RIT Isocenter Analysis Tool

Department and LINAC

Report For:	
Department	JW Pacific
LINAC	RIT Demo
Manufacturer	Varian
Model	TrueBeam

3D Displacements

Coordinate System	Varian IEC 1217
dX (mm)	-0.31
dY (mm)	0.17
dZ (mm)	-0.03
3D Displacement (mm)	0.36
Tolerance (mm)	1
Pass-Fail	Pass
SDx (mm)	0.2
SDy (mm)	0.25
SDz (mm)	0.2

dX, dY, and dZ are the average ball-Field displacement projections on their respective axes.
SDx, SDy, SDz are the standard deviations of ball-Field displacement projections on their respective axes.
3D Displacement is the 3D Euclidian distance between center of ball and center of radiation field as calculated by the Low et al. method. To pass, it must be less than 1 mm.

Image List and Results

File Name	Gantry	Couch	Col.	Vertical (mm)	Horizontal (mm)	Notes
...42.G0C90T0-0.dcm	0	0	90	0.36	0.1	
...2.G0C270T0-0.dcm	0	0	270	0.62	-0.28	
....G0C270T45-0.dcm	0	45	270	0.58	0.05	
....G0C270T90-0.dcm	0	90	270	0.35	-0.12	
...G0C270T270-0.dcm	0	270	270	0.49	-0.4	
...G0C270T315-0.dcm	0	315	270	0.9	-0.22	
...2.G90C90T0-0.dcm	90	0	90	0.3	0.03	
....G90C270T0-0.dcm	90	0	270	0.34	-0.27	
....G180C90T0-0.dcm	180	0	90	0.01	0.2	
...G180C270T0-0.dcm	180	0	270	0.09	-0.17	
....G270C90T0-0.dcm	270	0	90	0.13	0.13	
...G270C270T0-0.dcm	270	0	270	0.3	-0.19	

Vertical and Horizontal measurements are relative to image axes.

Measured and Calculated Analysis Results

Measured Pre-Optimization Results

Gantry	Couch	Collimator	X-Proj (mm)	Y-Proj (mm)	Z-Proj (mm)	W (mm)	GT (mm)	AB (mm)	R (mm)
0	0	90	0.1	-0.36	No Projection	0.37	0.05	0.15	0.16
0	0	270	-0.28	-0.62	No Projection	0.68	0.3	-0.23	0.38
0	45	270	0.05	-0.58	No Projection	0.58	0.32	-0.14	0.34
0	90	270	-0.12	-0.35	No Projection	0.37	0.29	-0.43	0.52
0	270	270	-0.4	-0.49	No Projection	0.63	0.54	-0.08	0.55
0	315	270	-0.22	-0.9	No Projection	0.93	0.71	0.04	0.71
90	0	90	No Projection	-0.3	-0.03	0.3	-0.02	0.07	0.07
90	0	270	No Projection	-0.34	0.27	0.44	0.03	-0.23	0.23
180	0	90	-0.2	-0.01	No Projection	0.2	-0.3	0.15	0.34
180	0	270	0.17	-0.09	No Projection	0.2	-0.22	-0.23	0.32
270	0	90	No Projection	-0.13	0.13	0.18	-0.19	0.08	0.2
270	0	270	No Projection	-0.3	-0.19	0.35	-0.02	-0.23	0.23

Calculated Pre-Optimization Results

Gantry	Couch	Collimator	X-Proj (mm)	Y-Proj (mm)	Z-Proj (mm)	W (mm)	GT (mm)	AB (mm)	R (mm)
0	45	90	0.43	-0.32	No Projection	0.53	0.06	0.24	0.25
180	45	270	0.5	-0.05	No Projection	0.5	-0.21	-0.32	0.38
180	45	90	0.13	0.03	No Projection	0.13	-0.29	0.06	0.3
0	90	90	0.26	-0.09	No Projection	0.27	0.04	-0.06	0.07
180	90	270	0.33	0.18	No Projection	0.38	-0.23	-0.02	0.23
180	90	90	-0.04	0.26	No Projection	0.26	-0.31	0.36	0.48
0	270	90	-0.02	-0.23	No Projection	0.23	0.28	0.3	0.41
180	270	270	0.05	0.04	No Projection	0.07	0.02	-0.37	0.37
180	270	90	-0.32	0.12	No Projection	0.34	-0.07	0.01	0.07
0	315	90	0.16	-0.64	No Projection	0.66	0.46	0.42	0.62
180	315	270	0.23	-0.37	No Projection	0.44	0.19	-0.49	0.53
180	315	90	-0.14	-0.29	No Projection	0.33	0.11	-0.12	0.16

- X, Y, and Z projections are pre-optimization isocenter drifts with ball setup error.
- W is the pre-optimization total deviation with setup error.
- GT is the pre-optimization gun-target deviation without setup error.
- AB is the pre-optimization lateral deviation without setup error.
- R is the pre-optimization machine deviation without setup error.
- The top Measured Results table is the physical measurements taken from the imported images.
- The bottom Calculated Results table is the virtual measurements calculated using the measured data.

*** Optimization in this context is the optimal physical shift of the gantry and/or couch.***

Optimized Analysis Results

Measured Post-Optimization Results

Gantry	Couch	Collimator	X-Proj (mm)	Y-Proj (mm)	Z-Proj (mm)	W (mm)	GT (mm)	AB (mm)	R (mm)
0	0	90	0.29	-0.17	No Projection	0.34	0.05	0.15	0.16
0	0	270	-0.09	-0.43	No Projection	0.44	0.3	-0.23	0.38
0	45	270	0.24	-0.39	No Projection	0.45	0.4	0.05	0.4
0	90	270	0.07	-0.16	No Projection	0.17	0.3	-0.05	0.3
0	270	270	-0.21	-0.3	No Projection	0.36	0.16	-0.08	0.18
0	315	270	-0.03	-0.71	No Projection	0.71	0.52	-0.04	0.52
90	0	90	No Projection	-0.11	-0.03	0.11	-0.02	0.07	0.07
90	0	270	No Projection	-0.15	0.27	0.31	0.03	-0.23	0.23
180	0	90	-0.01	0.18	No Projection	0.18	-0.3	0.15	0.34
180	0	270	0.37	0.1	No Projection	0.38	-0.22	-0.23	0.32
270	0	90	No Projection	0.06	0.13	0.14	-0.19	0.08	0.2
270	0	270	No Projection	-0.11	-0.19	0.22	-0.02	-0.23	0.23

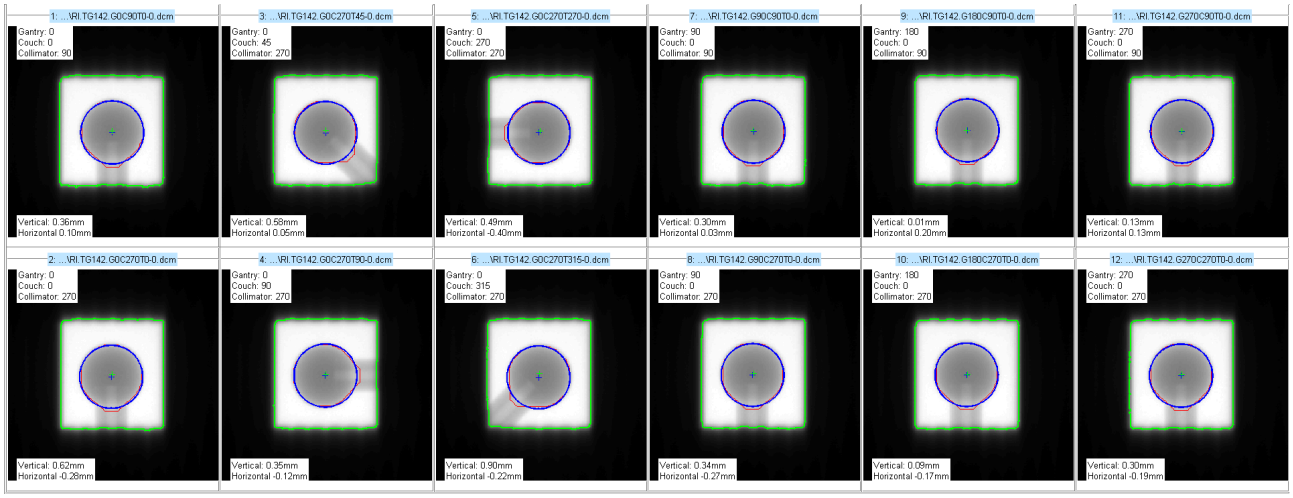
Calculated Post-Optimization Results

Gantry	Couch	Collimator	X-Proj (mm)	Y-Proj (mm)	Z-Proj (mm)	W (mm)	GT (mm)	AB (mm)	R (mm)
0	45	90	0.62	-0.13	No Projection	0.63	0.14	0.43	0.45
180	45	270	0.69	0.14	No Projection	0.71	-0.13	-0.51	0.52
180	45	90	0.32	0.22	No Projection	0.39	-0.21	-0.13	0.25
0	90	90	0.45	0.1	No Projection	0.46	0.04	0.33	0.33
180	90	270	0.53	0.37	No Projection	0.64	-0.23	-0.4	0.46
180	90	90	0.15	0.45	No Projection	0.47	-0.31	-0.02	0.31
0	270	90	0.17	-0.04	No Projection	0.18	-0.1	0.3	0.31
180	270	270	0.25	0.23	No Projection	0.34	-0.37	-0.37	0.52
180	270	90	-0.13	0.31	No Projection	0.33	-0.45	0	0.45
0	315	90	0.35	-0.45	No Projection	0.57	0.26	0.34	0.43
180	315	270	0.42	-0.18	No Projection	0.46	0	-0.41	0.41
180	315	90	0.05	-0.1	No Projection	0.11	-0.08	-0.04	0.09

X, Y, and Z projections are post-optimization isocenter drifts with ball setup error.
- W is the post-optimization total deviation with setup error.
- GT is the post-optimization gun-target deviation without setup error.
- AB is the post-optimization lateral deviation without setup error.
- R is the post-optimization deviation without setup error.
- The top Measured Results table is the optimized physical measurements taken from the imported images.
- The bottom Calculated Results table is the optimized virtual measurements calculated using the measured data.

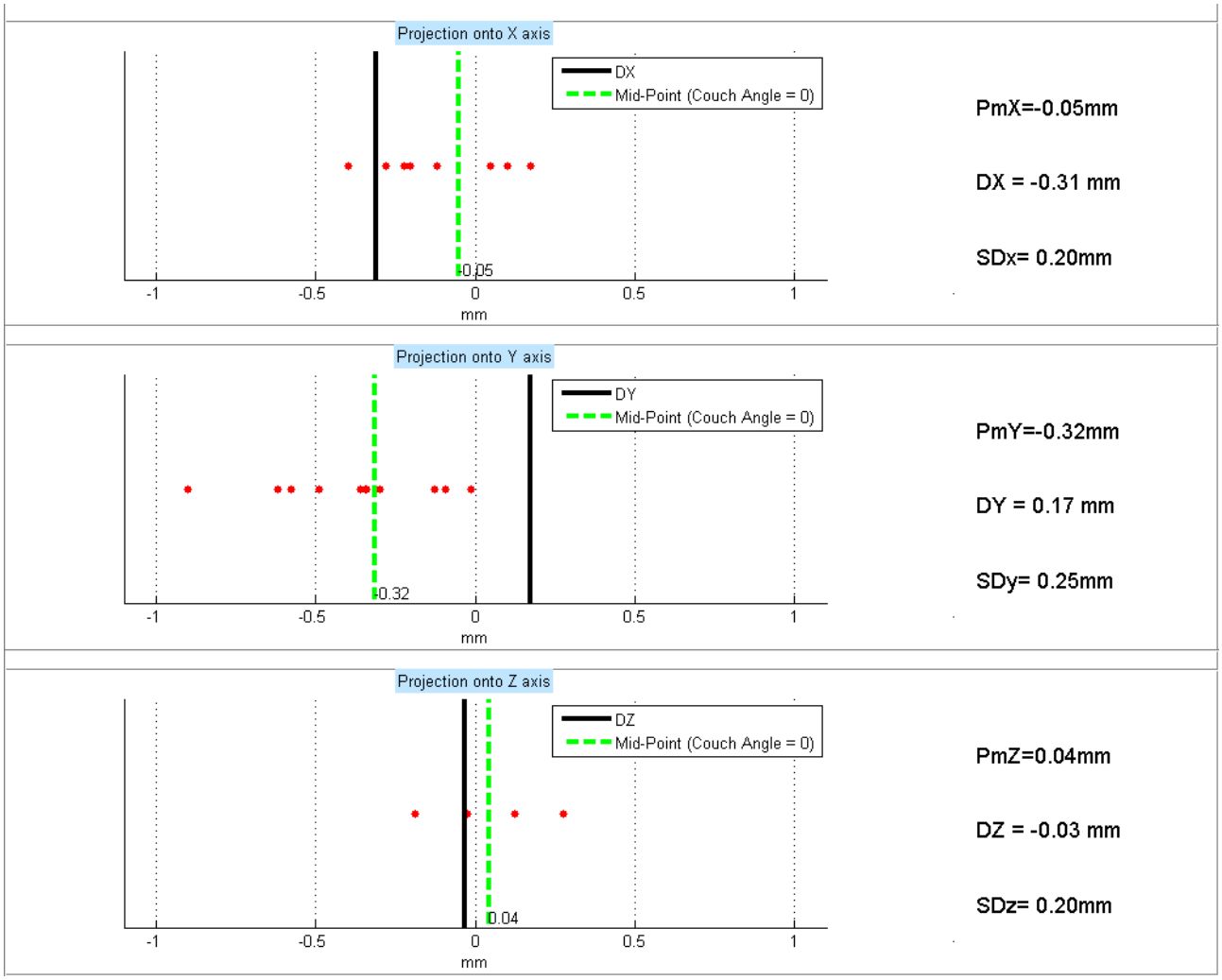
*** Optimization in this context is the optimal physical shift of the ball, couch, and/or gantry.***

Image List



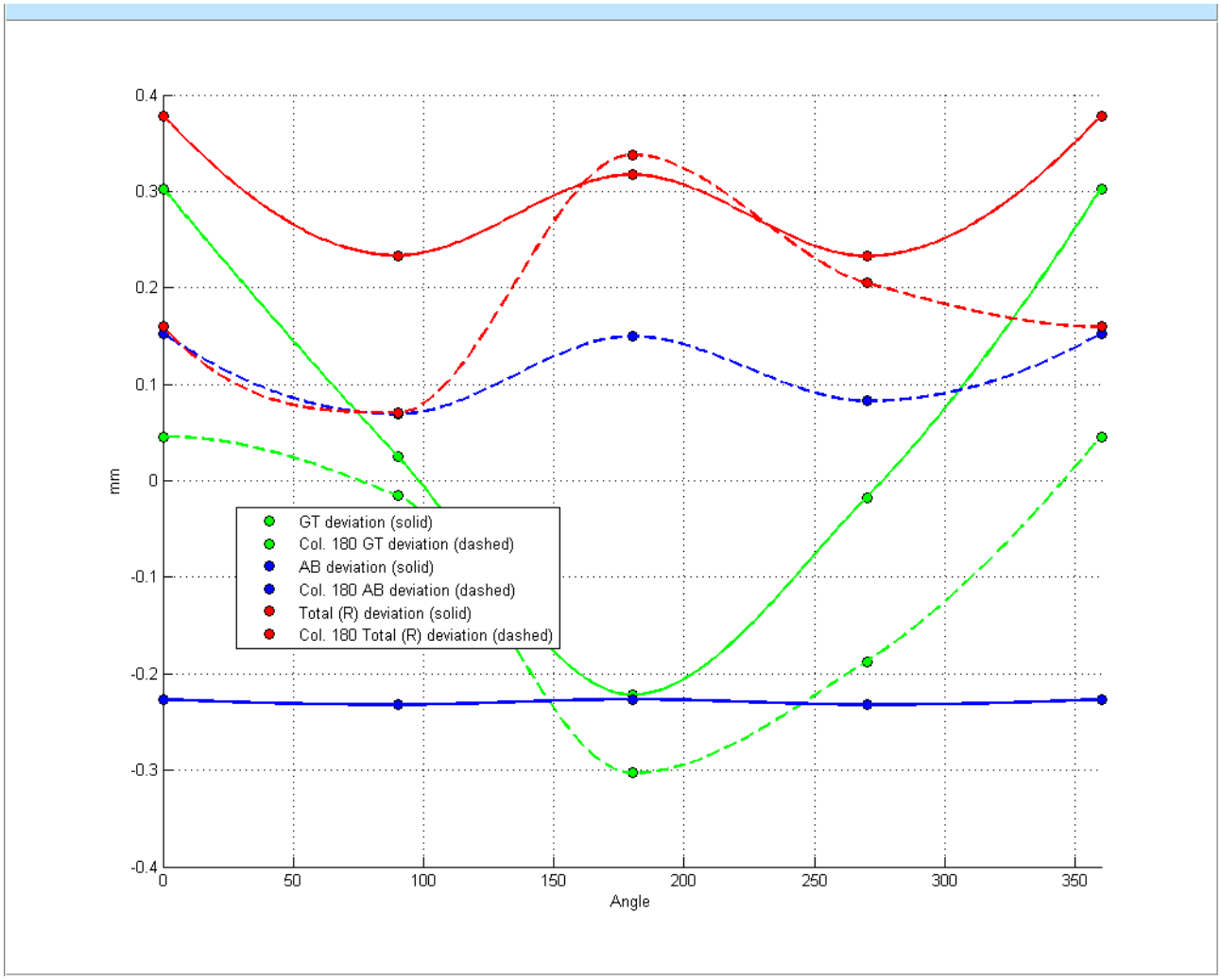
The software calculates and displays both the center point and boundaries of ball and radiation field along with the raw "Horizontal" and "Vertical" displacement for each image.

Axis Projection Detail



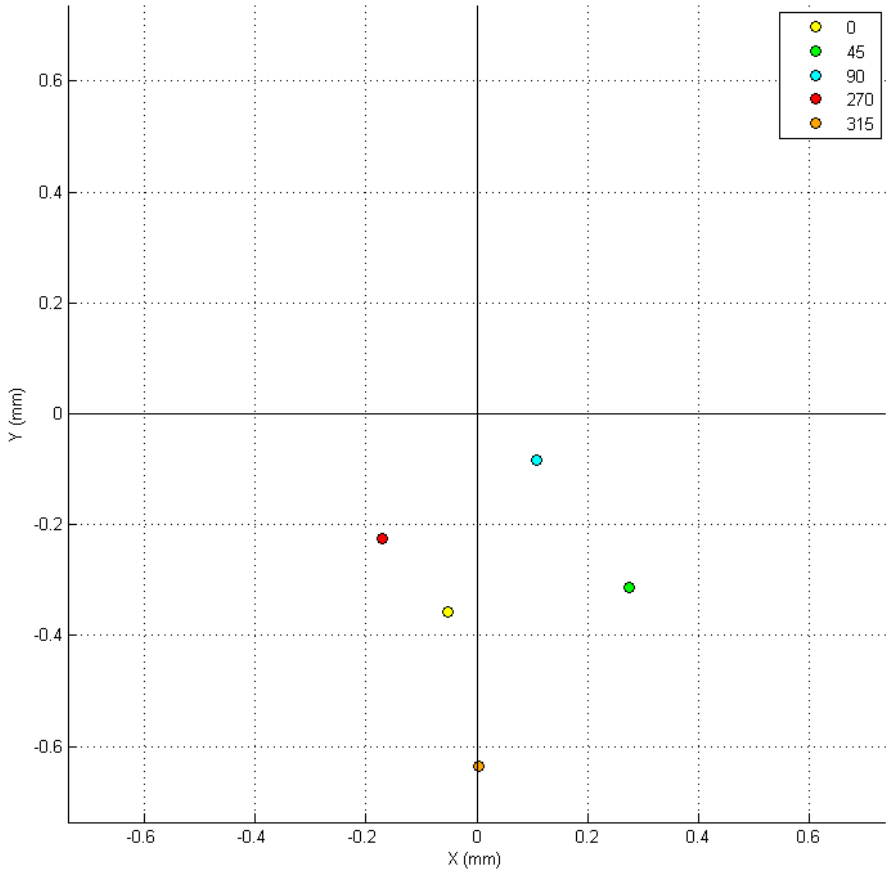
These plots show the ball-Field displacement projections onto the X, Y, and Z axes for all images.
- dX, dY, and dZ are shown as solid black lines.
- The mid-point between the extremes, when couch angle is 0, are shown as dotted green lines.
- PmX, PmY, and PmZ are the ball setup errors on their respective axes.

Beam Deviation Plot



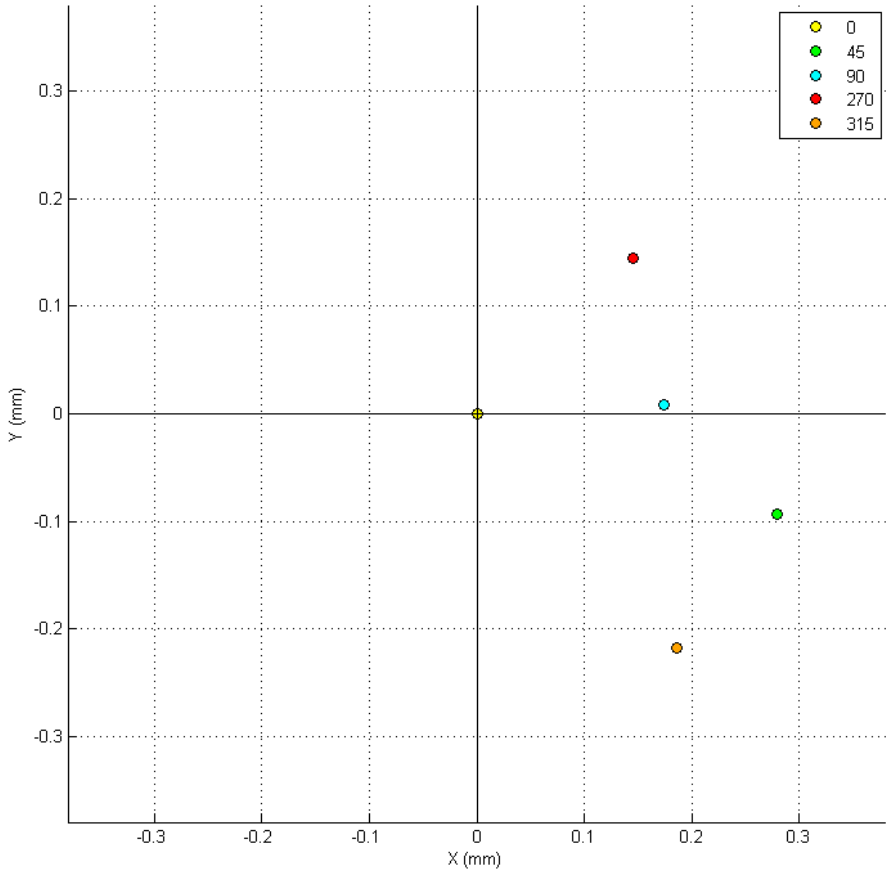
This plot shows the contributions from the gantry and collimator to the isocenter drift. The solid lines and dashed lines represent opposed collimator angles.

Couch Isocenter Fit (Gantry = 0) w.r.t. Gantry Isocenter



This plot shows couch (table) deviations pre-optimization without ball setup error and with respect to the gantry and collimator mid-point (Pm) for various couch angles.
*** Optimization in this context is the optimal physical shift of the gantry and/or couch.***

Optimized Couch Isocenter Fit (Hancock Method)



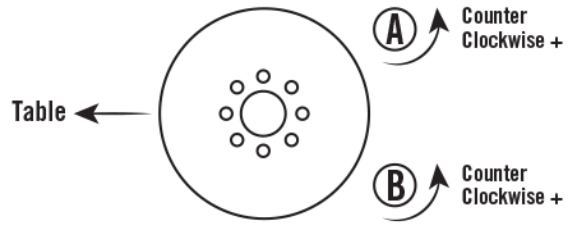
This plot shows couch (table) deviations post-optimization with respect to the gantry and collimator mid-point (Pm) for various couch angles.
*** Optimization in this context is the optimal physical shift of the ball, couch, and/or gantry.***

Couch Adjustments

Ball Setup Error Correction (X)	Shift ball 0.05 mm to the right if facing the gantry.
Ball Setup Error Correction (Y)	Shift ball 0.32 mm toward the gantry.
Ball Setup Error Correction (Z)	Shift ball 0.04 mm down.
GT Couch Axis Shift	Shift couch axis 0.19 mm toward the gantry.
AB Couch Axis Shift	Shift couch axis 0.19 mm to the right if facing the gantry.
GT Ball Correction Post-Couch Shift	Shift ball 0.17 mm toward the gantry.
AB Ball Correction Post-Couch Shift	Shift ball 0.14 mm to the left if facing the gantry.
Measured Maximum Total Deviation (W)	0.93 mm (measured, setup error included).
Pass-Fail	Pass
Measured Maximum Machine Deviation (R)	0.71 mm (setup error corrected).
Minimized Maximum Total Deviation (R)	0.52 mm (optimized).
Phi A (Flats)	0.01
Phi B (Flats)	-0.41
Phi A (Degrees)	0.57
Phi B (Degrees)	-24.52

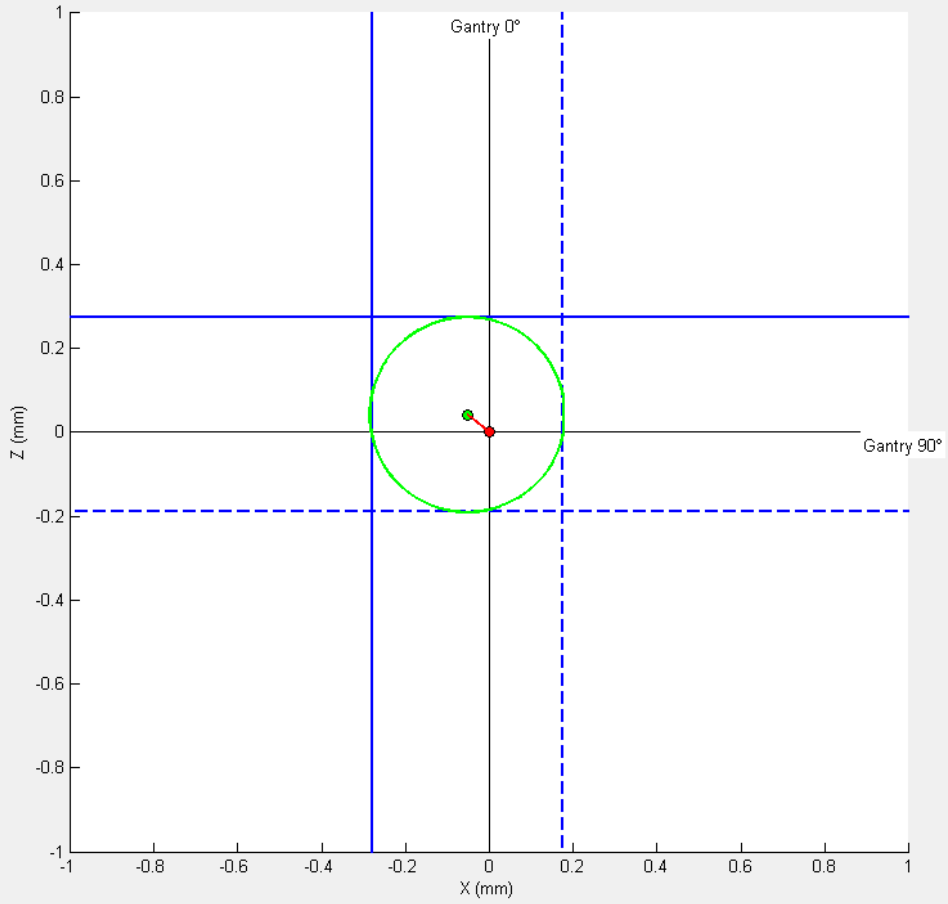
• Ball Setup Error Corrections show the amounts the ball must be shifted in the X, Y, and Z directions if couch adjustment is not applied.
• Couch axis shifts (GT and AB) show the amounts the couch (table) rotational axis center point must be shifted in the GT and AB directions.
• Ball corrections post-couch shift (GT and AB) show the amounts the ball must be shifted in the GT and AB directions if couch adjustment is applied.
• Measured Total Deviation shows the maximum deviation with only ball adjustment and without couch adjustment
• Minimized Total Deviation shows the maximum deviation, for any combination of gantry, collimator, and table rotation angles, after the couch adjustments and ball adjustments are applied.
• Phi A and Phi B show the amounts to turn the two screws in flats and in degrees.

Couch Alignment Diagram



This figure shows the direction to which the two screws in front of the main table rotational baseplate must be rotated in order to obtain the couch axis shift indicated in the Couch Adjustments table above.

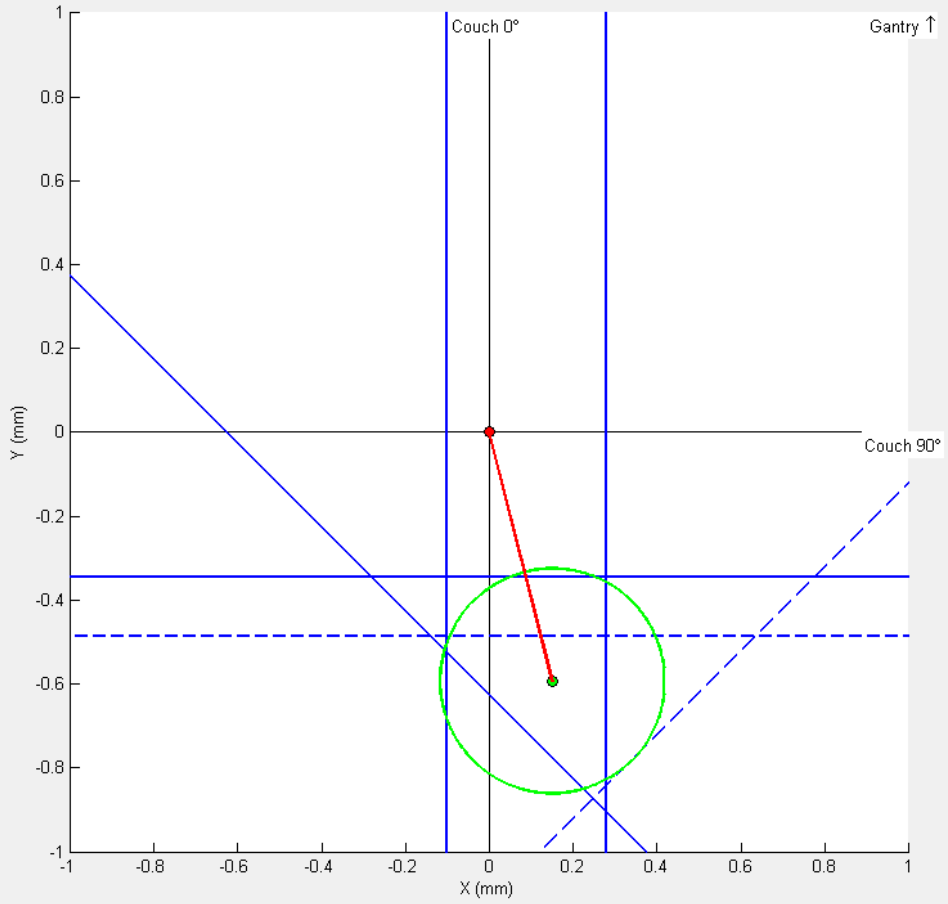
Virtual Gantry Starshot



Virtual Gantry Starshot Statistics

Starshot Radius (mm)	0.23
Horizontal Deviation (mm)	-0.05
Vertical Deviation (mm)	0.04
Starshot Center to BB Center (mm)	0.07
Collimator Angle (degrees)	270

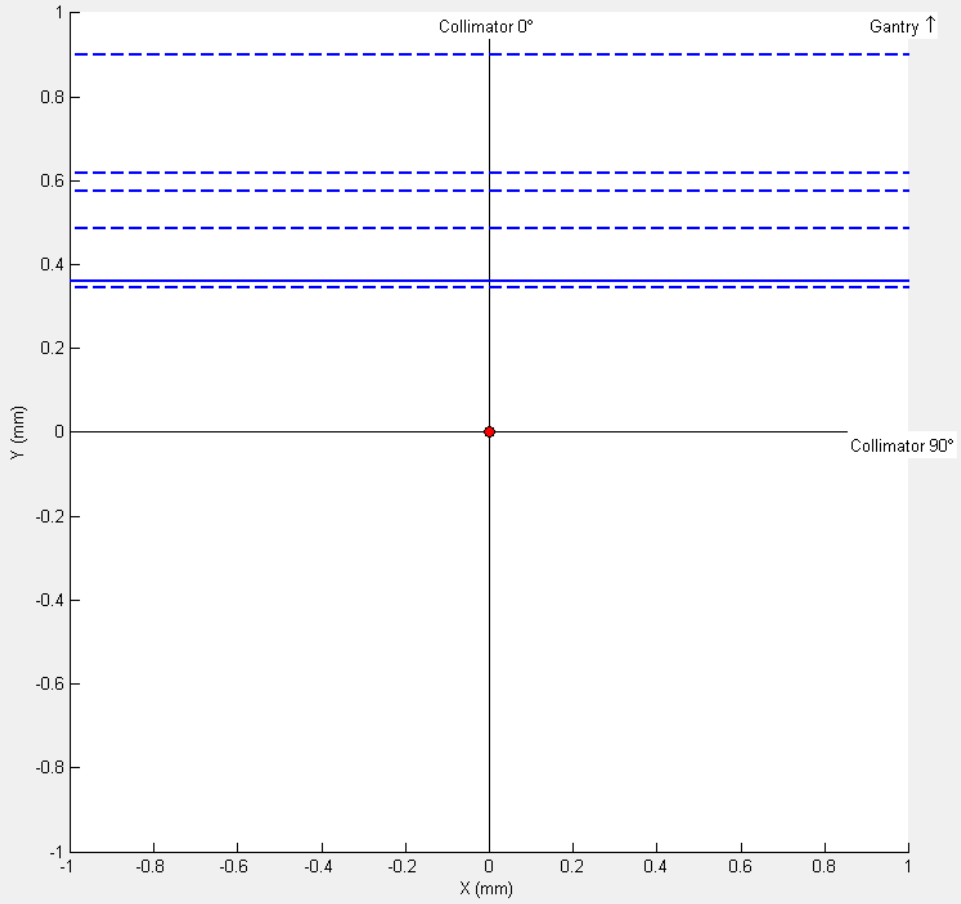
Virtual Couch Starshot



Virtual Couch Starshot Statistics

Starshot Radius (mm)	0.27
Horizontal Deviation (mm)	0.15
Vertical Deviation (mm)	-0.59
Starshot Center to BB Center (mm)	0.61

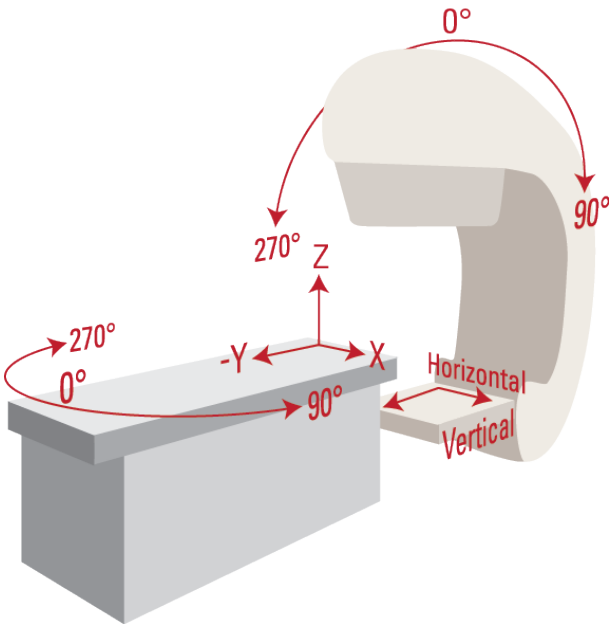
Virtual Collimator Starshot



Virtual Collimator Starshot Statistics

Starshot Radius (mm)	NaN
Horizontal Deviation (mm)	NaN
Vertical Deviation (mm)	NaN
Starshot Center to BB Center (mm)	NaN
Gantry Angle (degrees)	0

Coordinate System



Analysis Settings

Ball Size (cm)	1.5
Source to Imager Distance (cm)	170
Pixel Area Factor (Advanced)	1.2
Ball Segmentation Step Size (Advanced)	0.02
Ball Dilation Factor (Advanced)	20