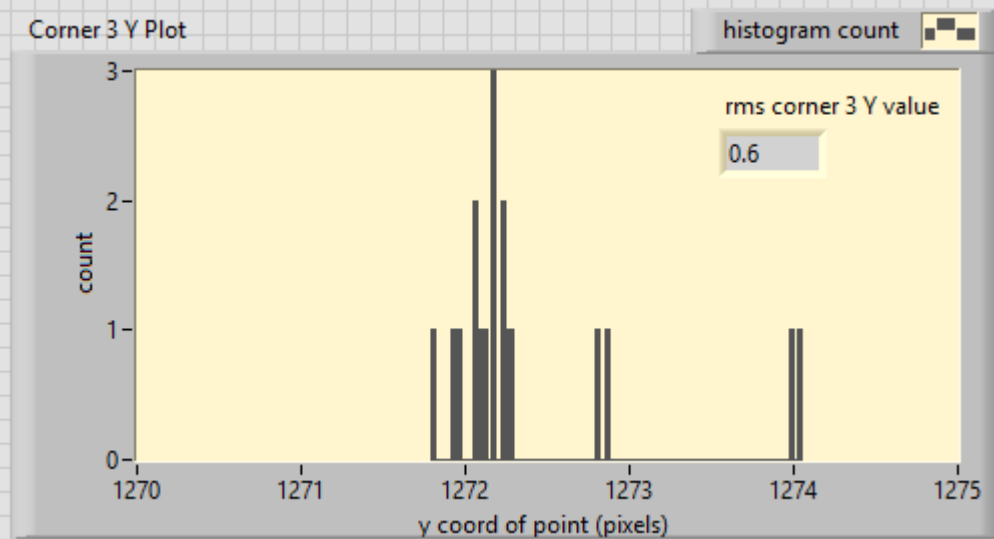
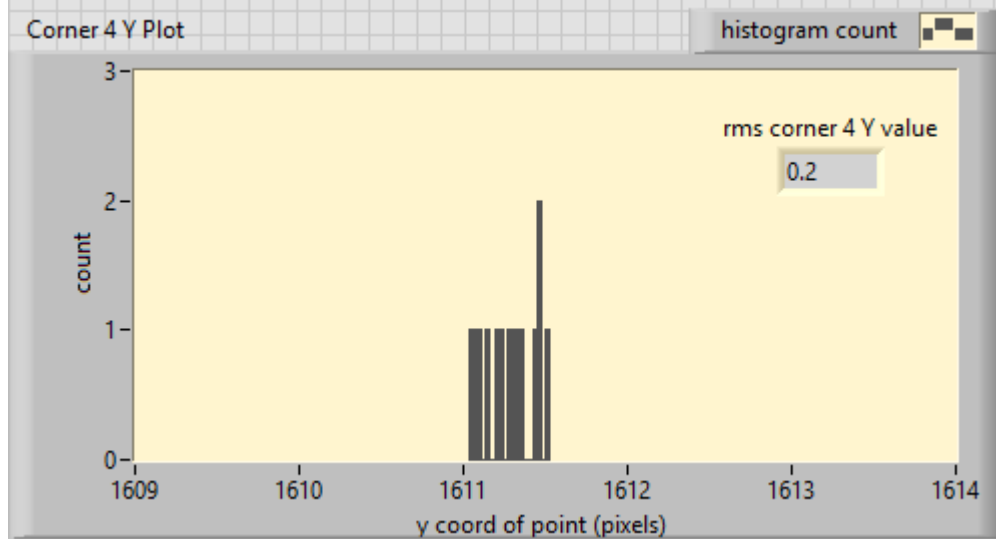
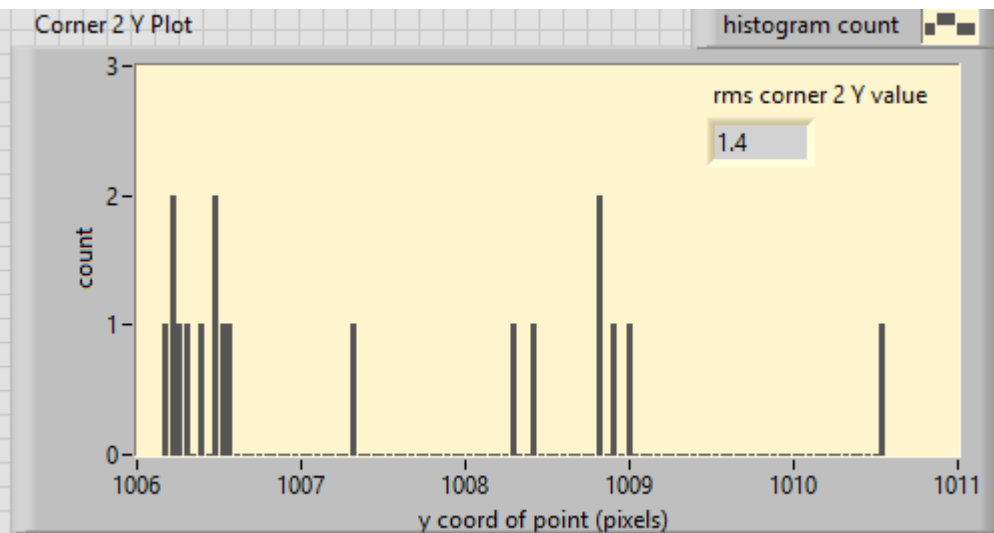
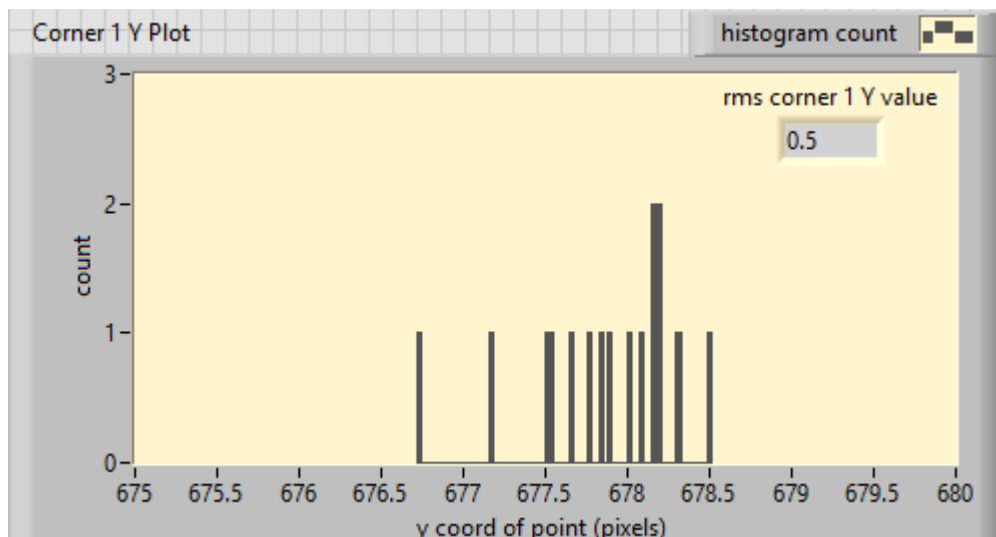
100 point dataset four dots



Old 20 point dataset

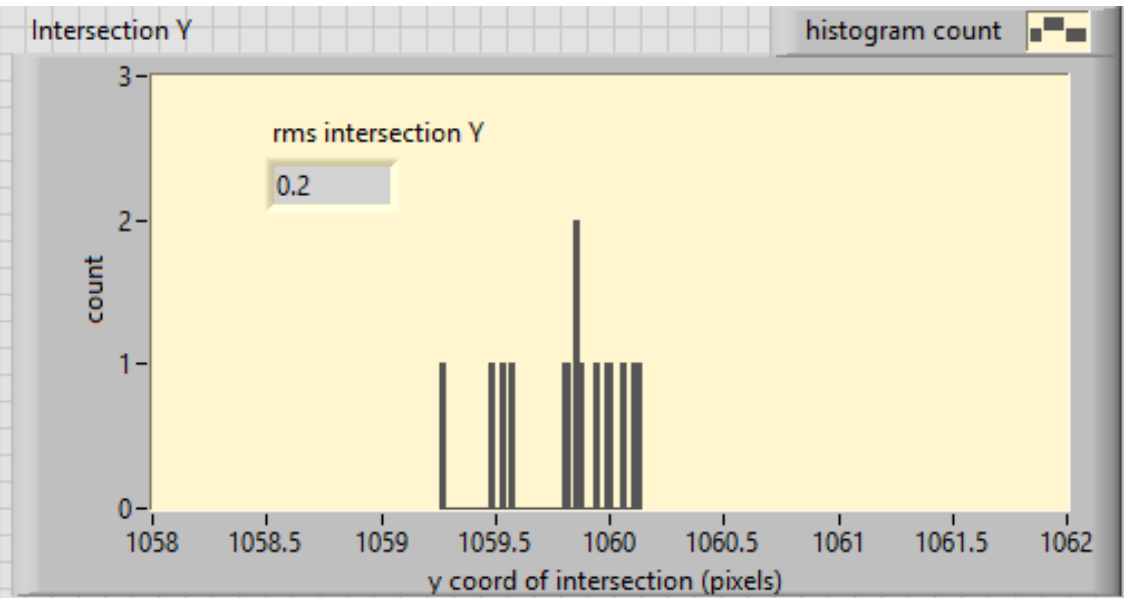
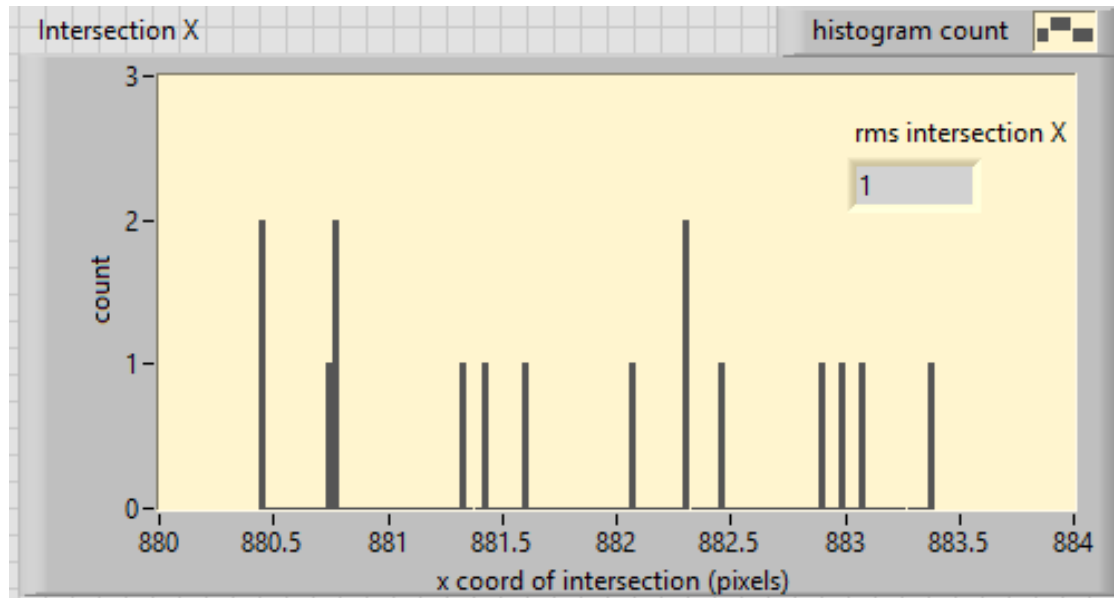


Old 20 point dataset

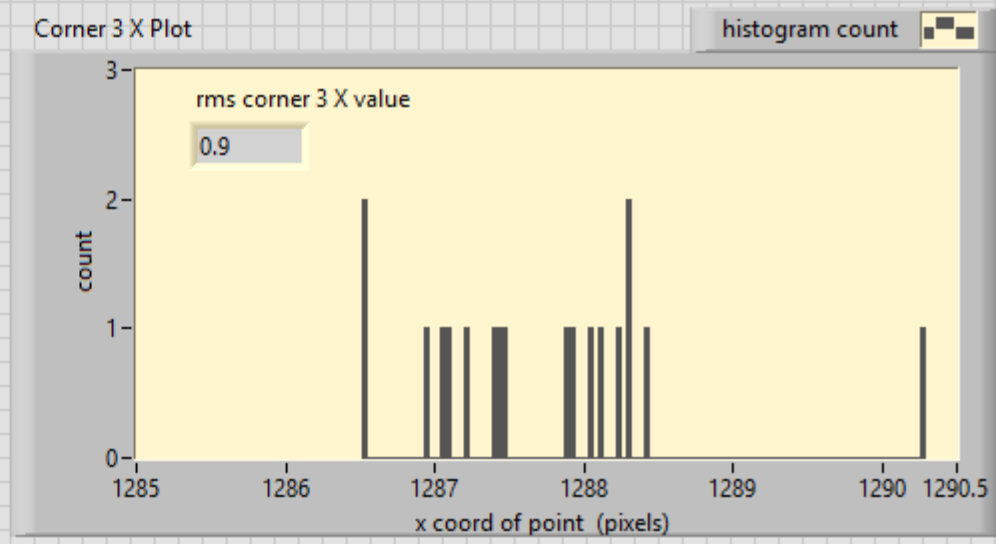
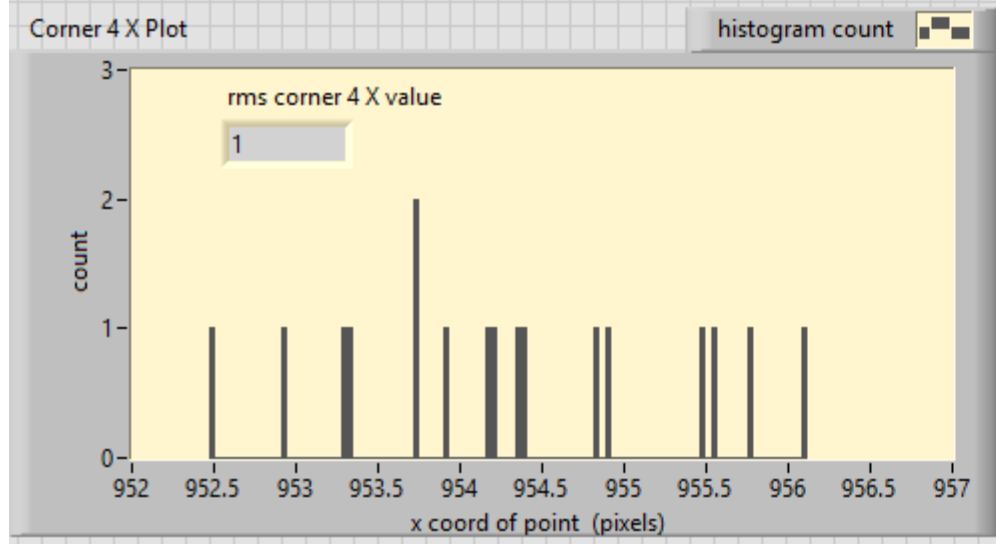
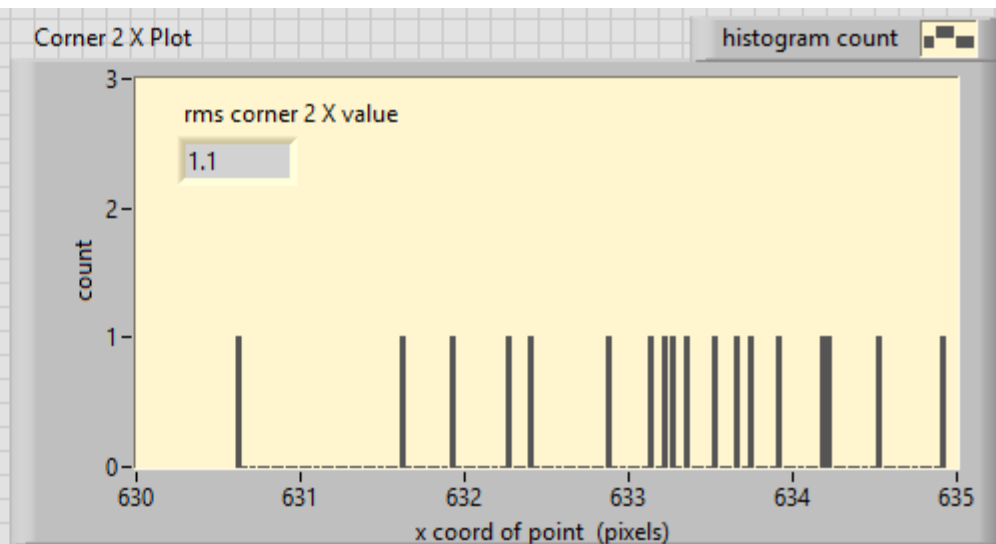
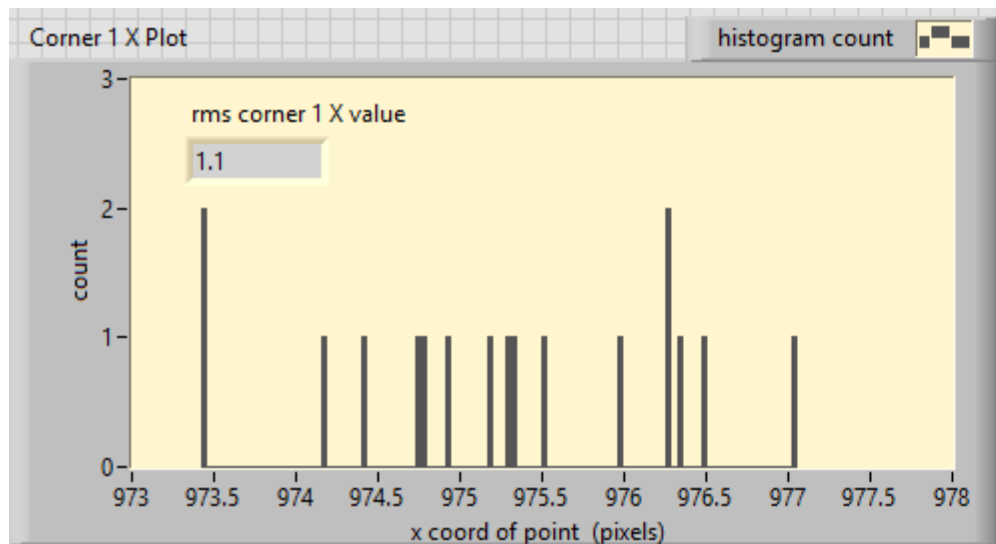


Corrected Intersection values

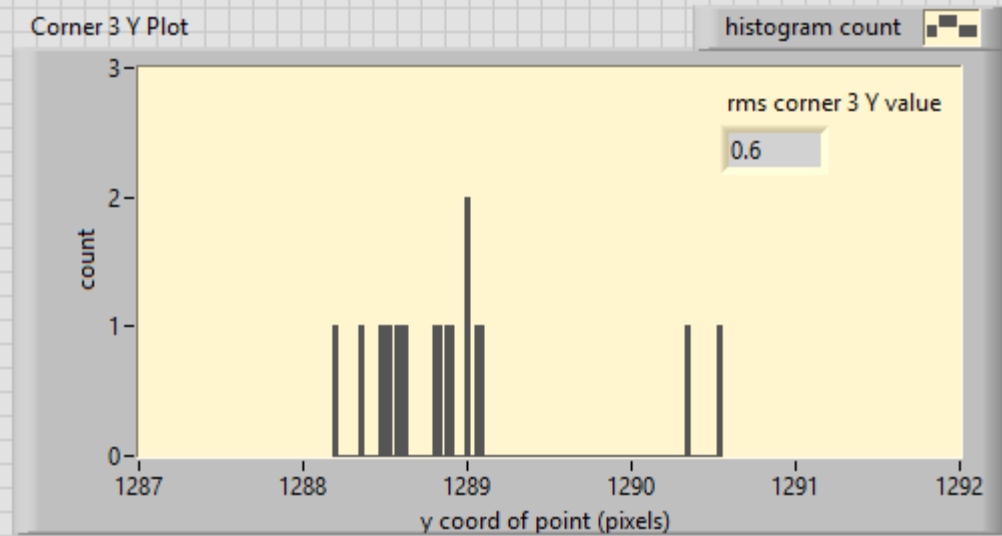
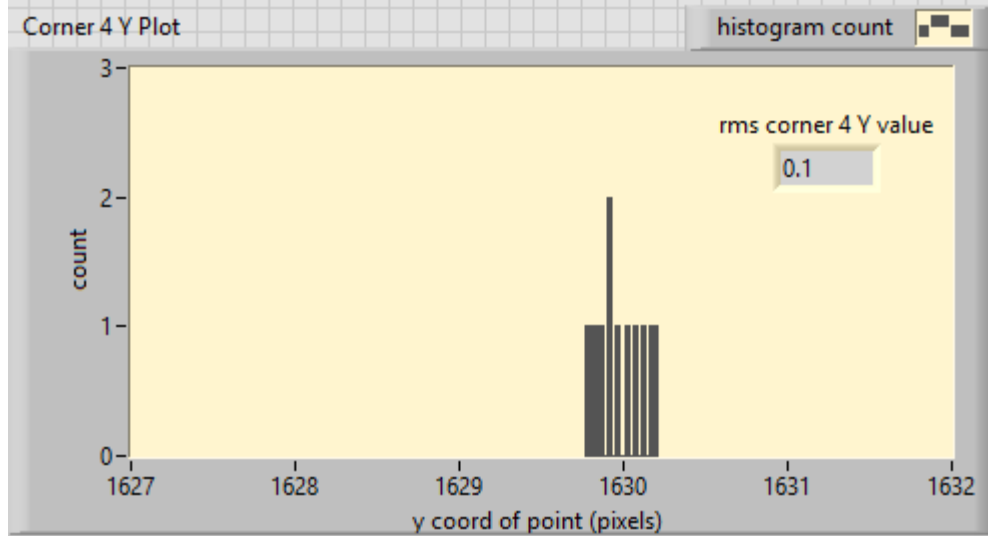
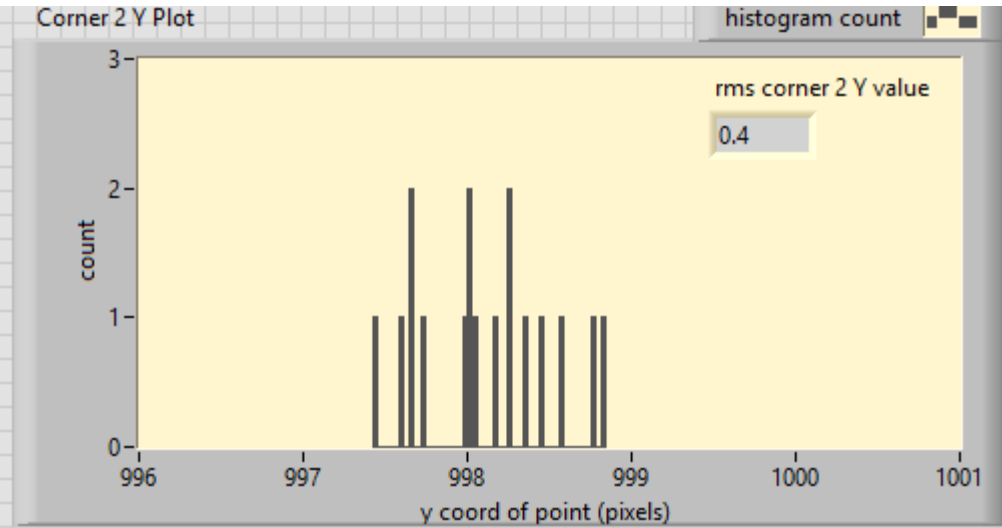
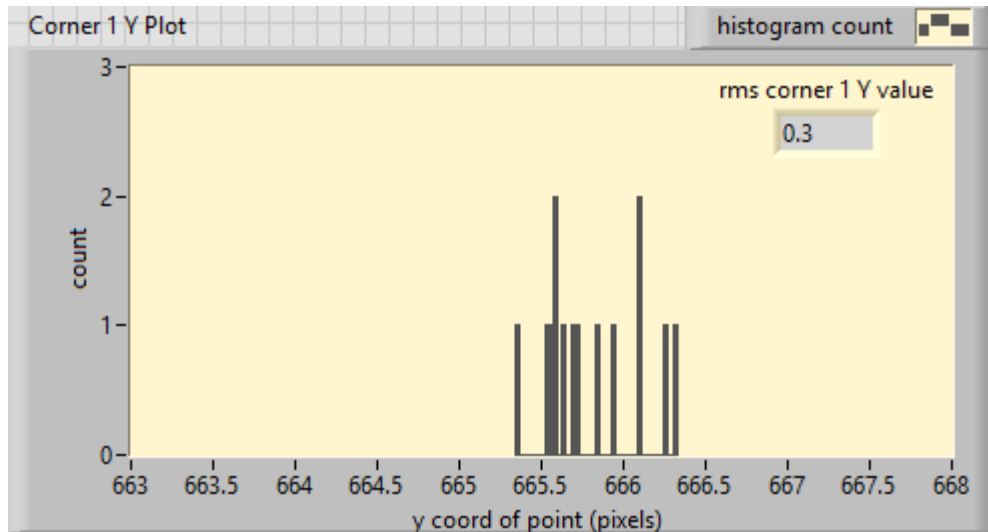
Old 20 point dataset



Old 20 point dataset fiducial "F"

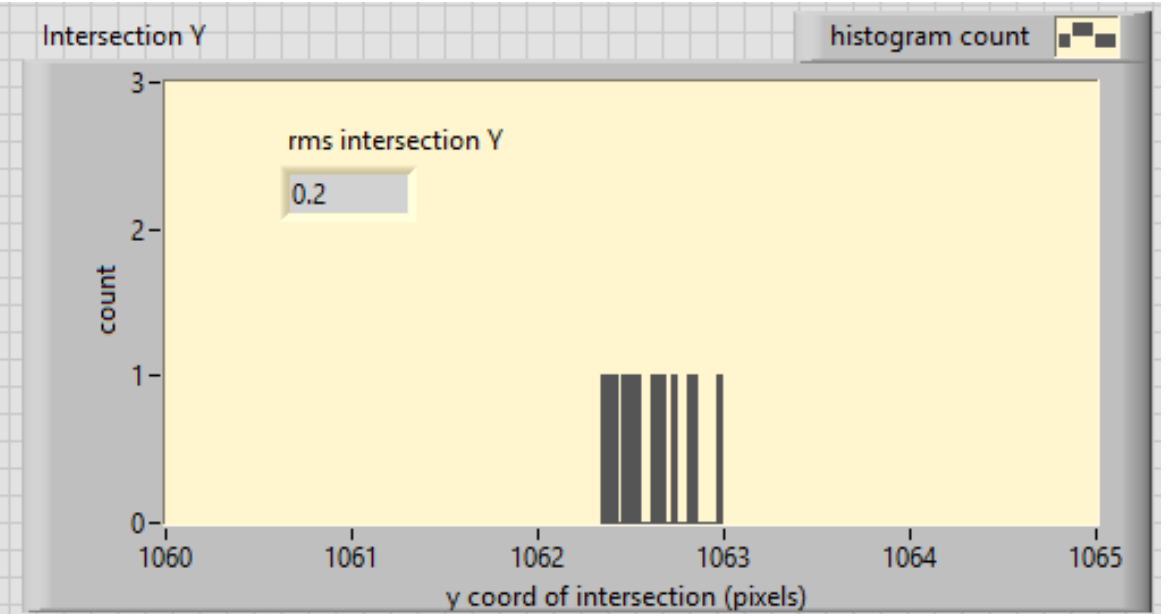
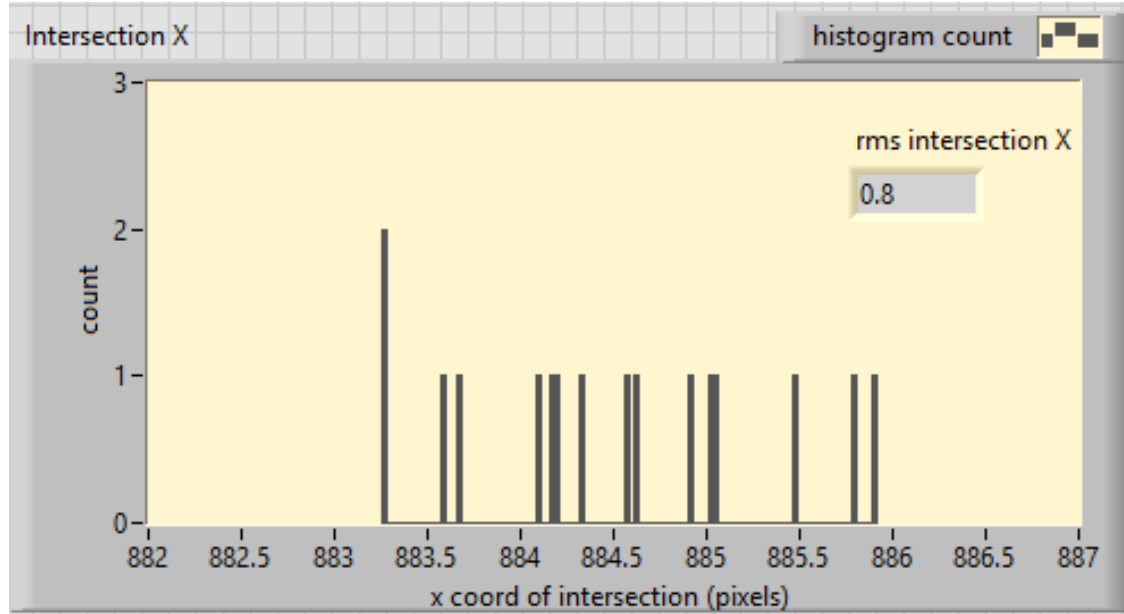


Old 20 point dataset fiducial "F"

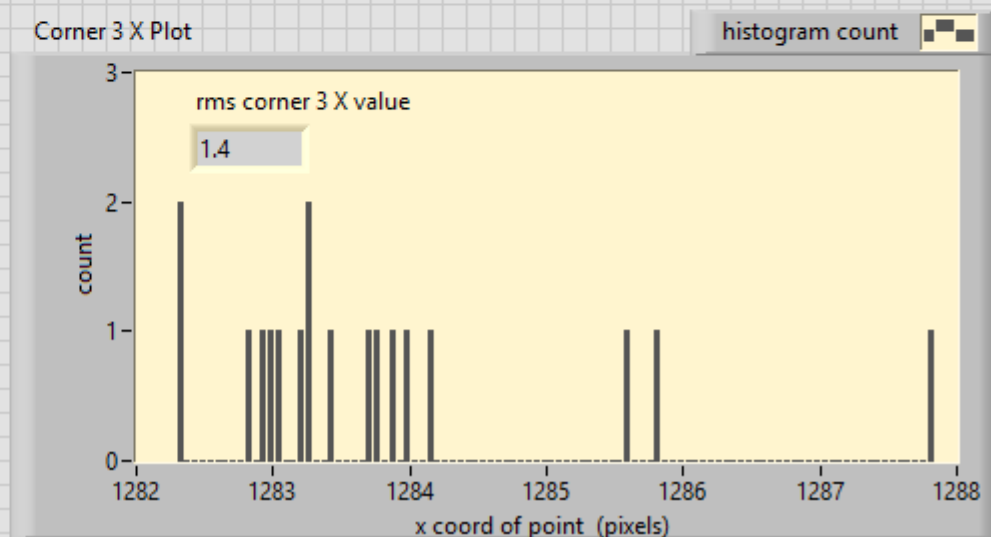
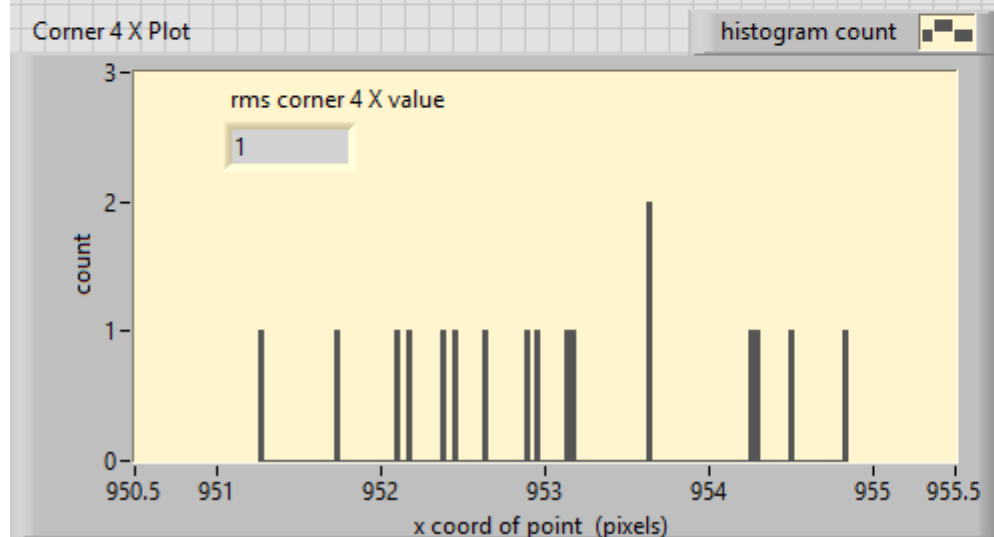
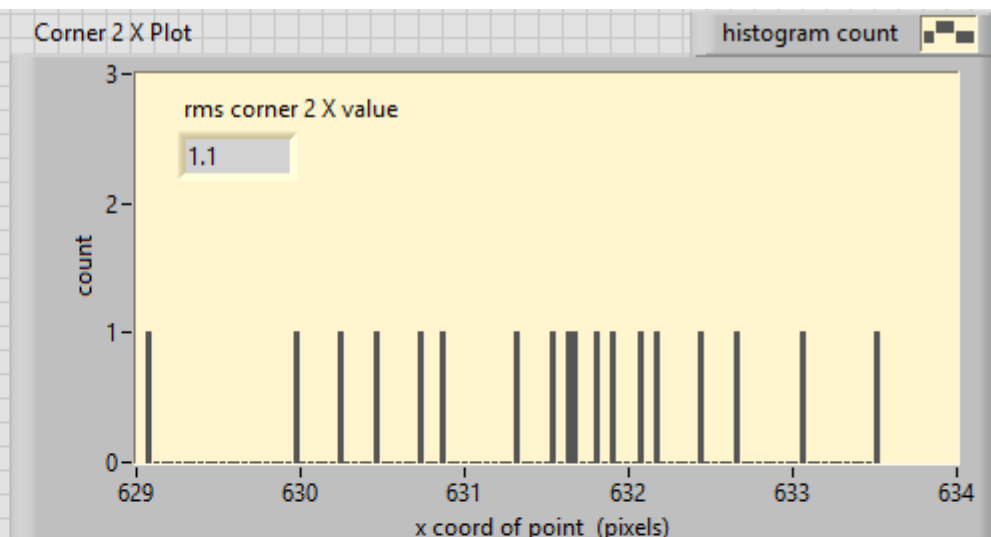
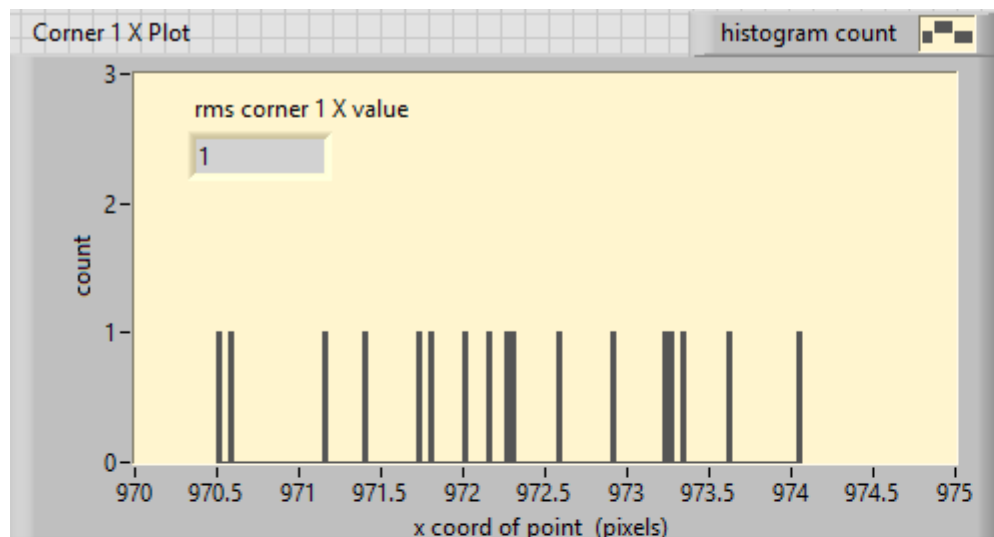


Corrected intersection values

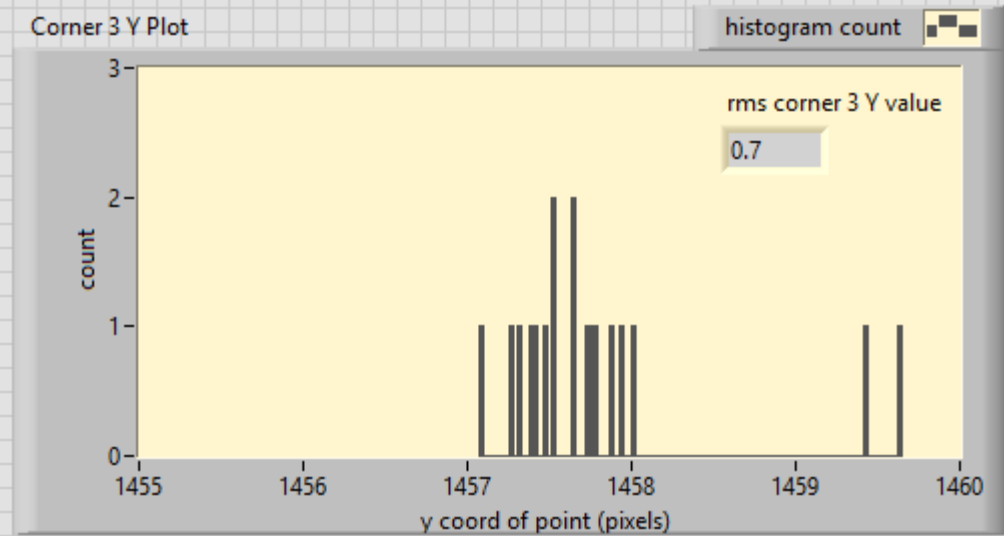
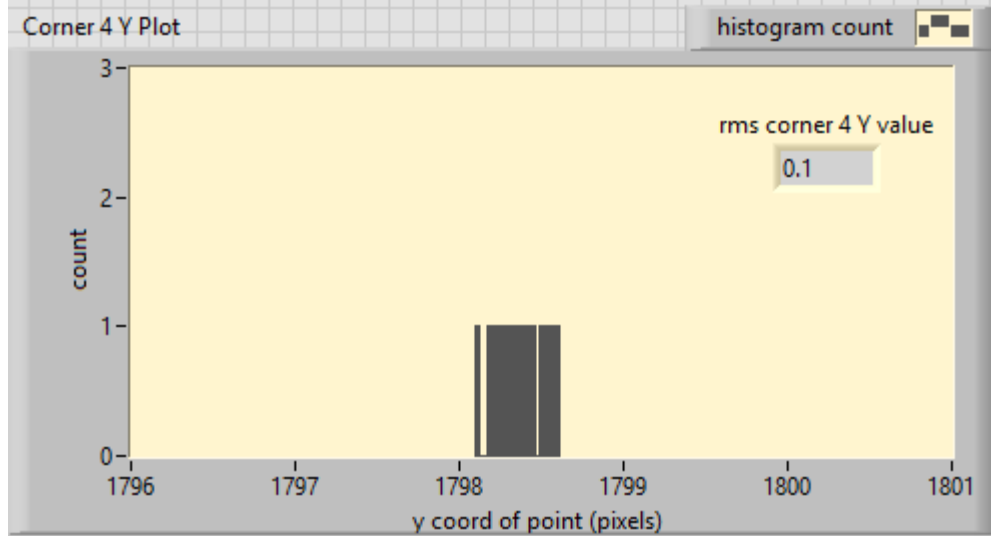
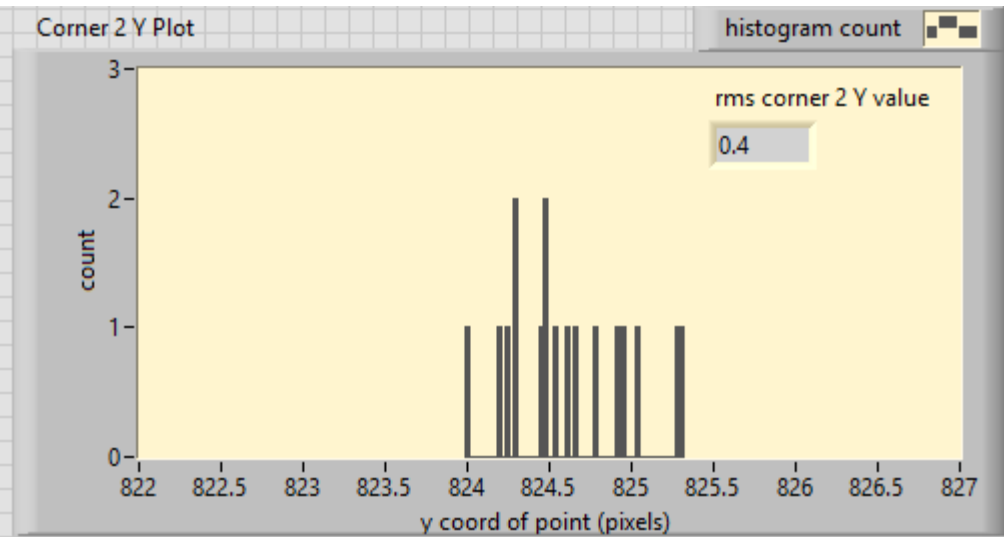
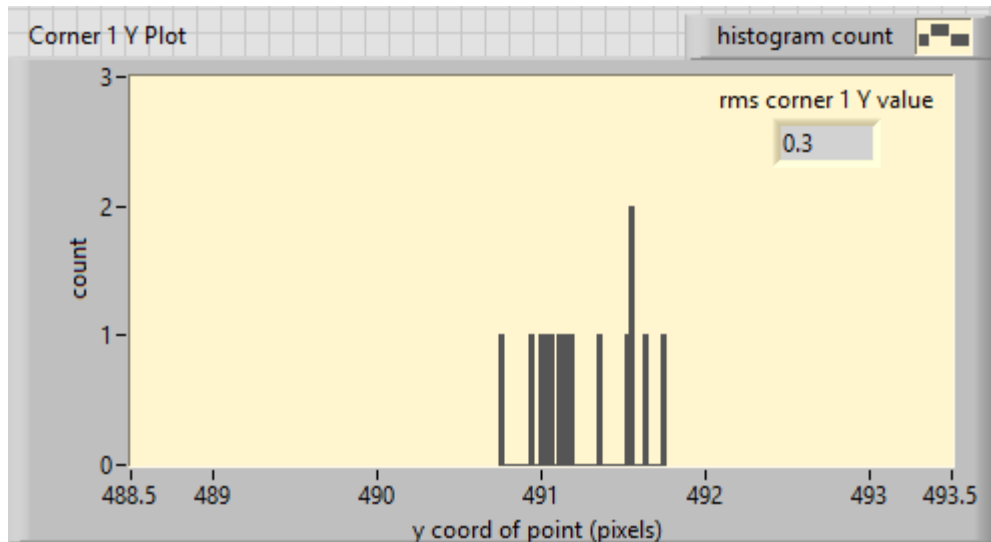
Old 20 point dataset fiducial "F"



Old 20 point dataset fiducial dots



Old 20 point dataset fiducial dots



Corrected intersection values

Old 20 point dataset fiducial dots

