# QIBA CT Small Lung Nodule Profile

# CTLX1 Validation Study

July 12, 2021 to October ?, 2021

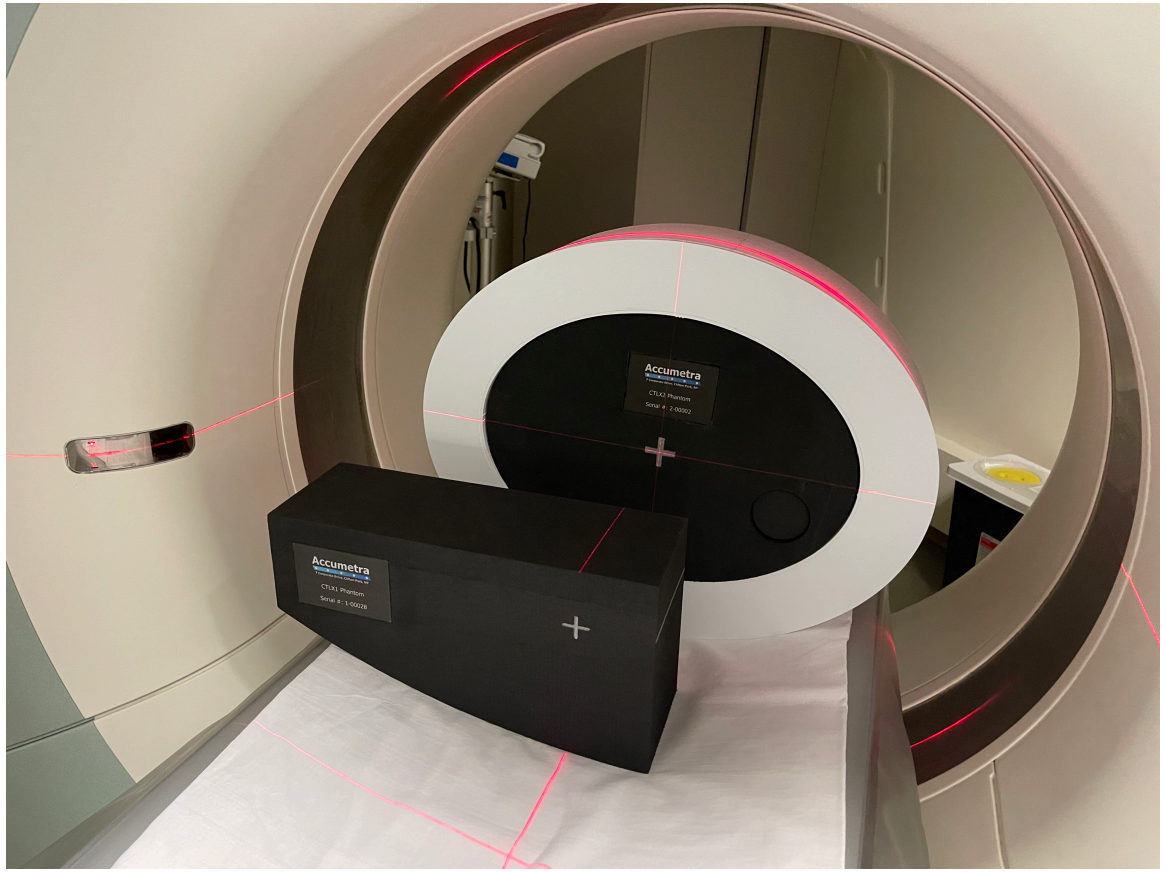
# Goal: Verify that the CTLX1 phantom analysis values are correct

QIBA SLN CT Image Quality Metrics

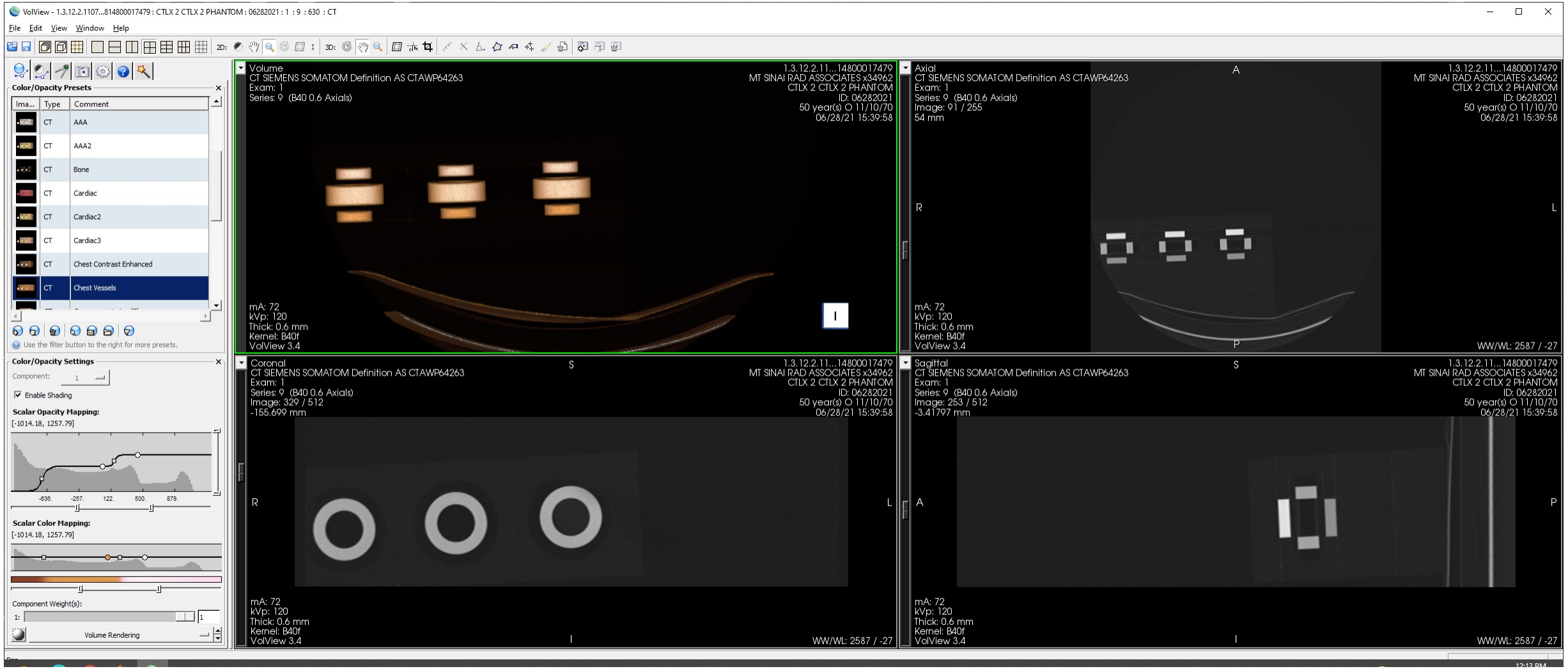
1. Edge Enhancement
2. 3D Resolution
3. Resolution Aspect
4. HU Bias (Air & Acrylic)
5. Image Noise (Air & Acrylic)
6. Spatial Warping

Distance From Iso-Center

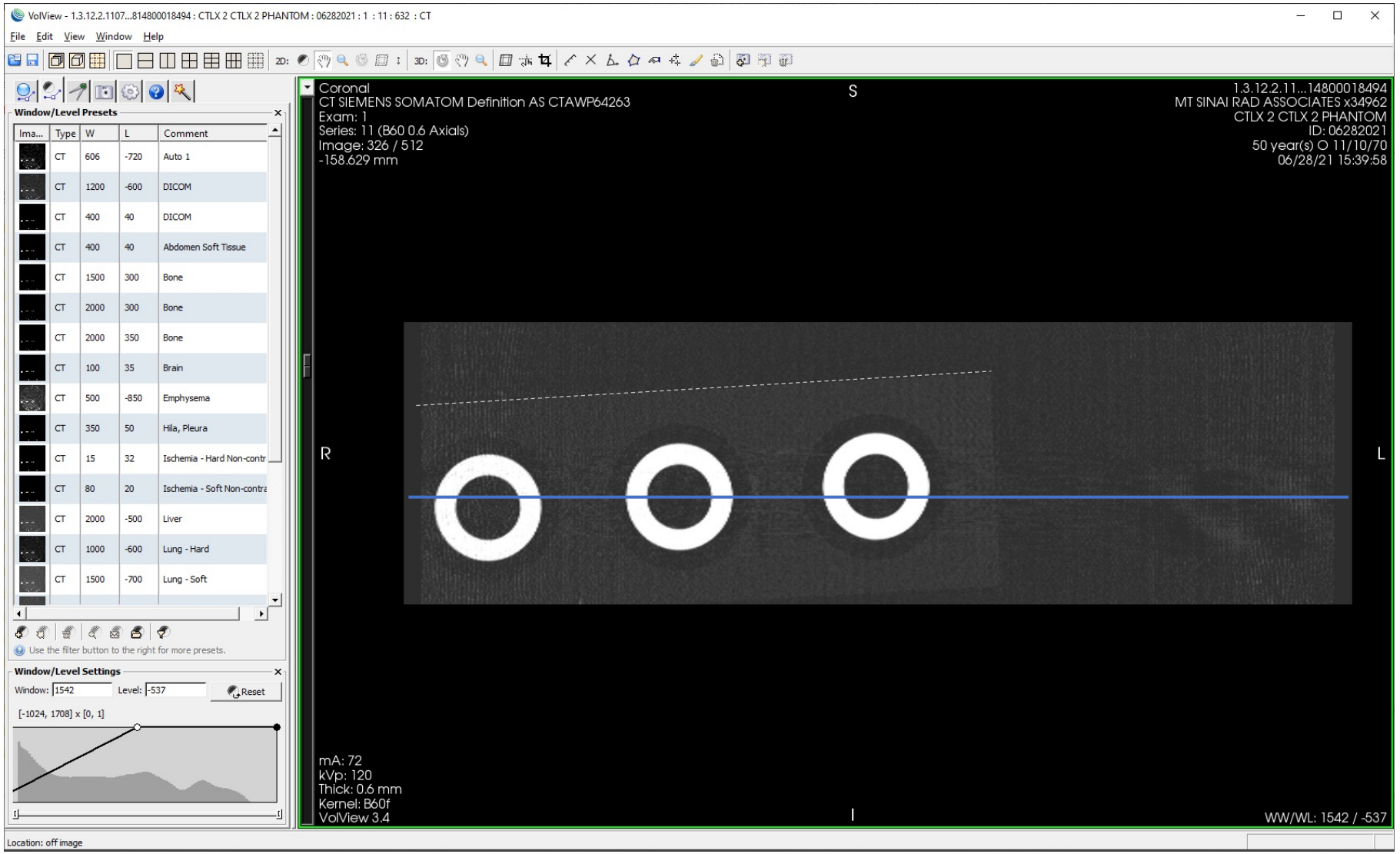
1. 0 mm
2. 100 mm
3. 200 mm (no other phantom can do this)



# CTLX1 Phantom



# CTLX1 Phantom




**Slice Selection Is A Source Of Variability For Manual Measurement**

**Non-alignment & Large FOV Is Supported by CTLX1 Analysis**

# Goal: Verify that the CTLX1 phantom analysis values are correct

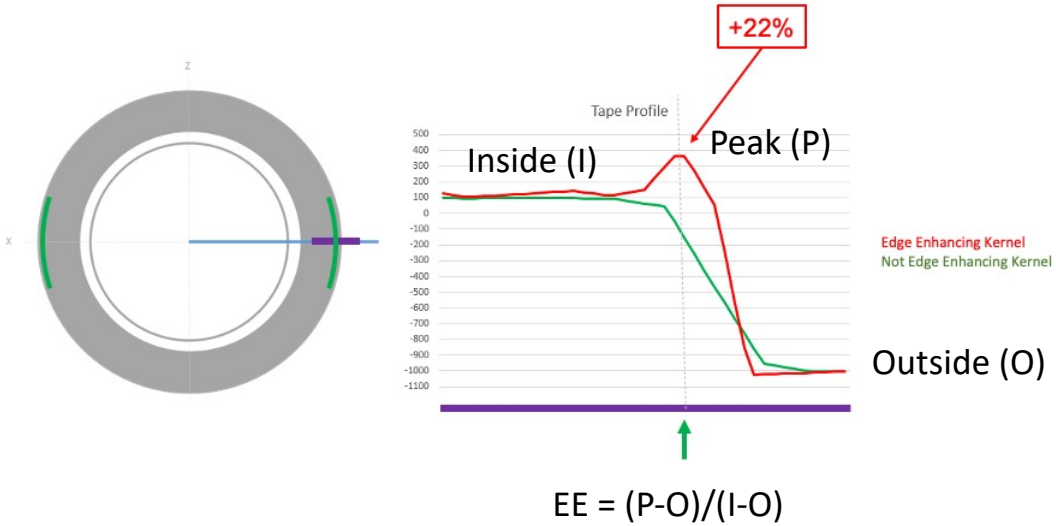
- Validation Study
  - The CTLX1 was CT scanned on a Siemens SOMATOM Definition AS varying:
    - Slice Thickness : 0.6 mm and 1.0 mm.
    - Reconstruction Kernel : B30f, B40f, and B60f (highly edge enhancing).
  - A CTLX1 scan from a 16 slice model known to exhibit spatial warping was obtained.
  - Accumetra's automated software was run on the main 6 scans and results distributed. Automated analysis of the scan known to exhibit spatial warping was done later due to an oversight. Accumetra in plane PSF sigma was converted to an MTF 50 for comparison.
  - OHSU and Mount Sinai received the 7 scans and manually measured the QIBA SLN metrics used by the QIBA SLN Profile, the most challenging being in-plane spatial resolution.

# Measurement Methods

For each of three modules in the CTLX1:

1. <u>Edge Enhancement:</u>
   - Pick a slice and manually measure.

2. <u>3D Resolution (in-plane):</u>
   - Pick a slice and manually measure MTF 50.




- Use a “standard” edge method to measure in-plane MTF 50.
  - Suggested use of AAPM TG 233 report – although not enough detail for perfect reproducibility.

- Verify expected behavior is present:
  - B30f in-plane resolution is lower than B40f for all datasets and modules.
  - Slice thickness does not significantly change resolution values.
  - Lower resolution is observed as a function of distance from iso-center.

# Measurement Methods

For each of three modules in the CTLX1:

2. Z Resolution (slice thickness)
   - Report the requested slice thickness (passed).

3. Resolution Aspect
   - Measurement not needed since aspect ratio is based on resolution measures.

4. HU Bias
   - Measure the mean HU value within the air and acrylic cylinder.

5. Image Noise (HU SD)
   - Measure the HU SD noise level within the air and acrylic cylinder.

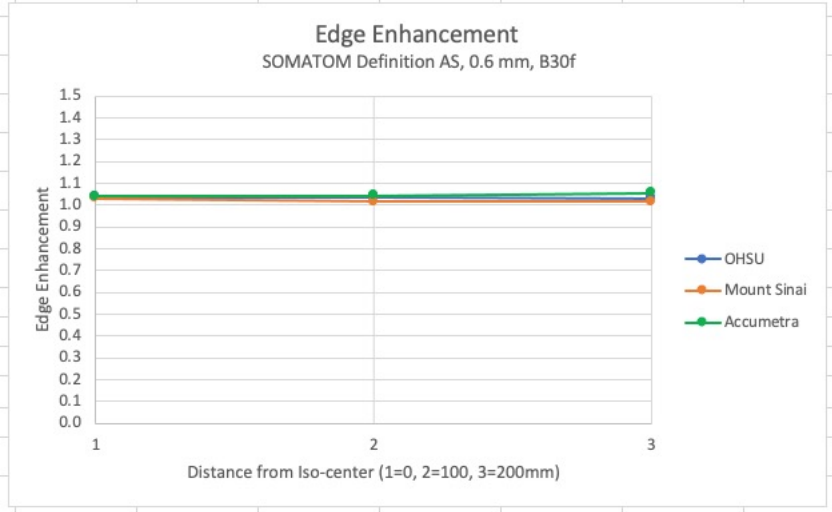
6. Spatial Warping
   - Visually grade whether spatial warping is present on a coronal view of the CTLX1 Delrin cylinder.

# CTLX1 Scans

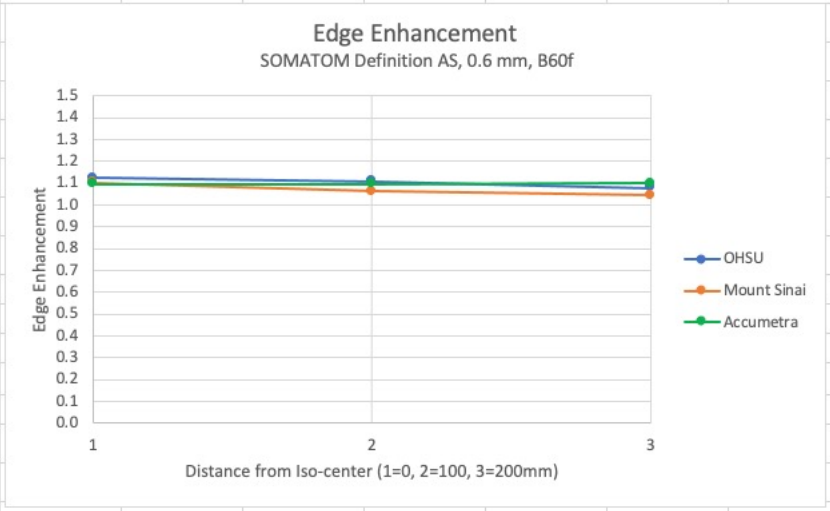
| Scan | Model | Kernel | Slice Thickness | Pass/Fail & Reason |
|---|---|---|---|---|
| 1 | SOMATOM Def AS | B30f | 0.6 mm | PASS |
| 2 | SOMATOM Def AS | B30f | 1.0 mm | PASS |
| 3 | SOMATOM Def AS | B40f | 0.6 mm | PASS |
| 4 | SOMATOM Def AS | B40f | 1.0 mm | PASS |
| 5 | SOMATOM Def AS | B60f | 0.6 mm | FAIL – EE |
| 6 | SOMATOM Def AS | B60f | 1.0 mm | FAIL - EE |
| 7 | LightSpeed16 | LUNG | 1.25 mm | FAIL – SW, EE |

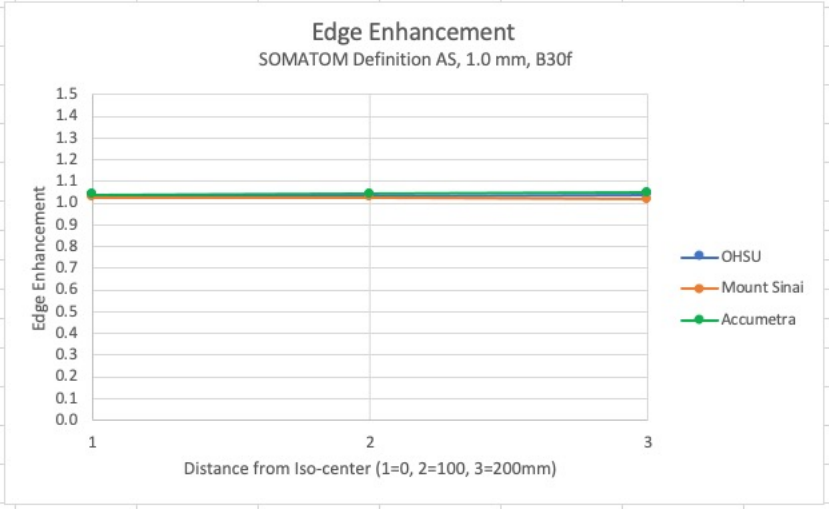
# Multi-center Study Results

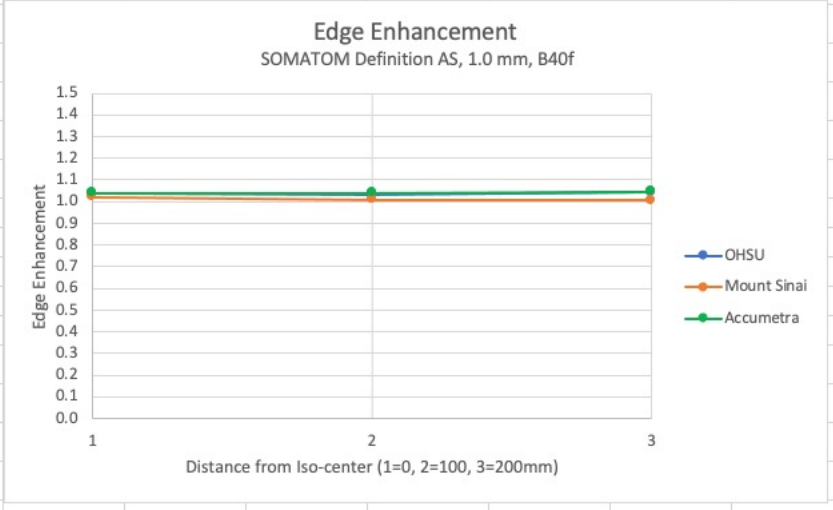
# OHSU, Mount Sinai, and Accumetra : Edge Enhancement

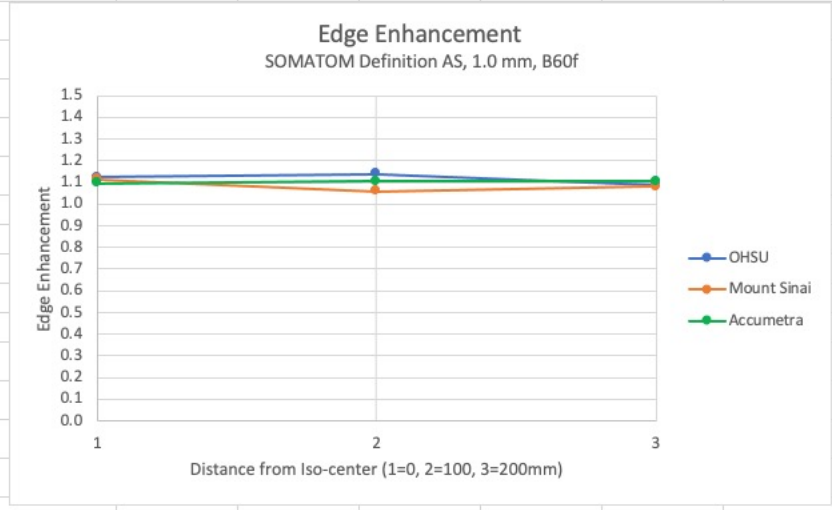






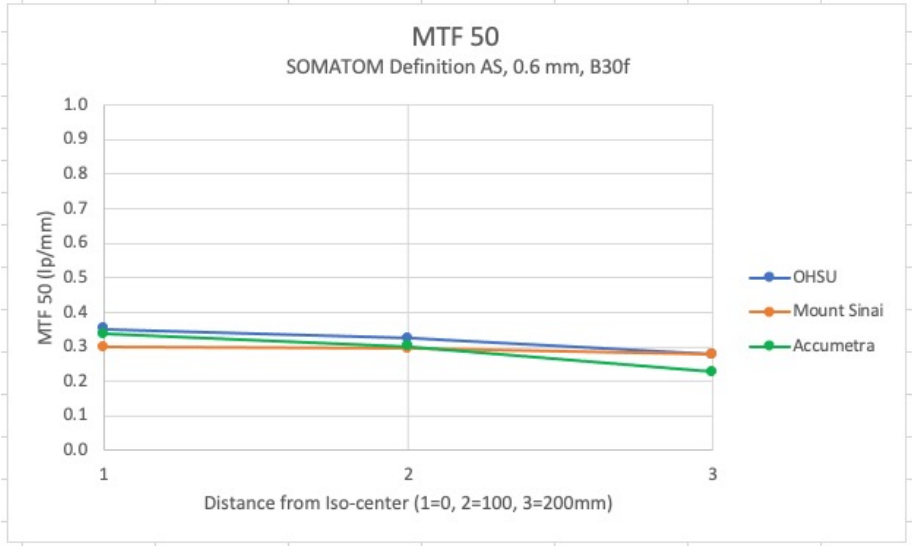



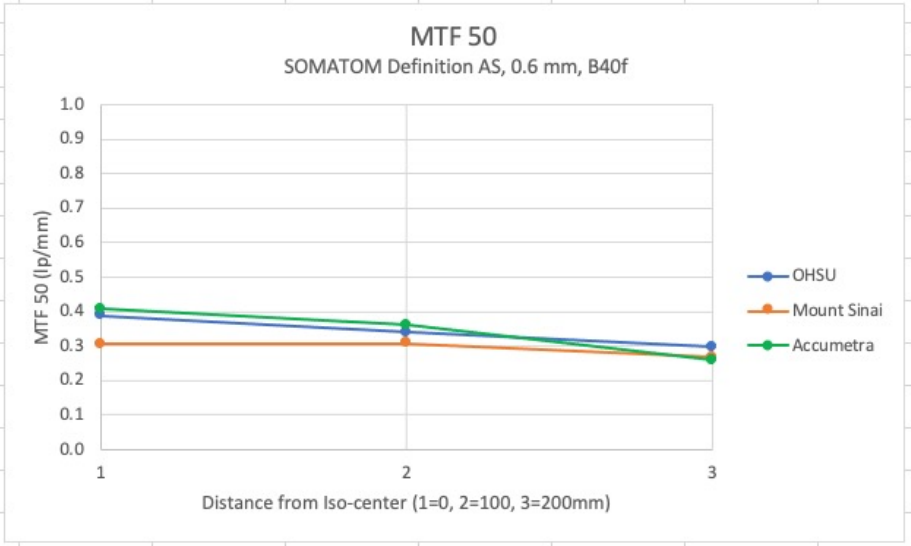



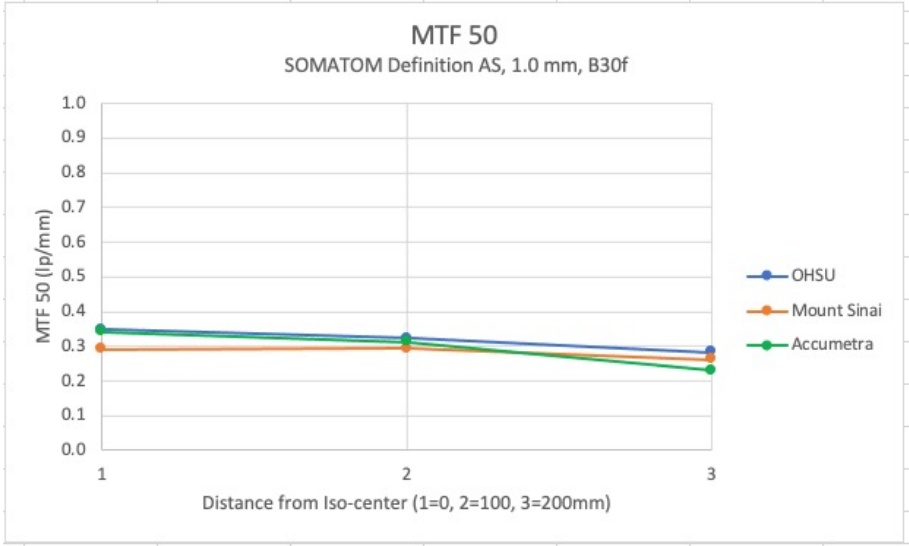



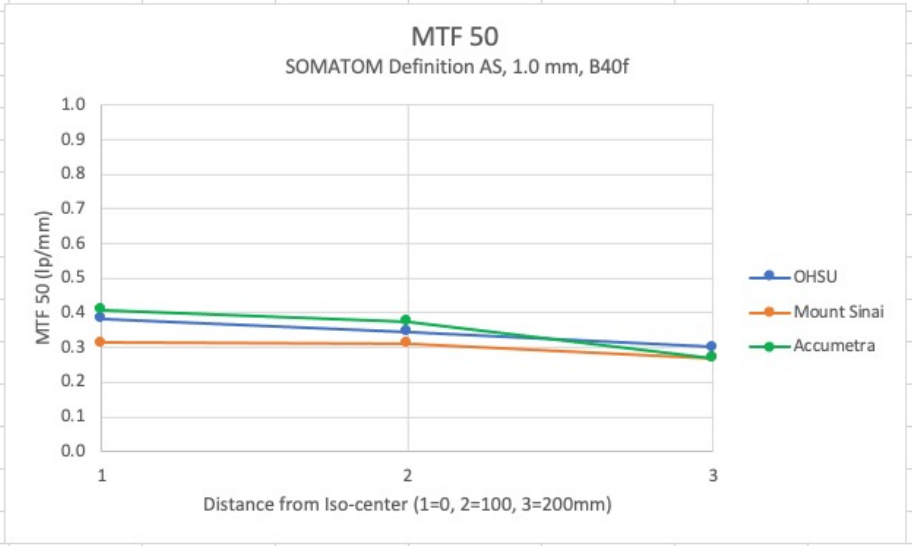
# Edge Enhancement

# OHSU, Mount Sinai, and Accumetra : MTF 50

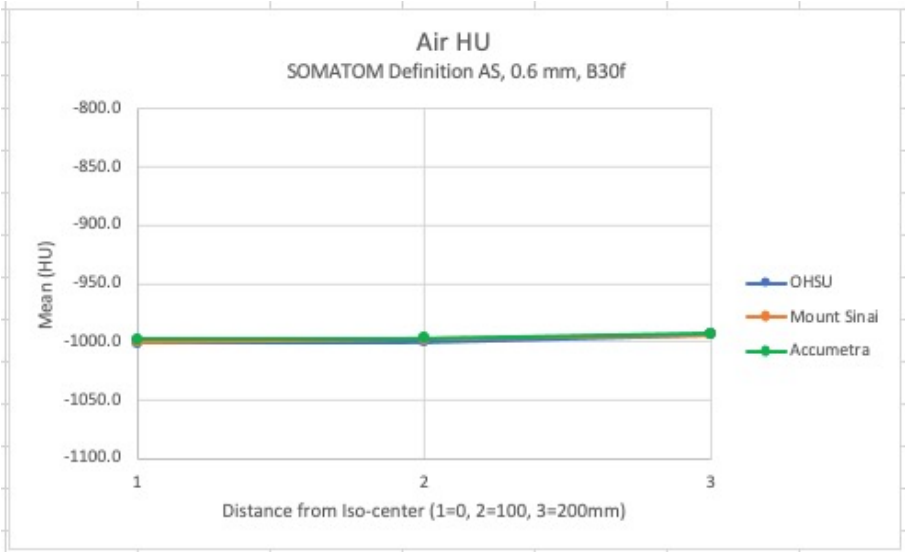


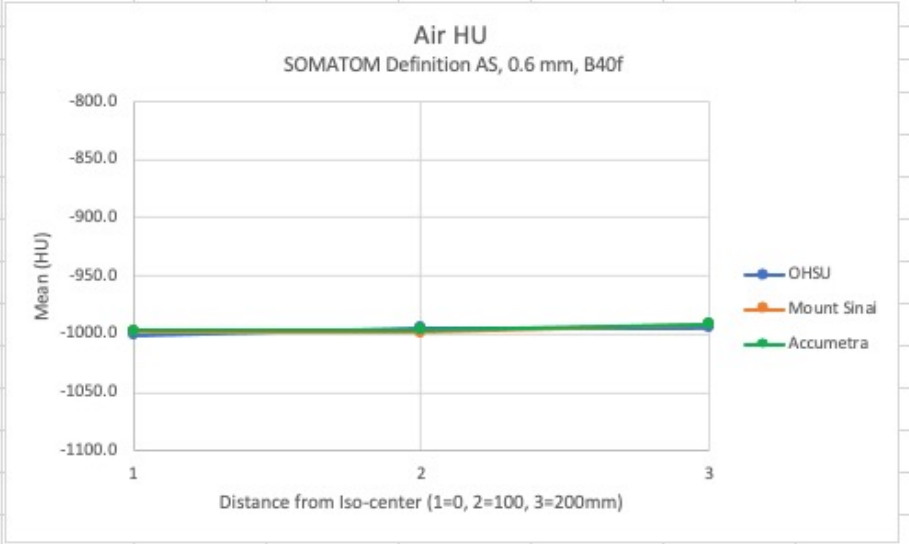



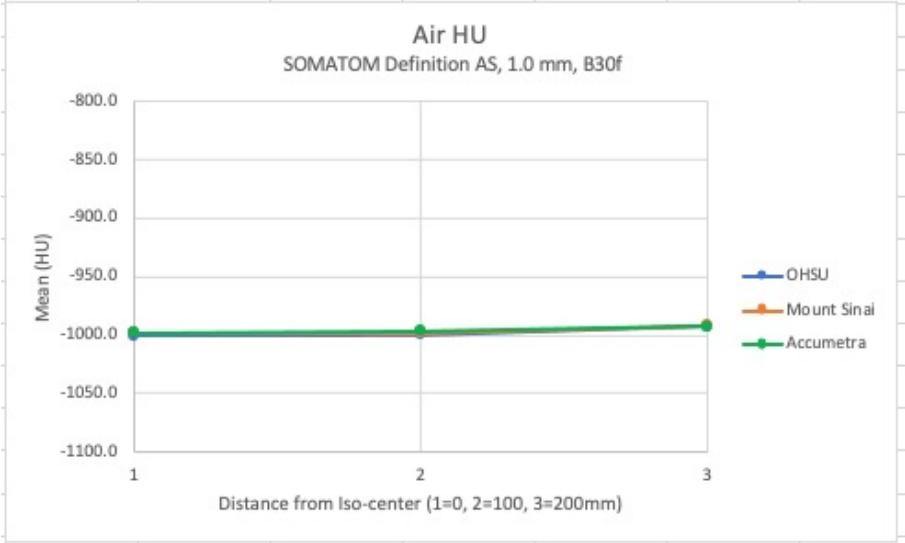



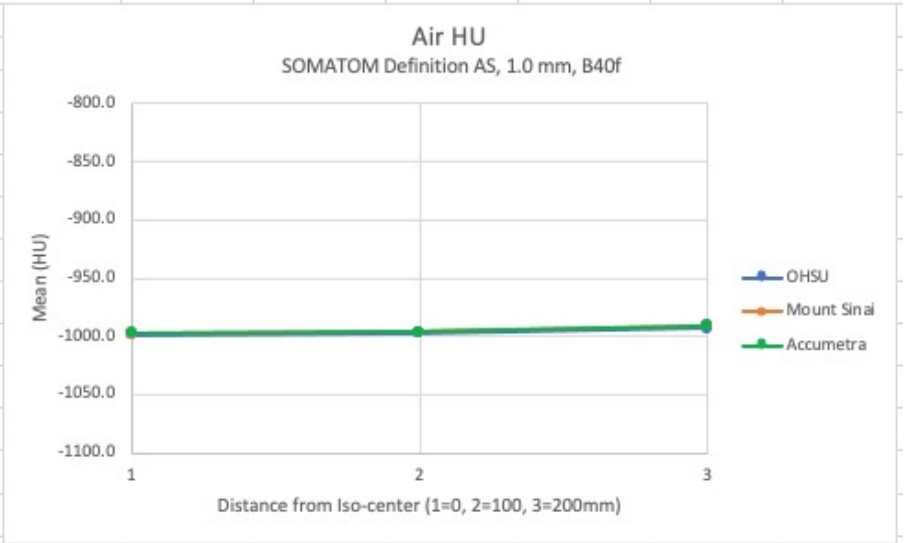



# OHSU, Mount Sinai, and Accumetra : Air HU

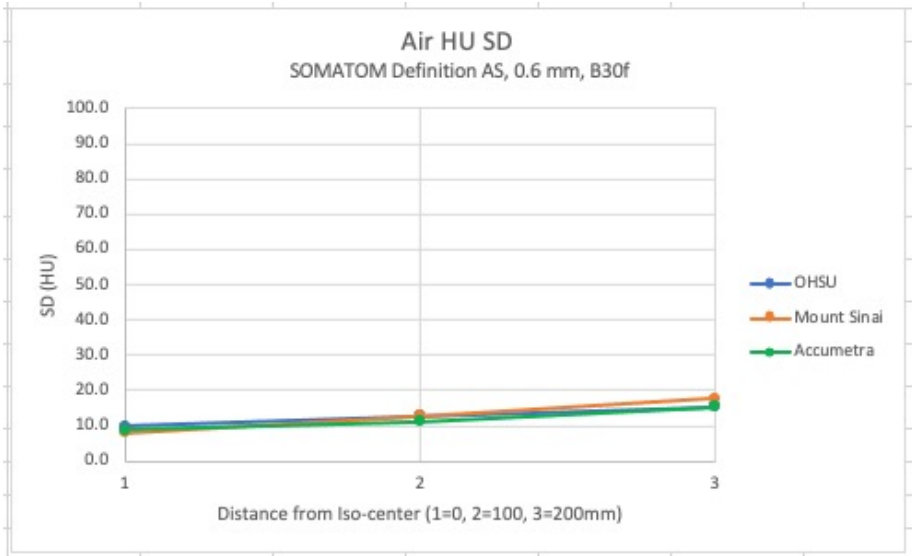


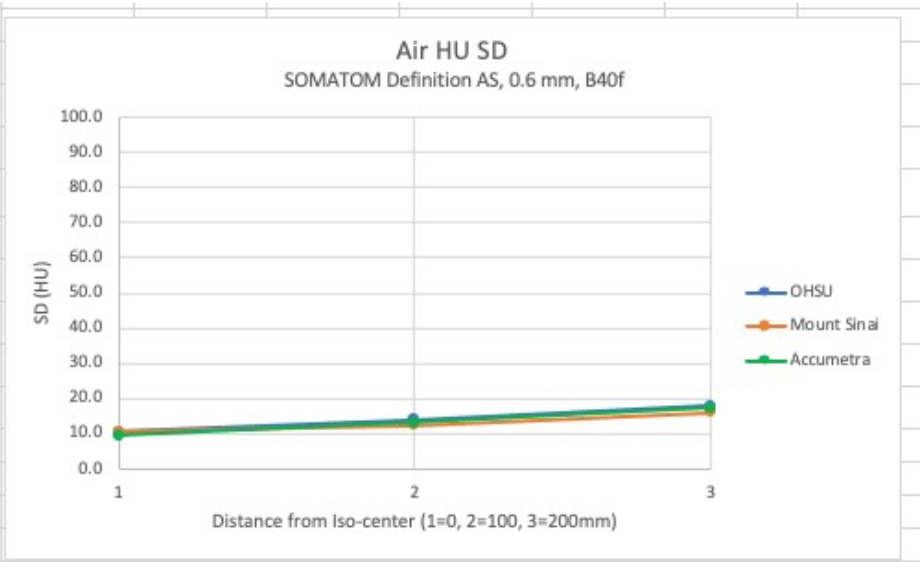



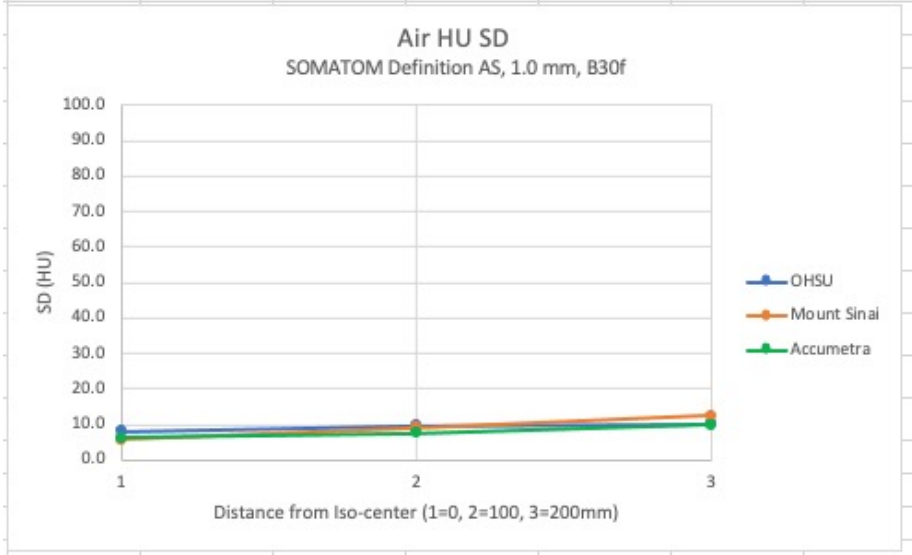



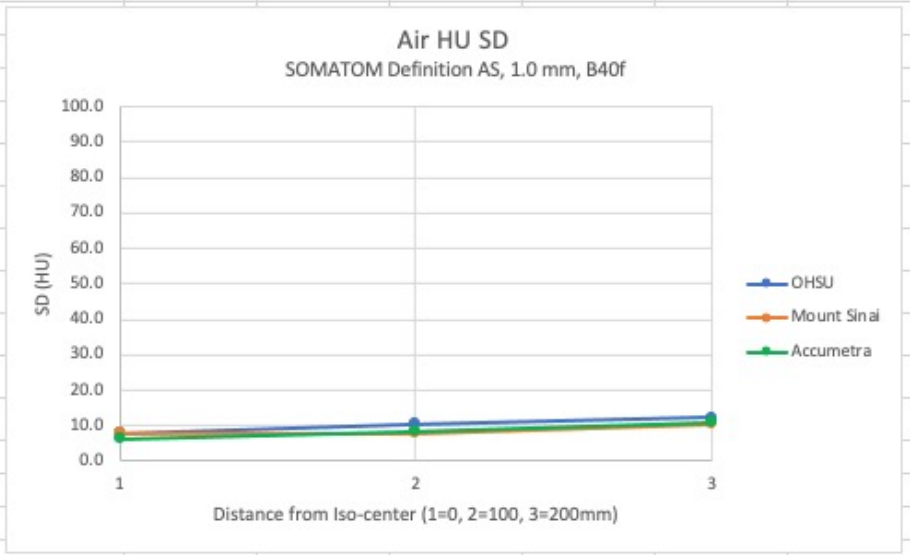



# OHSU, Mount Sinai, and Accumetra : Air HU SD

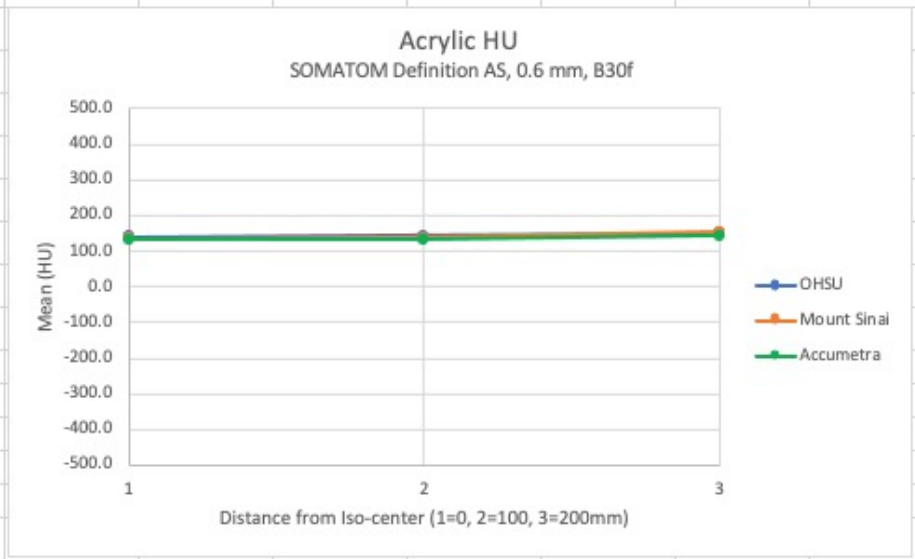


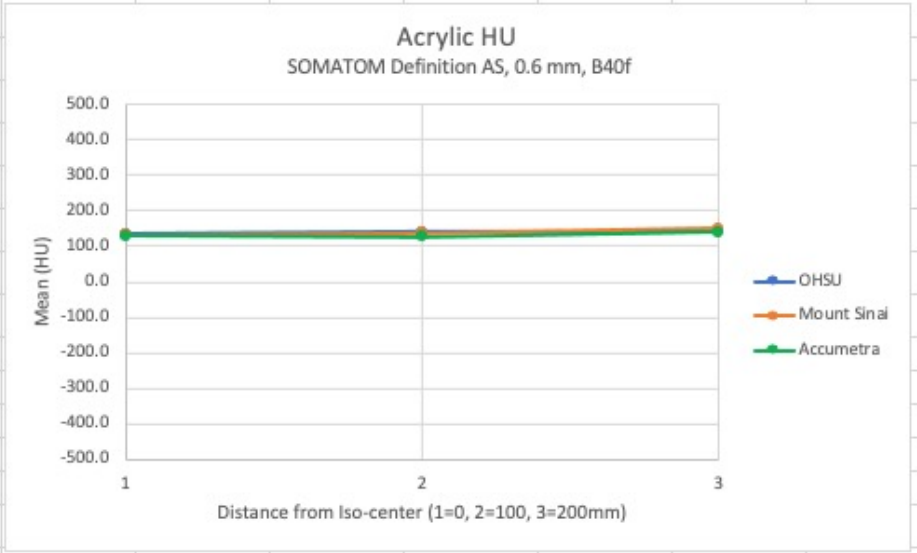



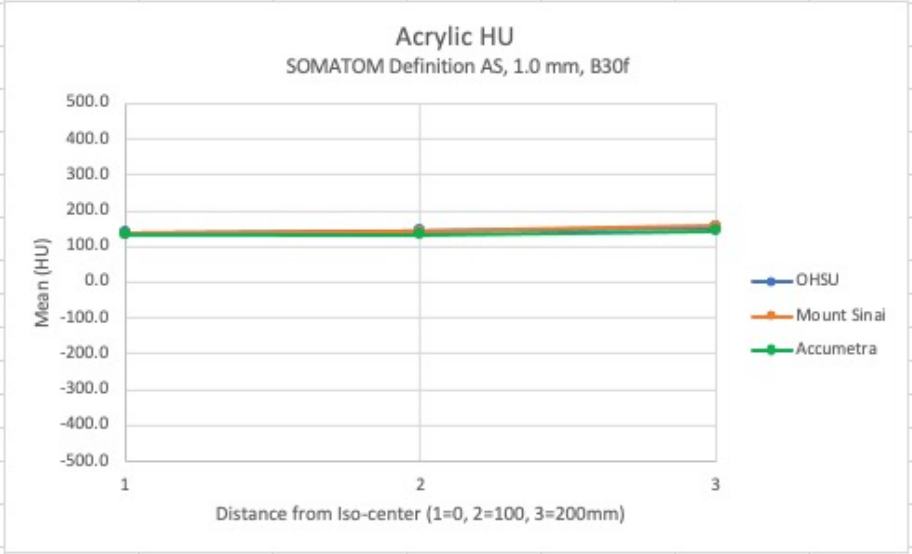



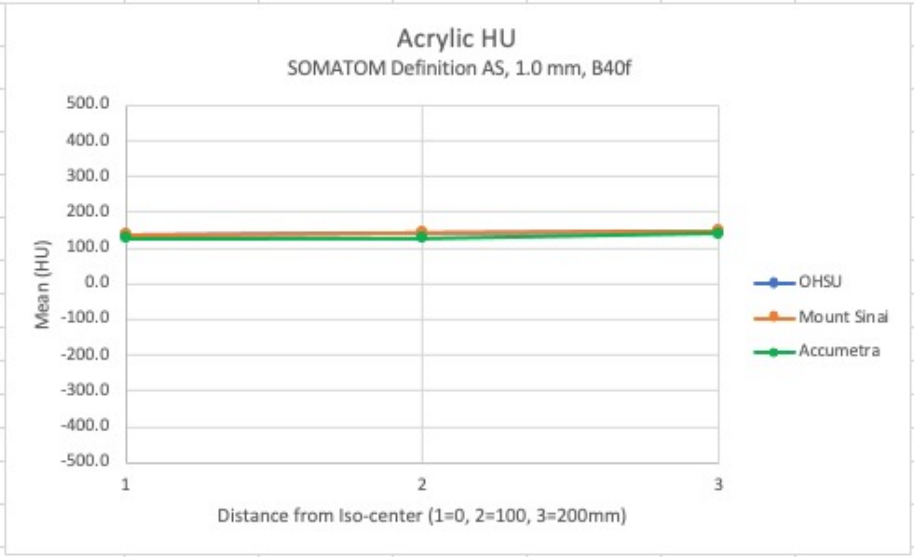



# OHSU, Mount Sinai, and Accumetra : Acrylic HU

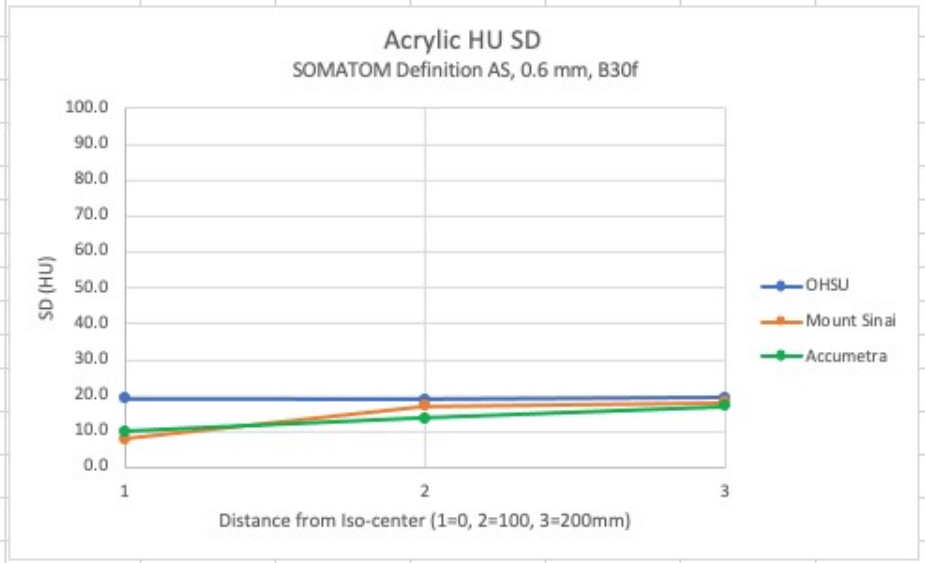


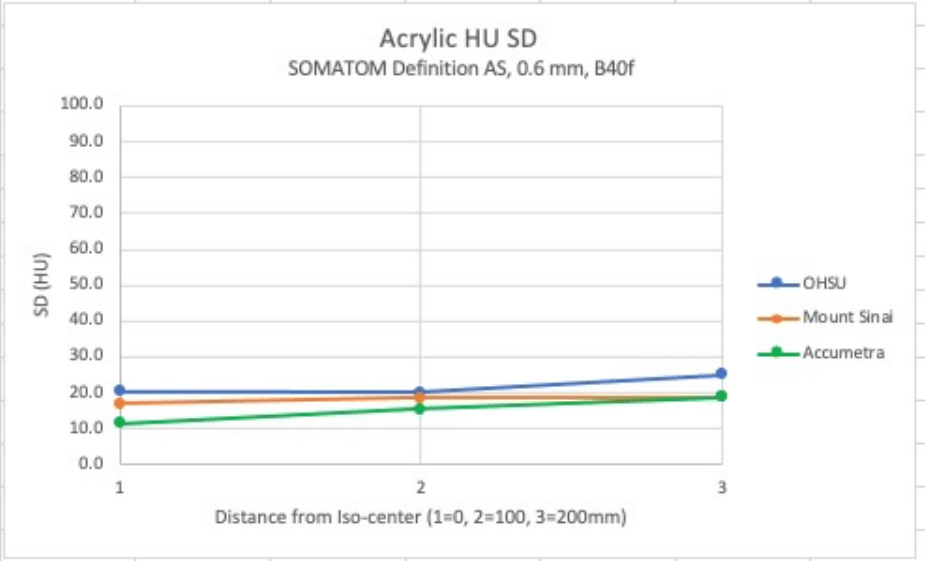



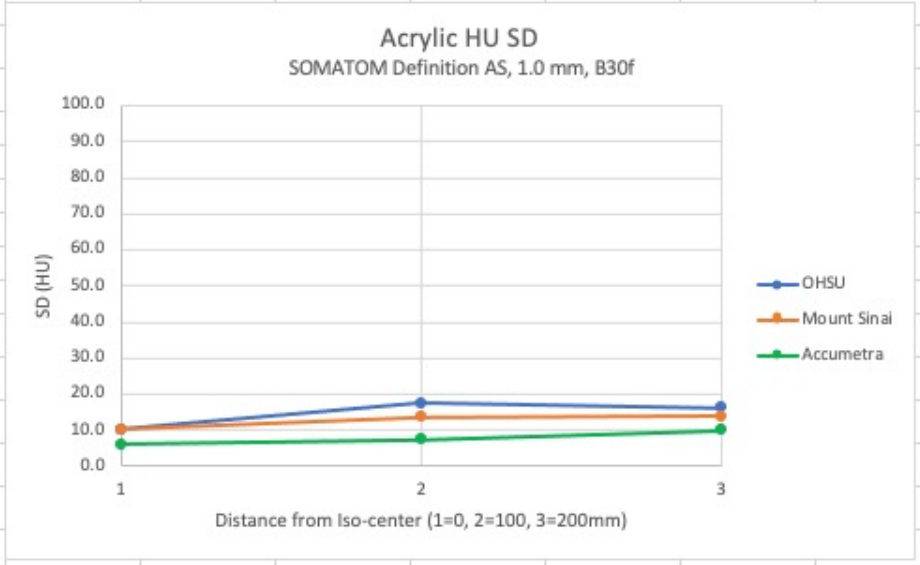



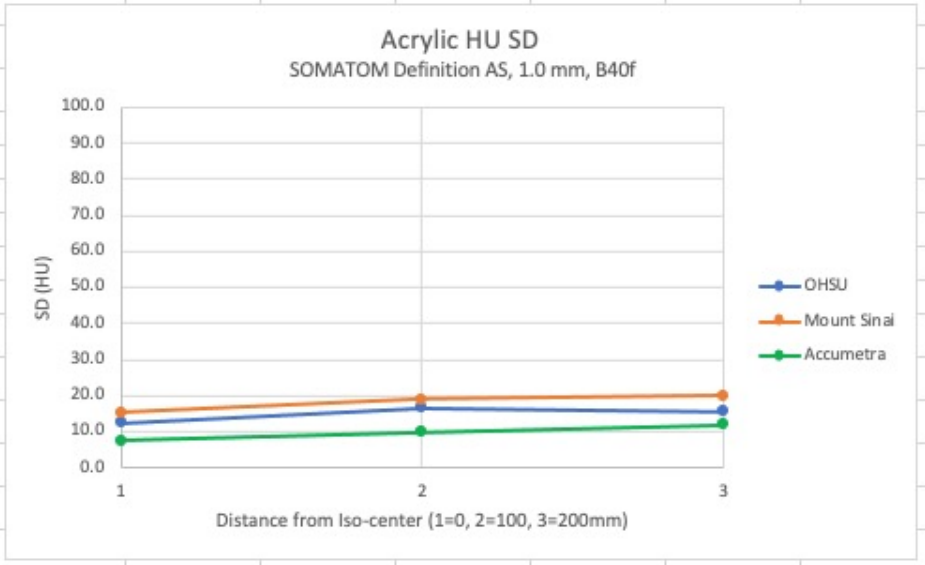



# OHSU, Mount Sinai, and Accumetra : Acrylic HU SD



# OHSU Results : Spatial Warping

| Z Spatial Warping | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | OHSU | | | Accumetra | | |
| | | Spatial Warping Y/N | | | Spatial Warping Y/N | | |
| | CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| | 1 CTLX1-B30-0.6 | N | N | N | 0.046 | 0.04 | 0.05 |
| | 2 CTLX1-B30-1.0 | N | N | N | 0.07 | 0.055 | 0.059 |
| | 3 CTLX1-B40-0.6 | N | N | N | 0.045 | 0.04 | 0.041 |
| | 4 CTLX1-B40-1.0 | N | N | N | 0.078 | 0.056 | 0.061 |
| | 5 CTLX1-B60-0.6 | N | N | N | 0.081 | 0.073 | 0.07 |
| | 6 CTLX1-B60-1.0 | N | N | N | 0.106 | 0.099 | 0.083 |
| | 7 ExtraScan | N | N | Y | 0.12 | 0.284 | 0.432 |

Any value > 0.3 is considered positive for Z spatial warping

100% agreement on spatial warping (but no visual cutoff guidance was provided)

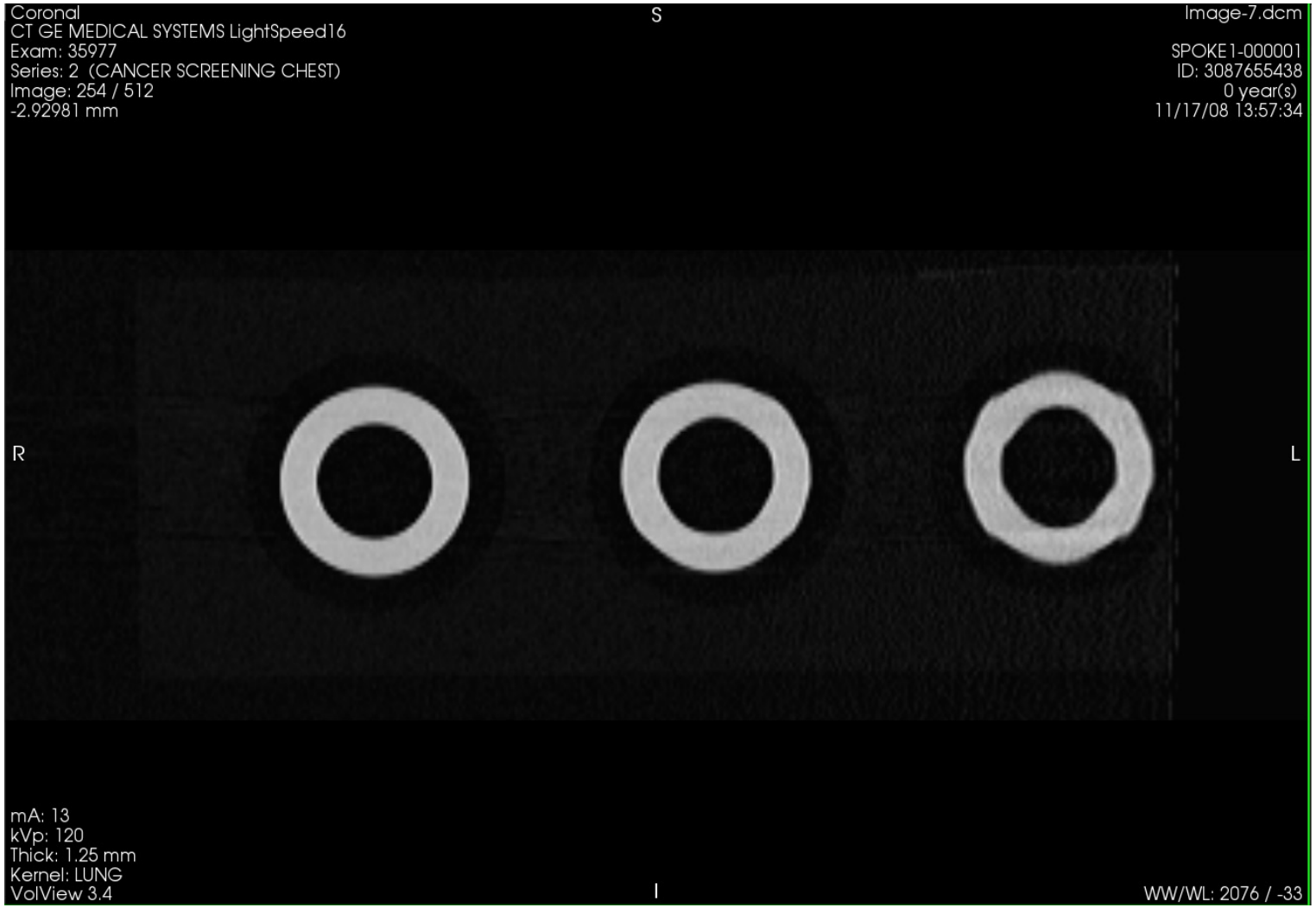
# Mount Sinai Results : Spatial Warping

| Z Spatial Warping | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mount Sinai Air HU SD | | | Accumetra Spatial Warping Y/N | | |
| | CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| | 1 CTLX1-B30-0.6 | No | No | No | 0.046 | 0.04 | 0.05 |
| | 2 CTLX1-B30-1.0 | No | No | No | 0.07 | 0.055 | 0.059 |
| | 3 CTLX1-B40-0.6 | No | No | No | 0.045 | 0.04 | 0.041 |
| | 4 CTLX1-B40-1.0 | No | No | No | 0.078 | 0.056 | 0.061 |
| | 5 CTLX1-B60-0.6 | No | No | No | 0.081 | 0.073 | 0.07 |
| | 6 CTLX1-B60-1.0 | No | No | No | 0.106 | 0.099 | 0.083 |
| | 7 ExtraScan | Yes | Yes | Yes | 0.12 | 0.284 | 0.432 |

Any value > 0.3 is considered positive for Z spatial warping

90.5% agreement on spatial warping (but no visual cutoff guidance was provided)

# Spatial Warping



# Many, Many Thanks

- Mount Sinai
  - Raj Subramaniam
  - Shirong Zhang
  - Jo-Ann Provencher
- OHSU
  - Tom Griglock
  - Celeste Leary
  - Grace Eliason

# Thank You

# Mount Sinai Results

# Mount Sinai Results : Edge Enhancement

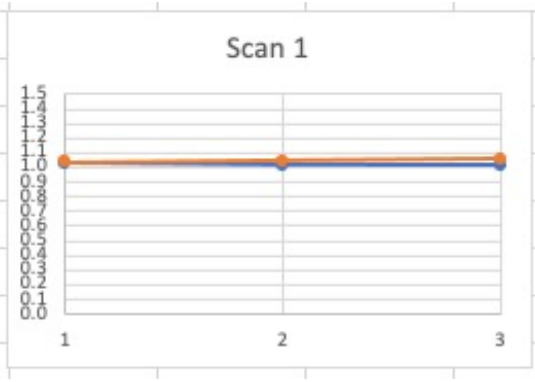
- 0.041

| Edge Enhancement | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mount Sinai Edge Enhancement | | | Accumetra Edge Enhancement | | |
| | CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| | 1 CTLX1-B30-0.6 | 1.030828959 | 1.016215453 | 1.014038764 | 1.039 | 1.044 | 1.055 |
| | 2 CTLX1-B30-1.0 | 1.028272744 | 1.02682247 | 1.017312554 | 1.038 | 1.043 | 1.05 |
| | 3 CTLX1-B40-0.6 | 1.023124604 | 1.018682454 | 1.018179733 | 1.042 | 1.039 | 1.04 |
| | 4 CTLX1-B40-1.0 | 1.021920053 | 1.007508767 | 1.005475721 | 1.04 | 1.041 | 1.046 |
| | 5 CTLX1-B60-0.6 | 1.104083428 | 1.064212223 | 1.044380626 | 1.097 | 1.098 | 1.1 |
| | 6 CTLX1-B60-1.0 | 1.112645846 | 1.059752188 | 1.078907765 | 1.094 | 1.104 | 1.105 |
| | 7 ExtraScan | | | | 1.192 | 1.205 | 1.185 |

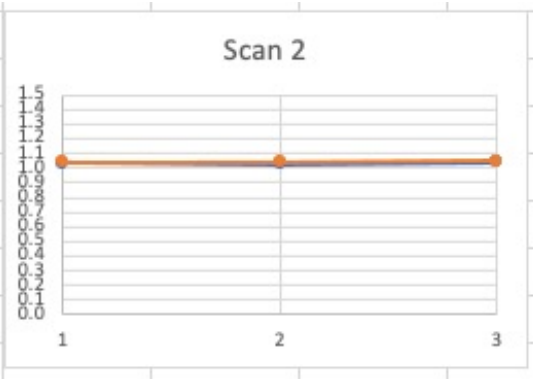
83% (5/6) agreement on Failure Due To Edge Enhancement (EE <= 1.05)

# Mount Sinai Results : Edge Enhancement

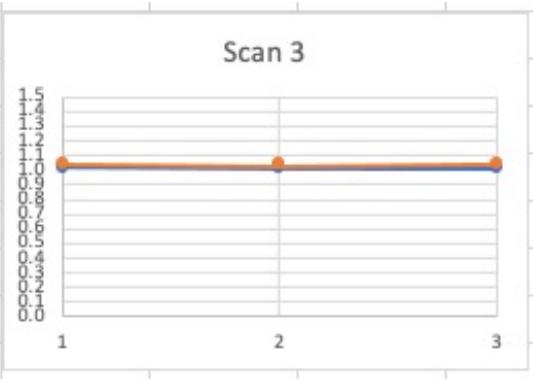
B30f 0.6mm



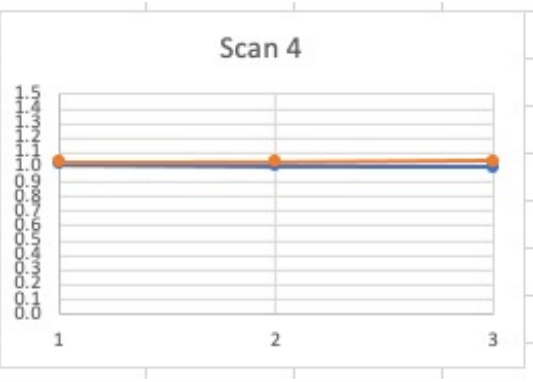

B30f 1.0mm



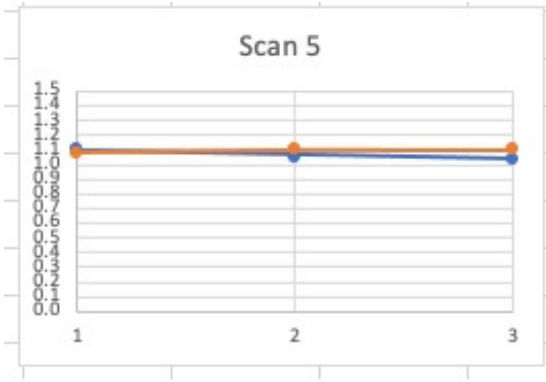

B40f 0.6mm



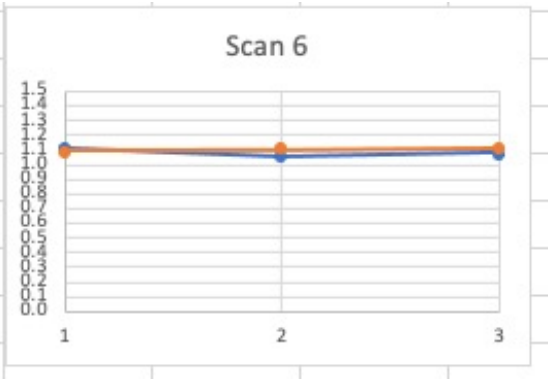

B40f 1.0mm




B60f 0.6mm




B60f 1.0mm




LUNG 1.25mm Warped

Mount Sinai
Accumetra

# Mount Sinai Results : Edge Enhancement

# Mount Sinai Results : In Plane Resolution

| In-Plane Resolution | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mount Sinai | | | Accumetra | | |
| | | MTF50 (lp/mm) | | | PSF to MTF50 (lp/mm) | | |
| | CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| | 1 CTLX1-B30-0.6 | 0.2980 | 0.2944 | 0.2770 | 0.336183611 | 0.301375362 | 0.225969709 |
| | 2 CTLX1-B30-1.0 | 0.2920 | 0.2928 | 0.2610 | 0.342452641 | 0.313238986 | 0.229662717 |
| | 3 CTLX1-B40-0.6 | 0.3055 | 0.3091 | 0.2688 | 0.406668244 | 0.361627107 | 0.259289129 |
| | 4 CTLX1-B40-1.0 | 0.3141 | 0.3114 | 0.2709 | 0.408383676 | 0.374706917 | 0.270135144 |
| | 5 CTLX1-B60-0.6 | 0.3606 | 0.3866 | 0.3889 | 0.817618307 | 0.817618307 | 0.817618307 |
| | 6 CTLX1-B60-1.0 | 0.3699 | 0.4057 | 0.3870 | 0.817618307 | 0.817618307 | 0.817618307 |
| | 7 ExtraScan | | | | 0.817618307 | 0.817618307 | 0.610932006 |

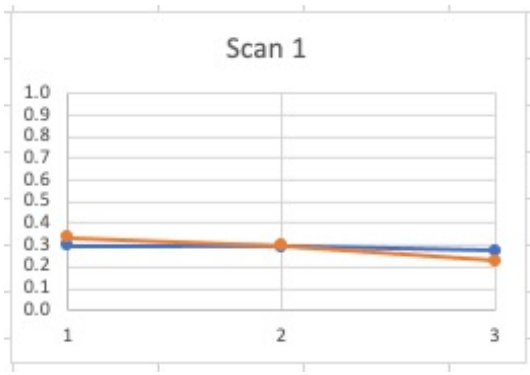
- ✓ Good levels of agreement on in-plane resolution
- ✓ B30f resolution is lower than B40f.
- ✓ Slice thickness does not significantly change resolution values.
- ✓ Lower resolution is observed as a function of distance from iso-center.

-0.10

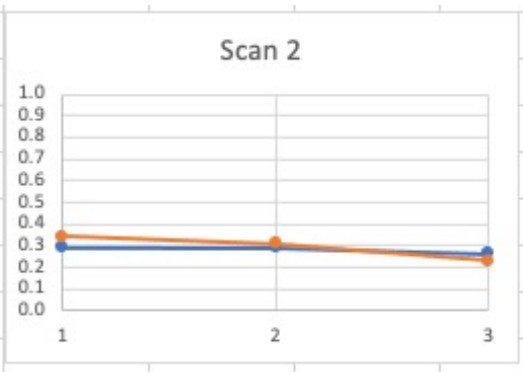
# Mount Sinai Results : In-Plane Resolution

IEC Longitudinal
Drift < 0.75 mm

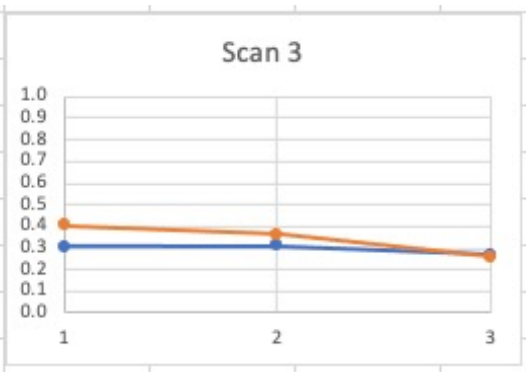
**B30f 0.6mm**



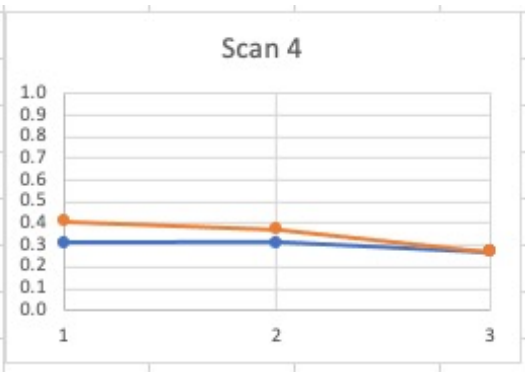

**B30f 1.0mm**




**B40f 0.6mm**

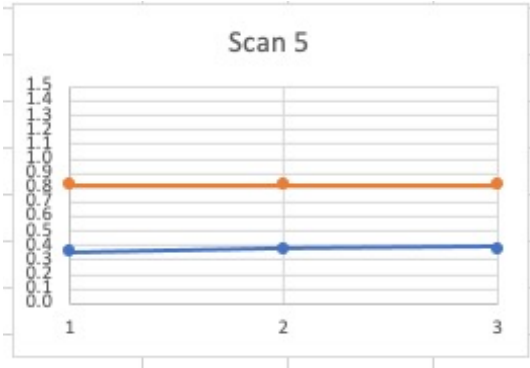



**B40f 1.0mm**

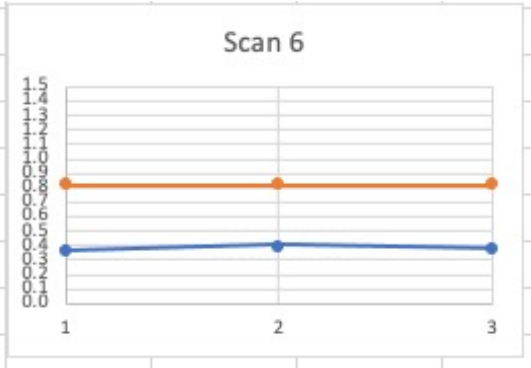



These Scans All Failed EE

**B60f 0.6mm**




**B60f 1.0mm**




**LUNG 1.25mm Warped**

Mount Sinai
Accumetra

We expect differences due to high edge enhancement (x/y resolution not valid when EE is high) and warping.

# Mount Sinai Results : Air & Acrylic HU Bias

**Air HU**

| | Mount Sinai Air Mean HU | | | Accumetra Air Mean HU | | |
|---|---|---|---|---|---|---|
| **CT Scan** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** |
| 1 CTLX1-B30-0.6 | -999.5 | -997.1 | -993.2 | -997.460 | -996.610 | -992.810 |
| 2 CTLX1-B30-1.0 | -997.8 | -997.8 | -992.2 | -997.77 | -996.580 | -992.820 |
| 3 CTLX1-B40-0.6 | -997.8 | -998.2 | -991.1 | -996.6 | -996.29 | -990.870 |
| 4 CTLX1-B40-1.0 | -997.6 | -996.2 | -991.0 | -996.71 | -995.92 | -990.78 |
| 5 CTLX1-B60-0.6 | -989.9 | -986.1 | -978.0 | -990.48 | -986.51 | -975.17 |
| 6 CTLX1-B60-1.0 | -988.9 | -986.6 | -975.3 | -990.82 | -986.28 | -974.59 |
| 7 ExtraScan | -998.4 | -994.9 | -980.6 | -998.79 | -993.54 | -987.36 |

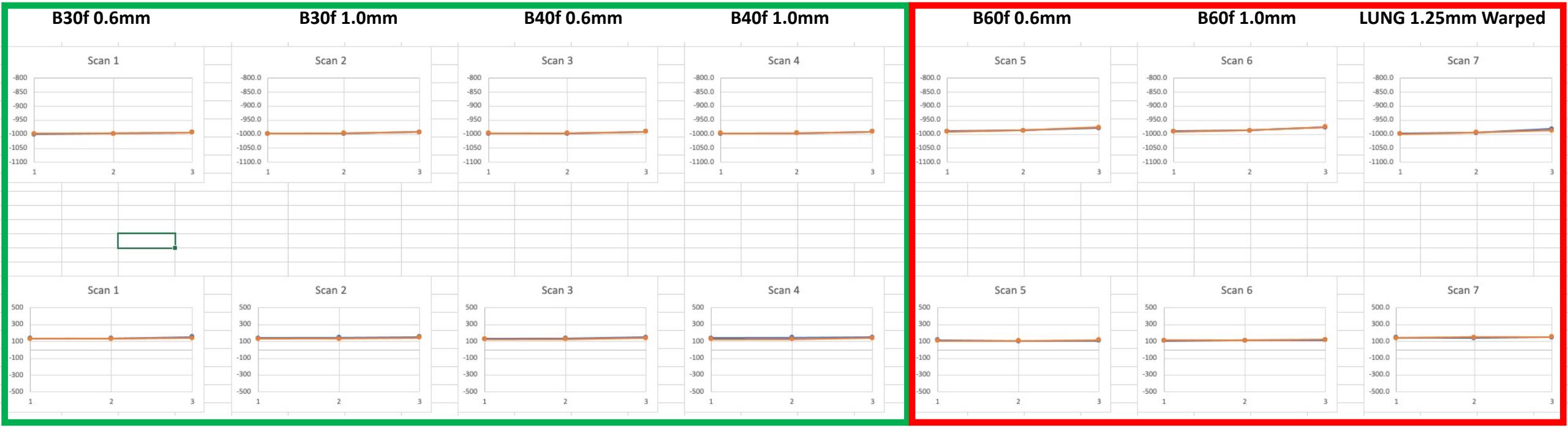
-2.04

**Acrylic HU**

| | Mount Sinai Acrylic Mean HU | | | Accumetra Acrylic Mean HU | | |
|---|---|---|---|---|---|---|
| **CT Scan** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** |
| 1 CTLX1-B30-0.6 | 135.6 | 138.9 | 154.0 | 132.71 | 132.4 | 143.27 |
| 2 CTLX1-B30-1.0 | 136.5 | 141.6 | 157.6 | 132.09 | 132.2 | 143.72 |
| 3 CTLX1-B40-0.6 | 132.7 | 135.8 | 149.0 | 128.09 | 128.19 | 139.83 |
| 4 CTLX1-B40-1.0 | 137.9 | 142.4 | 149.4 | 127.85 | 128.12 | 139.37 |
| 5 CTLX1-B60-0.6 | 115.7 | 104.4 | 108.8 | 110.76 | 107.51 | 117.1 |
| 6 CTLX1-B60-1.0 | 112.2 | 112.7 | 118.0 | 111.05 | 109.56 | 120.85 |
| 7 ExtraScan | 143.3 | 139.9 | 147.8 | 139.22 | 149.46 | 154.23 |

14.28

# Mount Sinai Results : Air & Acrylic Bias




Mount Sinai
Accumetra

# Mount Sinai Results : Air & Acrylic Image Noise (HU SD)

**Air HU SD**

| | Mount Sinai Air HU SD | | | Accumetra Air HU SD | | |
|---|---|---|---|---|---|---|
| **CT Scan** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** |
| 1 CTLX1-B30-0.6 | 8.0 | 12.8 | 17.6 | 8.910 | 11.33 | 15.22 |
| 2 CTLX1-B30-1.0 | 5.6 | 9.0 | 12.4 | 6.1 | 7.41 | 9.98 |
| 3 CTLX1-B40-0.6 | 10.7 | 12.4 | 16.1 | 9.6 | 13.15 | 17.41 |
| 4 CTLX1-B40-1.0 | 7.9 | 7.8 | 10.5 | 6.25 | 8.31 | 10.97 |
| 5 CTLX1-B60-0.6 | 30.6 | 42.4 | 52.2 | 29.85 | 41.92 | 57.82 |
| 6 CTLX1-B60-1.0 | 19.8 | 26.8 | 37.6 | 18.72 | 27.36 | 40.5 |
| 7 ExtraScan | 22.1 | 28.1 | 41.0 | 21.34 | 28.22 | 35.79 |

2.42

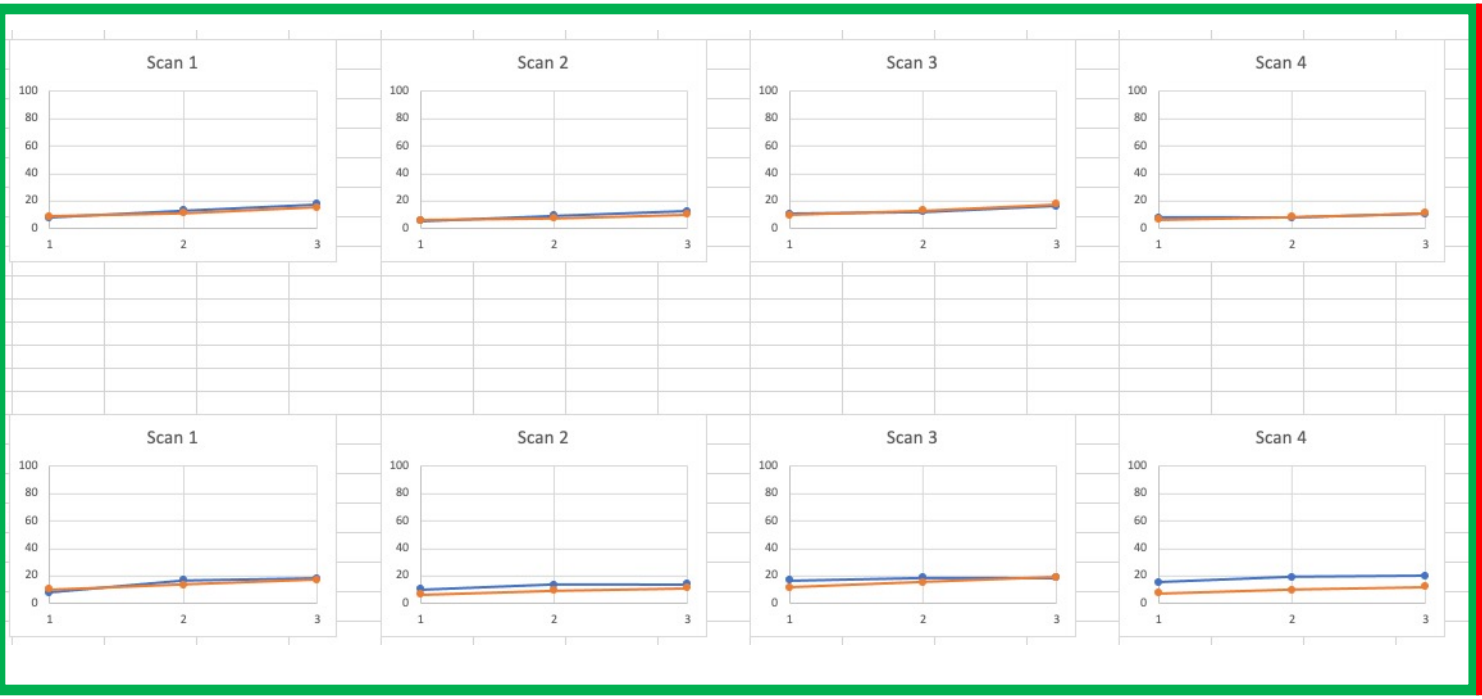
**Acrylic HU SD**

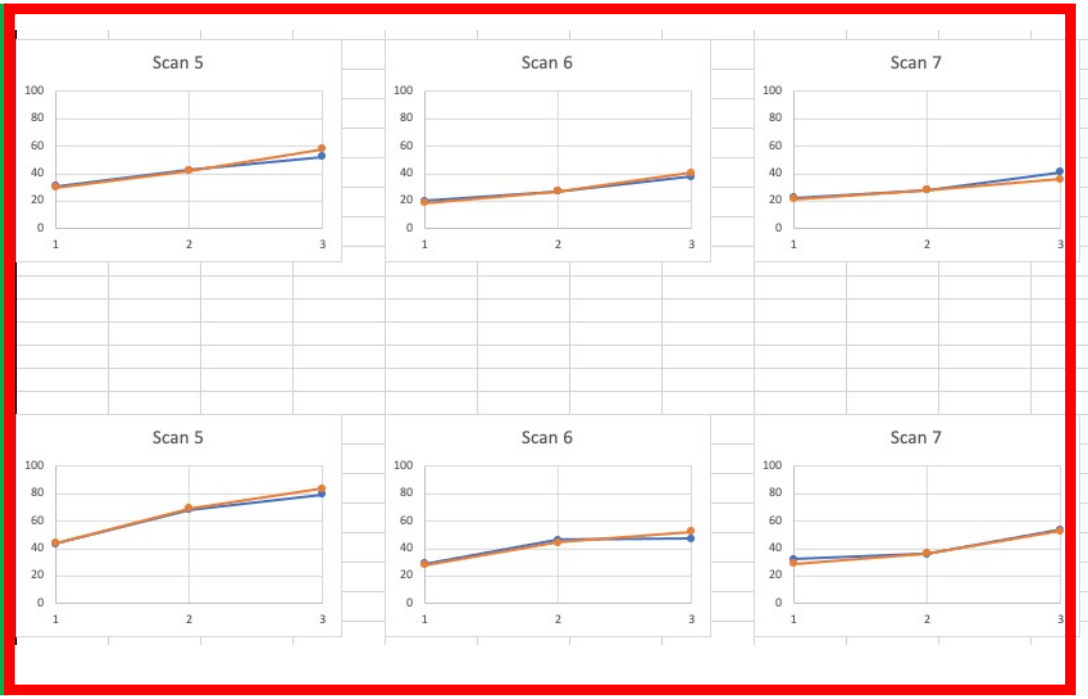
| | Mount Sinai Air HU SD | | | Accumetra Acrylic HU SD | | |
|---|---|---|---|---|---|---|
| **CT Scan** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** |
| 1 CTLX1-B30-0.6 | 8.0 | 16.9 | 18.1 | 10.06 | 13.59 | 17.1 |
| 2 CTLX1-B30-1.0 | 10.2 | 13.6 | 13.8 | 6.5 | 9.55 | 10.92 |
| 3 CTLX1-B40-0.6 | 16.9 | 18.5 | 18.8 | 11.59 | 15.35 | 18.91 |
| 4 CTLX1-B40-1.0 | 15.3 | 19.0 | 19.8 | 7.51 | 9.76 | 11.88 |
| 5 CTLX1-B60-0.6 | 43.6 | 68.1 | 79.6 | 43.98 | 69.29 | 83.69 |
| 6 CTLX1-B60-1.0 | 28.7 | 46.4 | 47.1 | 27.82 | 44.42 | 52.32 |
| 7 ExtraScan | 32.0 | 36.0 | 53.5 | 28.71 | 36.59 | 52.72 |

9.24

# Mount Sinai Results : Air & Acrylic Image Noise (HU SD)

**B30f 0.6mm** | **B30f 1.0mm** | **B40f 0.6mm** | **B40f 1.0mm** | **B60f 0.6mm** | **B60f 1.0mm** | **LUNG 1.25mm Warped**




**Mount Sinai**
**Accumetra**

We expect differences due to high edge enhancement (noise impacted when EE is high) and warping.

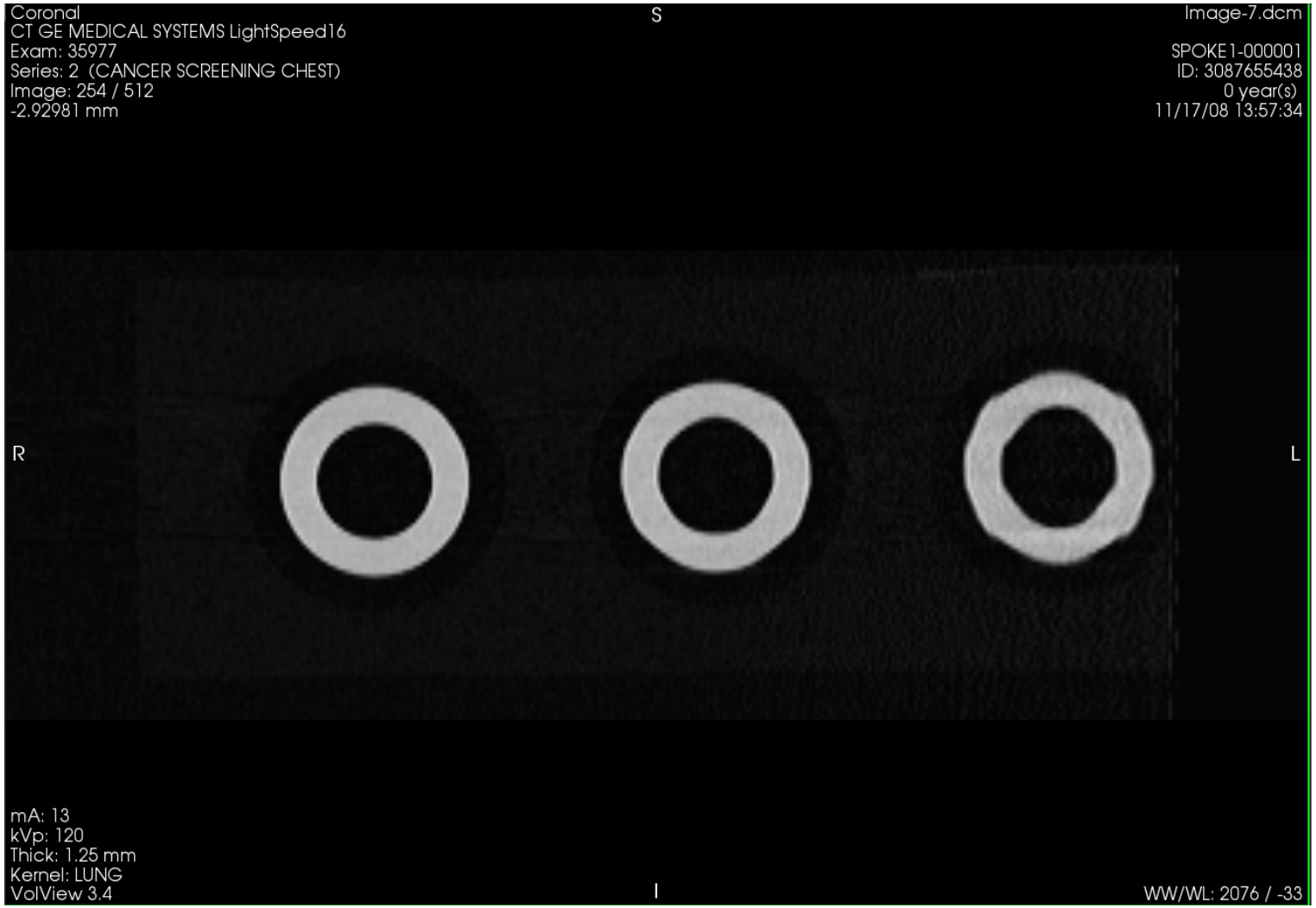
# Mount Sinai Results : Spatial Warping

| Z Spatial Warping | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mount Sinai Air HU SD | | | Accumetra Spatial Warping Y/N | | |
| | CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| | 1 CTLX1-B30-0.6 | No | No | No | 0.046 | 0.04 | 0.05 |
| | 2 CTLX1-B30-1.0 | No | No | No | 0.07 | 0.055 | 0.059 |
| | 3 CTLX1-B40-0.6 | No | No | No | 0.045 | 0.04 | 0.041 |
| | 4 CTLX1-B40-1.0 | No | No | No | 0.078 | 0.056 | 0.061 |
| | 5 CTLX1-B60-0.6 | No | No | No | 0.081 | 0.073 | 0.07 |
| | 6 CTLX1-B60-1.0 | No | No | No | 0.106 | 0.099 | 0.083 |
| | 7 ExtraScan | Yes | Yes | Yes | 0.12 | 0.284 | 0.432 |

Any value > 0.3 is considered positive for Z spatial warping

90.5% agreement on spatial warping (but no visual cutoff guidance was provided)

# Mount Sinai Results : Spatial Warping



# Preliminary Findings & Observations

- From OHSU Review on 10/1/21
  - Remeasure using multiple slices.
  - We should put SD on graphs (particularly acrylic).

# OHSU Results

# OHSU Results : Edge Enhancement

- 0.02

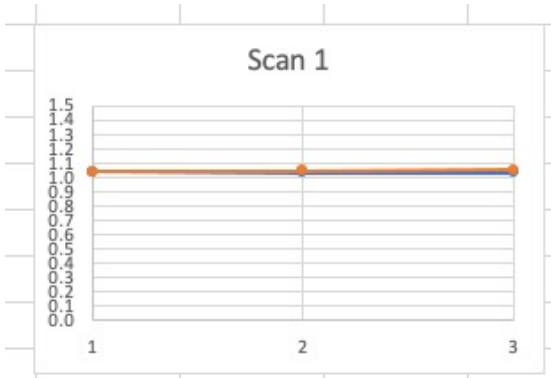
Edge Enhancement

| | OHSU Edge Enhancement | | | Accumetra Edge Enhancement | | |
|---|---|---|---|---|---|---|
| CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| 1 CTLX1-B30-0.6 | 1.038 | 1.036 | 1.035 | 1.039 | 1.044 | 1.055 |
| 2 CTLX1-B30-1.0 | 1.034 | 1.033 | 1.039 | 1.038 | 1.043 | 1.05 |
| 3 CTLX1-B40-0.6 | 1.037 | 1.019 | 1.039 | 1.042 | 1.039 | 1.04 |
| 4 CTLX1-B40-1.0 | 1.037 | 1.034 | 1.041 | 1.04 | 1.041 | 1.046 |
| 5 CTLX1-B60-0.6 | 1.125 | 1.110 | 1.079 | 1.097 | 1.098 | 1.1 |
| 6 CTLX1-B60-1.0 | 1.124 | 1.138 | 1.085 | 1.094 | 1.104 | 1.105 |
| 7 ExtraScan | 1.152 | 1.193 | 1.134 | 1.192 | 1.205 | 1.185 |

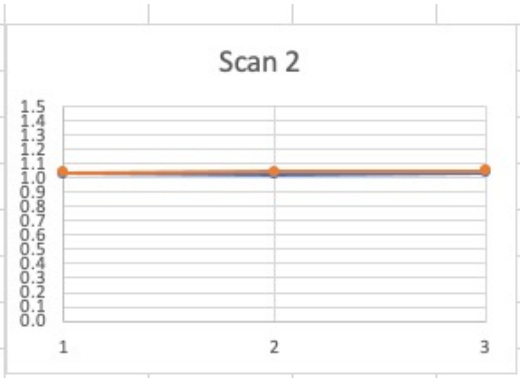
100% agreement on Failure Due To Edge Enhancement (EE <= 1.05)

# OHSU Results : Edge Enhancement

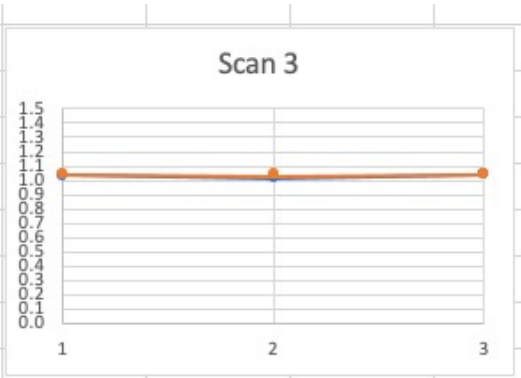
B30f 0.6mm




B30f 1.0mm

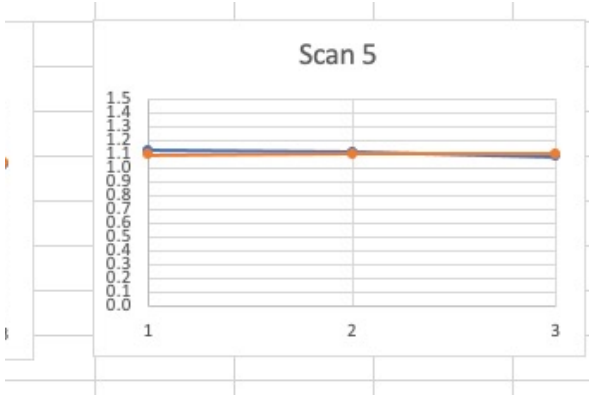



B40f 0.6mm




B40f 1.0mm


B60f 0.6mm




B60f 1.0mm


LUNG 1.25mm Warped


OHSU
Accumetra

# OHSU Results : Edge Enhancement

# OHSU Results : In Plane Resolution

| In-Plane Resolution | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | OHSU MTF50 (lp/mm) | | | Accumetra PSF to MTF50 (lp/mm) | | |
| | CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| | 1 CTLX1-B30-0.6 | 0.351 | 0.325 | 0.279 | 0.336183611 | 0.301375362 | 0.225969709 |
| | 2 CTLX1-B30-1.0 | 0.349 | 0.323 | 0.282 | 0.342452641 | 0.313238986 | 0.229662717 |
| | 3 CTLX1-B40-0.6 | 0.388 | 0.340 | 0.298 | 0.406668244 | 0.361627107 | 0.259289129 |
| | 4 CTLX1-B40-1.0 | 0.385 | 0.346 | 0.301 | 0.408383676 | 0.374706917 | 0.270135144 |
| | 5 CTLX1-B60-0.6 | 0.651 | 0.551 | 0.472 | 0.817618307 | 0.817618307 | 0.817618307 |
| | 6 CTLX1-B60-1.0 | 0.687 | 0.533 | 0.476 | 0.817618307 | 0.817618307 | 0.817618307 |
| | 7 ExtraScan | 0.724 | 0.443 | 0.396 | 0.817618307 | 0.817618307 | 0.610932006 |

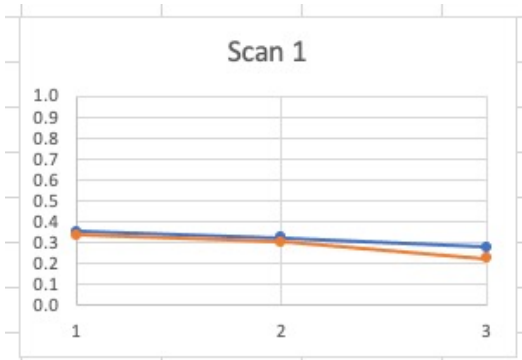
- ✓ High levels of agreement on in-plane resolution
- ✓ B30f resolution is lower than B40f.
- ✓ Slice thickness does not significantly change resolution values.
- ✓ Lower resolution is observed as a function of distance from iso-center.

0.053

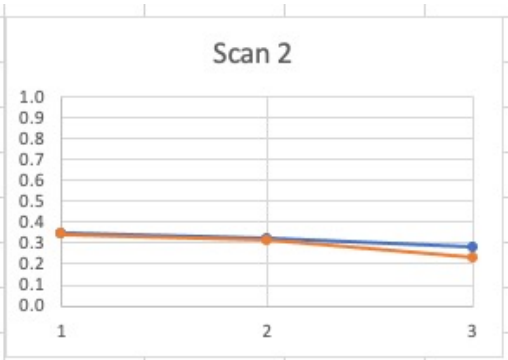
# OHSU Results : In-Plane Resolution

IEC Longitudinal
Drift < 0.75 mm

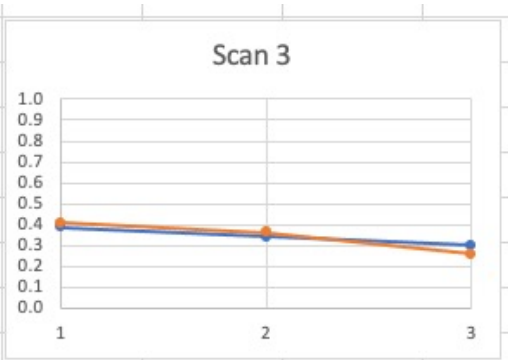
**B30f 0.6mm**



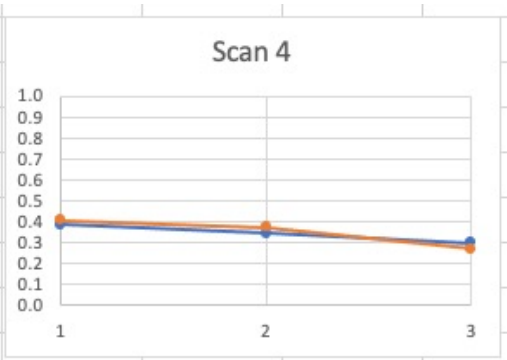

**B30f 1.0mm**




**B40f 0.6mm**

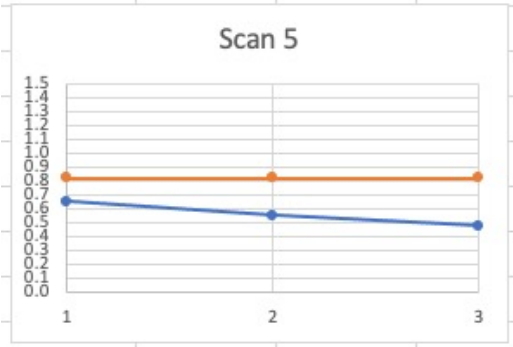



**B40f 1.0mm**

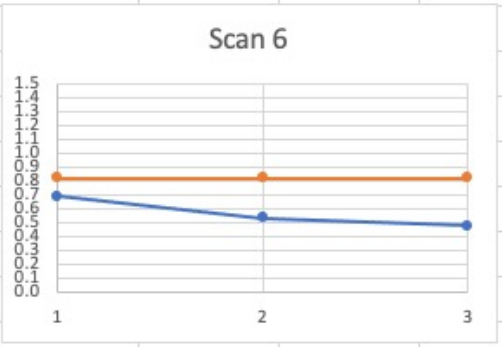



These Scans All Failed EE

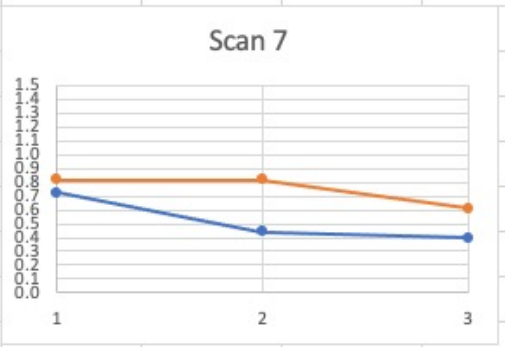
**B60f 0.6mm**




**B60f 1.0mm**




**LUNG 1.25mm Warped**




OHSU
Accumetra

We expect differences due to high edge enhancement (x/y resolution not valid when EE is high) and warping.

# OHSU Results : Air & Acrylic HU Bias

**Air HU**

| | OHSU Air Mean HU | | | Accumetra Air Mean HU | | |
|---|---|---|---|---|---|---|
| CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| 1 CTLX1-B30-0.6 | -1000.525 | -999.548 | -993.452 | -997.460 | -996.610 | -992.810 |
| 2 CTLX1-B30-1.0 | -1000.389 | -1000.096 | -992.516 | -997.77 | -996.580 | -992.820 |
| 3 CTLX1-B40-0.6 | -1001.006 | -994.625 | -994.629 | -996.6 | -996.29 | -990.870 |
| 4 CTLX1-B40-1.0 | -998.698 | -997.144 | -993.035 | -996.71 | -995.92 | -990.78 |
| 5 CTLX1-B60-0.6 | -989.127 | -987.739 | -974.875 | -990.48 | -986.51 | -975.17 |
| 6 CTLX1-B60-1.0 | -991.645 | -983.287 | -970.175 | -990.82 | -986.28 | -974.59 |
| 7 ExtraScan | -1000.309 | -999.02 | -987.47 | -998.79 | -993.54 | -987.36 |

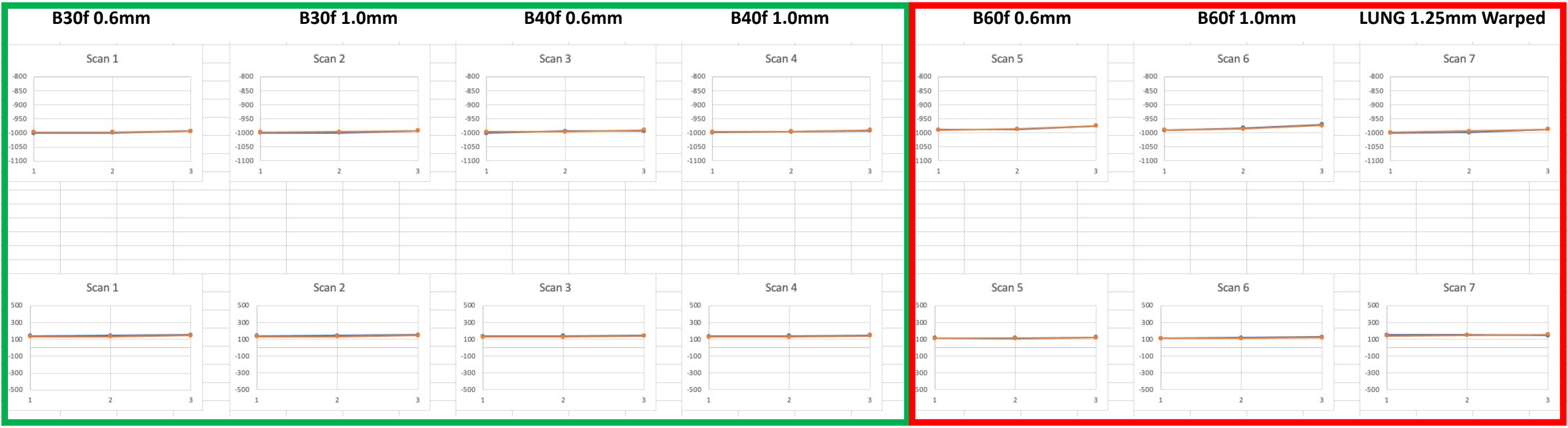
-4.406

**Acrylic HU**

| | OHSU Acrylic Mean HU | | | Accumetra Acrylic Mean HU | | |
|---|---|---|---|---|---|---|
| CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| 1 CTLX1-B30-0.6 | 140.349 | 143.405 | 151.621 | 132.71 | 132.4 | 143.27 |
| 2 CTLX1-B30-1.0 | 137.878 | 145.03 | 153.219 | 132.09 | 132.2 | 143.72 |
| 3 CTLX1-B40-0.6 | 135.379 | 140.884 | 142.054 | 128.09 | 128.19 | 139.83 |
| 4 CTLX1-B40-1.0 | 134.813 | 139.952 | 146.407 | 127.85 | 128.12 | 139.37 |
| 5 CTLX1-B60-0.6 | 113.698 | 116.406 | 122.362 | 110.76 | 107.51 | 117.1 |
| 6 CTLX1-B60-1.0 | 112.13 | 116.808 | 126.714 | 111.05 | 109.56 | 120.85 |
| 7 ExtraScan | 153.347 | 151.873 | 142.828 | 139.22 | 149.46 | 154.23 |

12.83

# OHSU Results : Air & Acrylic Bias




OHSU
Accumetra

# OHSU Results : Air & Acrylic Image Noise (HU SD)

**Air HU SD**

| | OHSU Air HU SD | | | Accumetra Air HU SD | | |
|---|---|---|---|---|---|---|
| **CT Scan** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** |
| 1 CTLX1-B30-0.6 | 9.911 | 12.739 | 15.452 | 8.910 | 11.33 | 15.22 |
| 2 CTLX1-B30-1.0 | 8.021 | 9.516 | 10.172 | 6.1 | 7.41 | 9.98 |
| 3 CTLX1-B40-0.6 | 10.687 | 13.971 | 17.959 | 9.6 | 13.15 | 17.41 |
| 4 CTLX1-B40-1.0 | 7.862 | 10.56 | 12.313 | 6.25 | 8.31 | 10.97 |
| 5 CTLX1-B60-0.6 | 31.958 | 41.786 | 55.442 | 29.85 | 41.92 | 57.82 |
| 6 CTLX1-B60-1.0 | 18.562 | 30.372 | 46.306 | 18.72 | 27.36 | 40.5 |
| 7 ExtraScan | 20.822 | 24.533 | 36.47 | 21.34 | 28.22 | 35.79 |

2.106

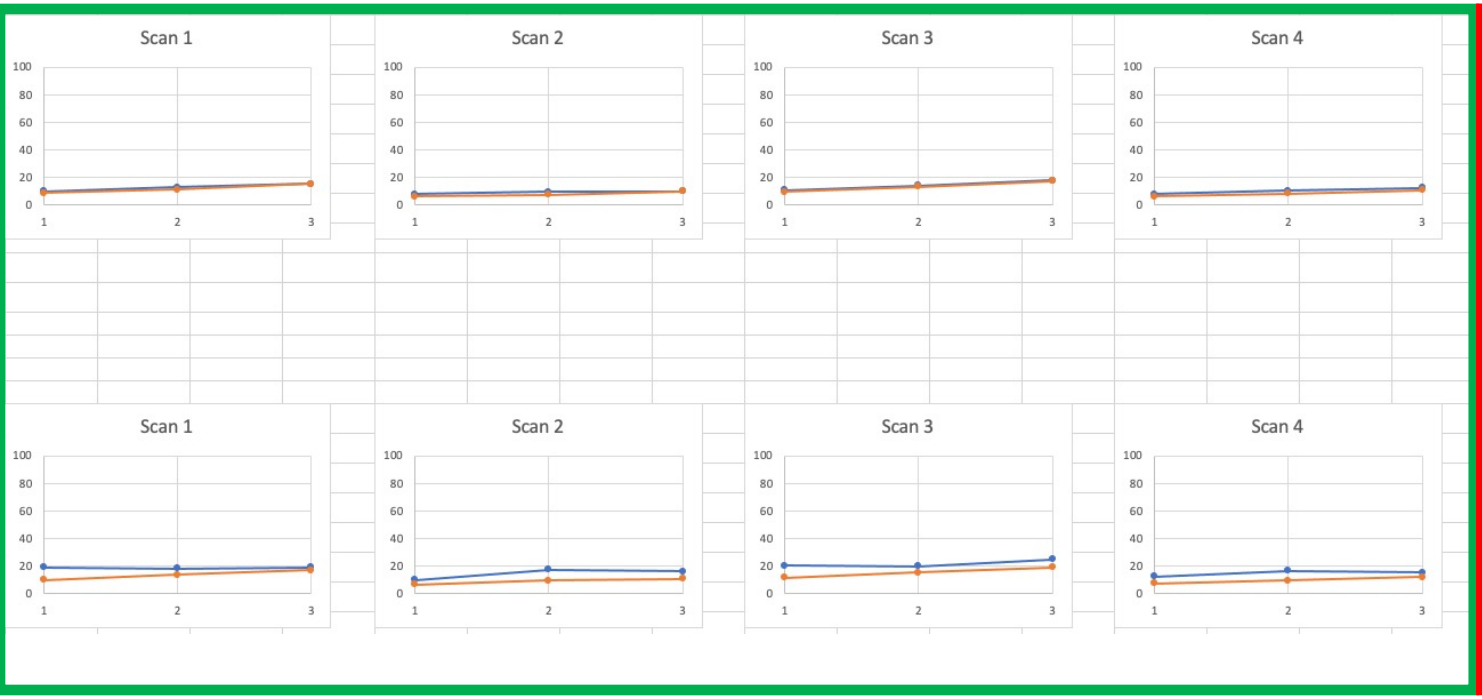
**Acrylic HU SD**

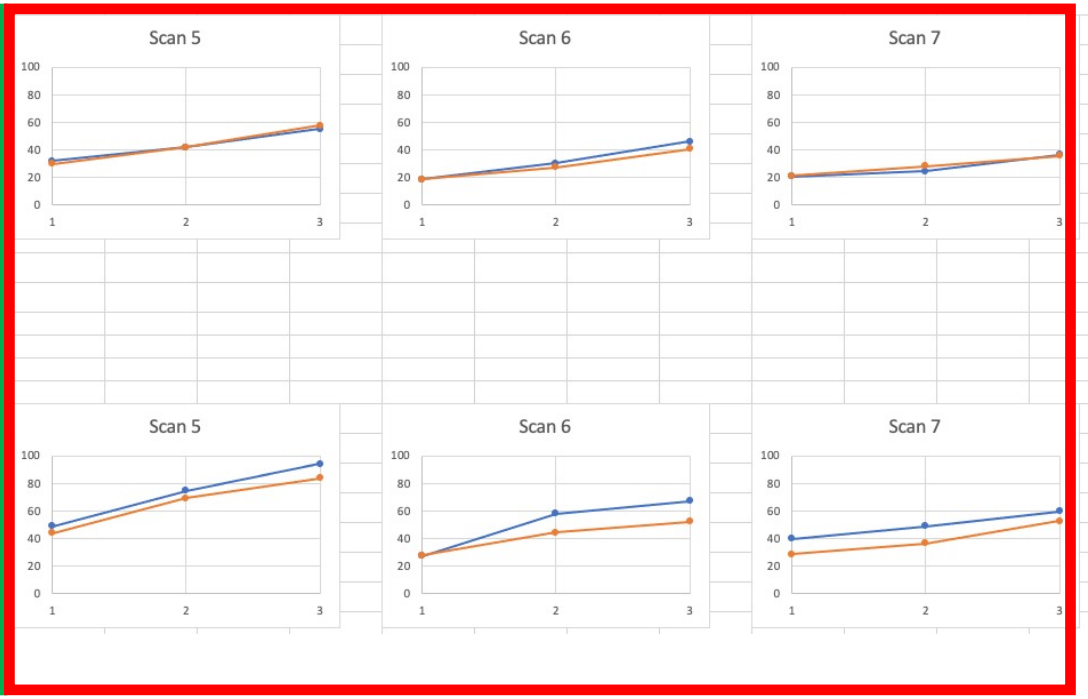
| | OHSU Acrylic HU SD | | | Accumetra Acrylic HU SD | | |
|---|---|---|---|---|---|---|
| **CT Scan** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** | **Module @ 0mm** | **Module @ 100mm** | **Module @ 200mm** |
| 1 CTLX1-B30-0.6 | 19.297 | 18.894 | 19.3 | 10.06 | 13.59 | 17.1 |
| 2 CTLX1-B30-1.0 | 10.052 | 17.573 | 16.257 | 6.5 | 9.55 | 10.92 |
| 3 CTLX1-B40-0.6 | 20.545 | 19.983 | 25.099 | 11.59 | 15.35 | 18.91 |
| 4 CTLX1-B40-1.0 | 12.465 | 16.657 | 15.436 | 7.51 | 9.76 | 11.88 |
| 5 CTLX1-B60-0.6 | 48.827 | 74.957 | 94.353 | 43.98 | 69.29 | 83.69 |
| 6 CTLX1-B60-1.0 | 27.409 | 58.178 | 67.377 | 27.82 | 44.42 | 52.32 |
| 7 ExtraScan | 39.875 | 48.908 | 59.813 | 28.71 | 36.59 | 52.72 |

-8.955

# OHSU Results : Air & Acrylic Image Noise (HU SD)

**B30f 0.6mm** | **B30f 1.0mm** | **B40f 0.6mm** | **B40f 1.0mm** | **B60f 0.6mm** | **B60f 1.0mm** | **LUNG 1.25mm Warped**




**OHSU**
**Accumetra**

We expect differences due to high edge enhancement (noise impacted when EE is high) and warping.

# OHSU Results : Spatial Warping

| Z Spatial Warping | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | OHSU | | | Accumetra | | |
| | | Spatial Warping Y/N | | | Spatial Warping Y/N | | |
| | CT Scan | Module @ 0mm | Module @ 100mm | Module @ 200mm | Module @ 0mm | Module @ 100mm | Module @ 200mm |
| | 1 CTLX1-B30-0.6 | N | N | N | 0.046 | 0.04 | 0.05 |
| | 2 CTLX1-B30-1.0 | N | N | N | 0.07 | 0.055 | 0.059 |
| | 3 CTLX1-B40-0.6 | N | N | N | 0.045 | 0.04 | 0.041 |
| | 4 CTLX1-B40-1.0 | N | N | N | 0.078 | 0.056 | 0.061 |
| | 5 CTLX1-B60-0.6 | N | N | N | 0.081 | 0.073 | 0.07 |
| | 6 CTLX1-B60-1.0 | N | N | N | 0.106 | 0.099 | 0.083 |
| | 7 ExtraScan | N | N | Y | 0.12 | 0.284 | 0.432 |

Any value > 0.3 is considered positive for Z spatial warping

100% agreement on spatial warping (but no visual cutoff guidance was provided)

# OHSU Results : Spatial Warping