

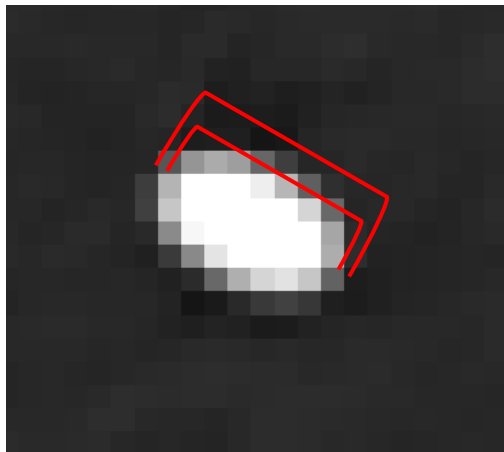
# Improving the Impact of the QIBA CT Small Lung Nodule Profile

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October 29, 2020

# Small Lung Nodule Measurement



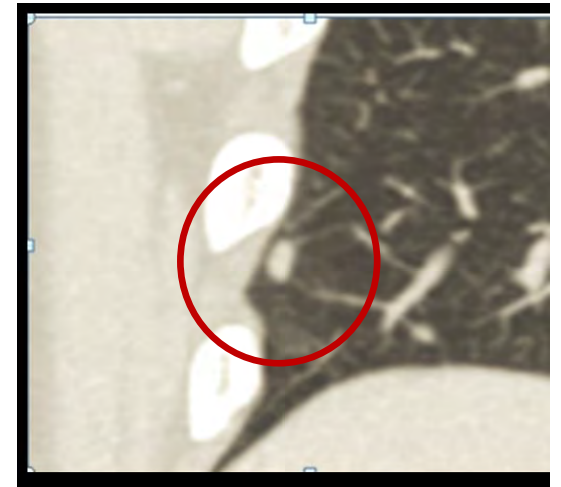
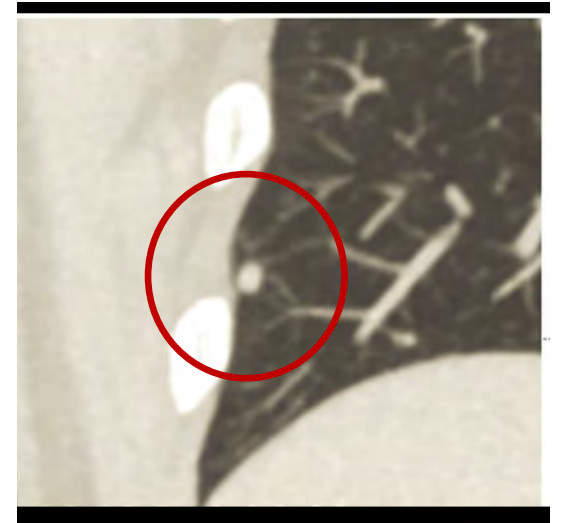
**For a 6.0 x 3.6 x 3.6 mm Lung Nodule:**

We are working with axial CT images with a maximum nodule diameter of between 6 and 9 pixels

**+1mm Max Diameter Increase**

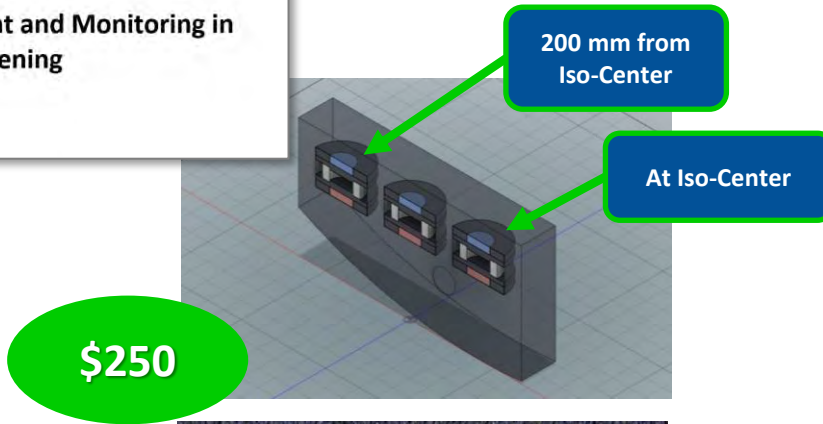
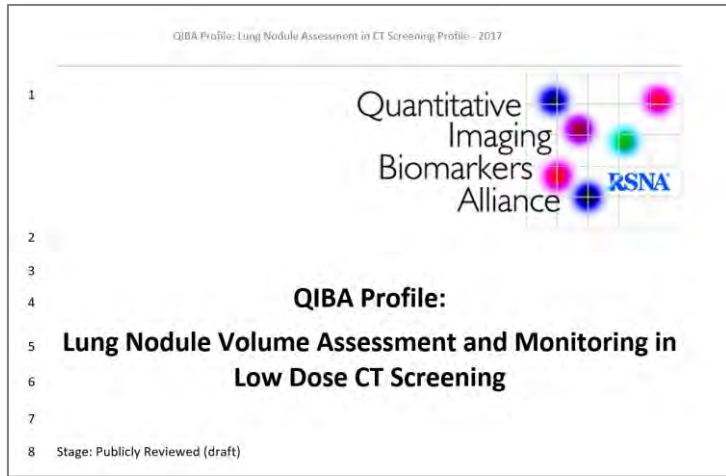
| Nodule Diameter | Diameter Change % | Volume Change % |
|-----------------|-------------------|-----------------|
| 6.0             | 17%               | 59%             |
| 7.0             | 14%               | 49%             |
| 8.0             | 13%               | 42%             |
| 9.0             | 11%               | 37%             |
| 10.0            | 10%               | 33%             |

**If This Is TRULY a +1.0 mm Max Diameter Increase Over 6 Months, This Is a > 250% Volume Increase Over A Year (640% for 3m)**



**Numerous CT Image Quality Issues Can Bias This Measurement**  
**Use of Precise and Quality Controlled Quantitative Image Measurement Tools Is Critical**

# QIBA CT Small Lung Nodule Profile



Smallest Size Lung Nodule That a CT Lung Cancer Screening Site Needs To Be Able To Reliably Measure

- **Fundamental CT Image Properties**

- 3D Resolution:
  - 3D PSF Ellipsoid Volume  $\leq 1.5\text{mm}^3$
- 3D Resolution Aspect:
  - PSF Z/X  $\leq 2.0$
- Linearity Bias:
  - Air and Acrylic Bias  $< 35$  HU
- Image Noise:
  - Acrylic Noise  $\leq 50$  HU SD
- Kernel Edge Enhancement:
  - Air to Delrin Enhancement  $\leq 5\%$
- 3D Spatial Warping:
  - Delrin Cylinder RMSE  $\leq 0.3$  mm

- **Lung Nodule Volume Change Performance**

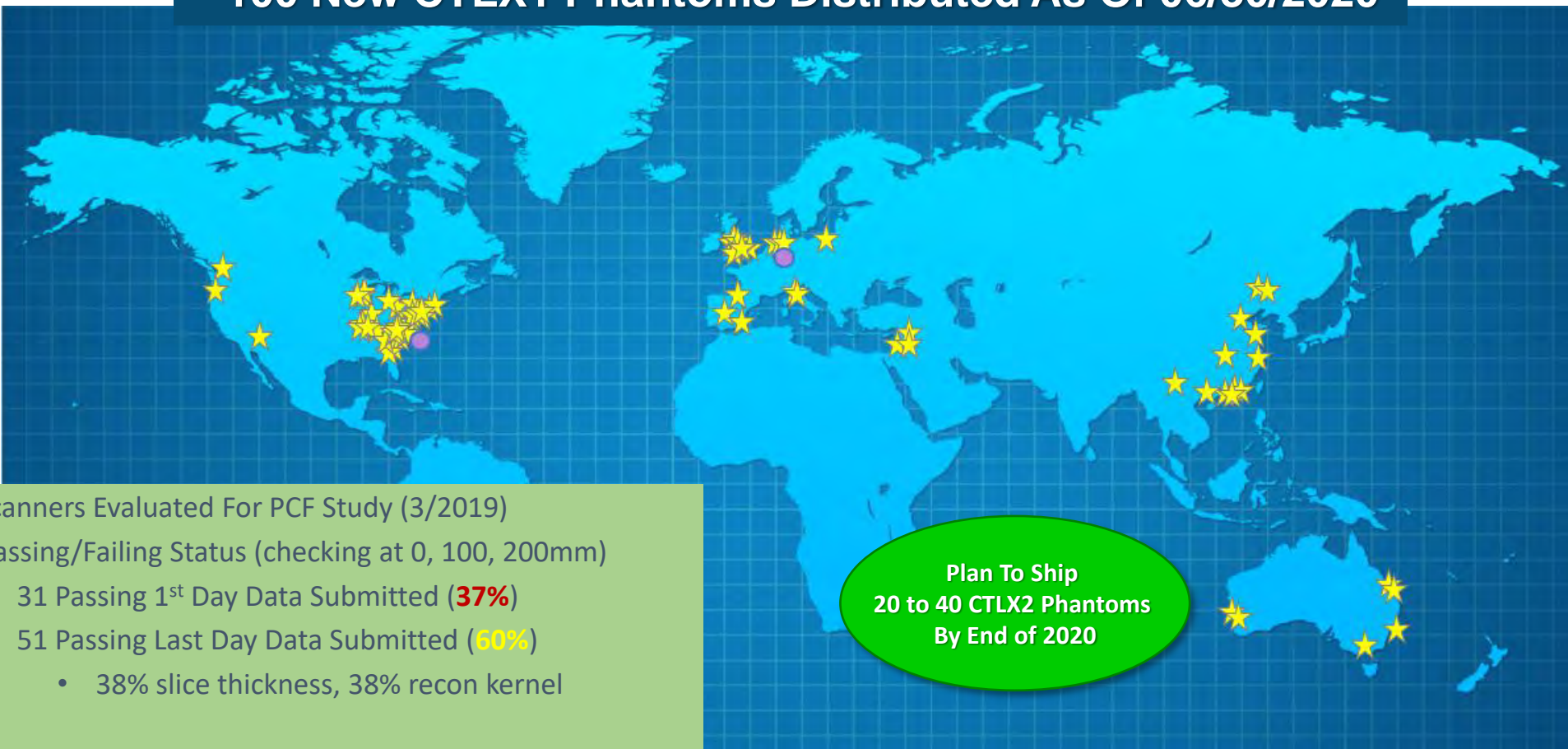
- Verifies That Image Quality Meets or Exceeds The QIBA CT Lung Nodule Profile Volume Change Measurement Recommendations



# QIBA CT Small Lung Nodule Profile

## Many Thanks to the Prevent Cancer Foundation

100 New CTLX1 Phantoms Distributed As Of 06/30/2020



85 CT Scanners Evaluated For PCF Study (3/2019)

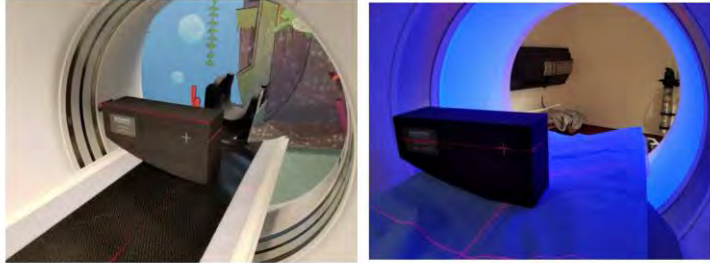
- Passing/Failing Status (checking at 0, 100, 200mm)
  - 31 Passing 1<sup>st</sup> Day Data Submitted (**37%**)
  - 51 Passing Last Day Data Submitted (**60%**)
    - 38% slice thickness, 38% recon kernel
- If we do study now, expect to go from 30 % to 75%

Plan To Ship  
20 to 40 CTLX2 Phantoms  
By End of 2020



# QIBA SLN Profile In Use Throughout The World

## ACCUMETRA IQ PHANTOM




Children's hospital

NIH  
CTLX1 phantom scan


- Potential context of use
  - Image quality assessment of CT system for lung cancer screening

Curtesy Rick Avila, Accumetra



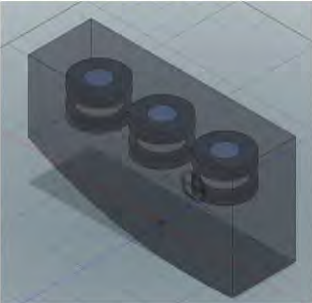
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### Accumetra CTLX1 phantom



Unique phantom looks at performance across imaged field

- Three modules placed at 0mm, 102mm, and 204mm from isocentre
- Each module is hollow cylinder of Delrin
- Air region inside and outside cylinder
- Teflon cylinder and Acrylic cylinder above and below Delrin respectively



Leeds is first site in the world to use this phantom on a mobile CT scanner



Taylor & Francis  
Taylor & Francis Group

### Canadian Journal of Respiratory, Critical Care, and Sleep Medicine

Revue canadienne des soins respiratoires et critiques et de la médecine du sommeil

ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/ucts20>

#### Management of screen-detected lung nodules: A Canadian partnership against cancer guidance document

Stephen Lam , Heather Bryant , Laura Donahoe , Ashleigh Domingo , Craig Earle , Christian Finley , Anne V. Gonzalez , Christopher Hergott , Rayjean J. Hung , Anne Marie Ireland , Michael Lovas , Daria Manos , John Mayo , Donna E. Maziak , Micheal McInnis , Renelle Myers , Erika Nicholson , Christopher Politis , Heidi Schmidt , Harman S. Sekhon , Marie Soprovich , Archie Stewart , Martin Tammemagi , Jana L. Taylor , Ming-Sound Tsao , Matthew T. Warkentin & Kazuhiro Yasufuku

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To link to this article: <https://doi.org/10.1080/24745332.2020.1819175>

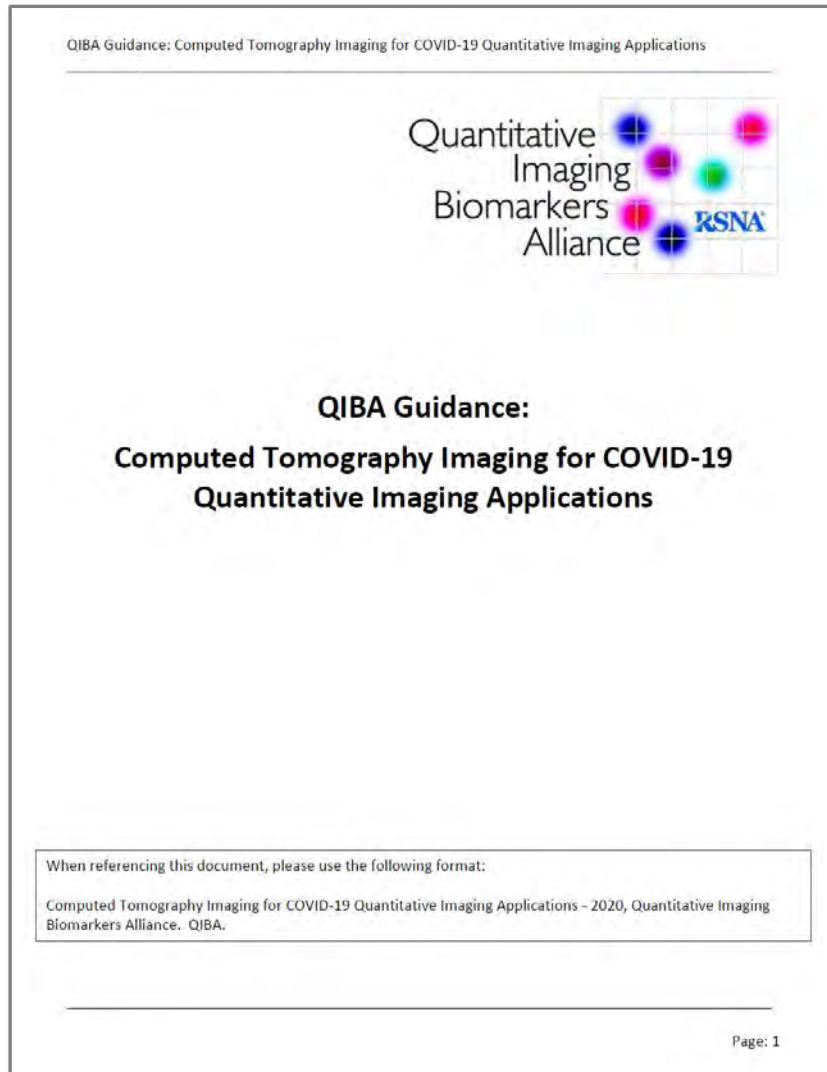
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# QIBA COVID-19 CT Imaging Guidance



**Table 1:** Recommended reconstruction kernels for quantitative CT COVID-19 applications.

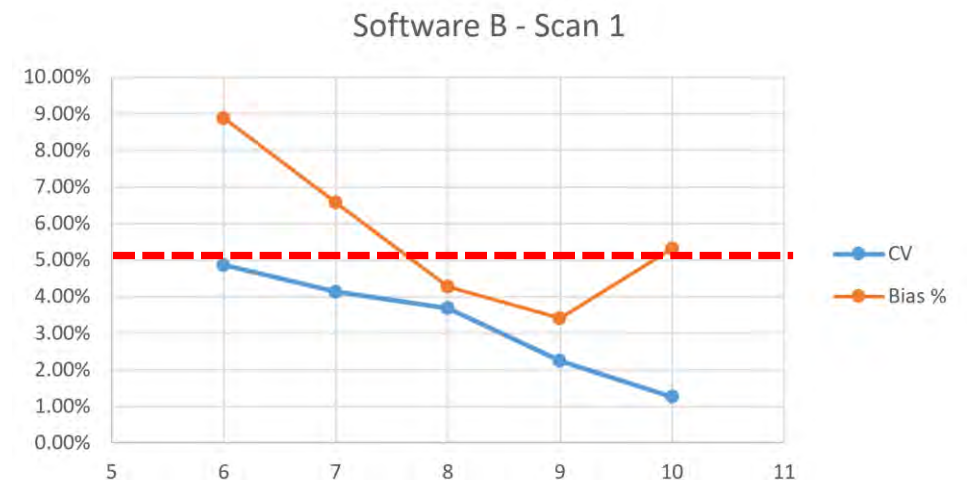
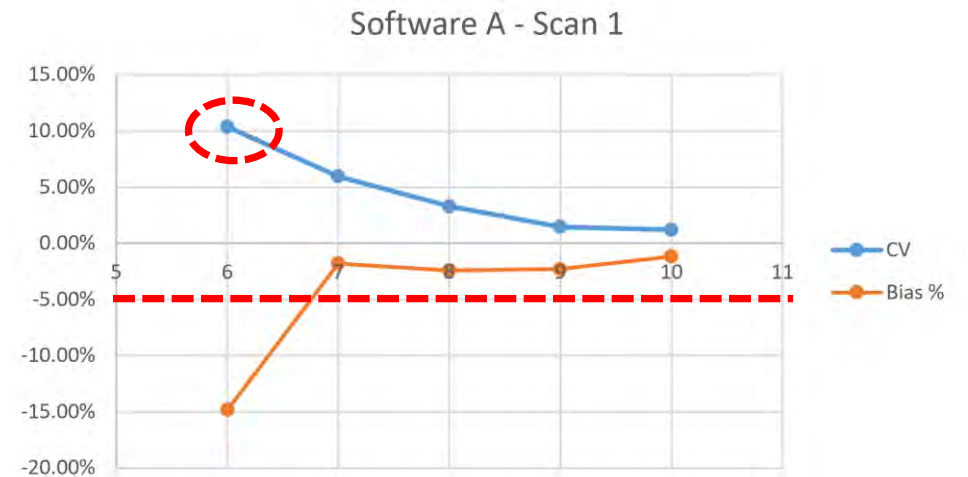
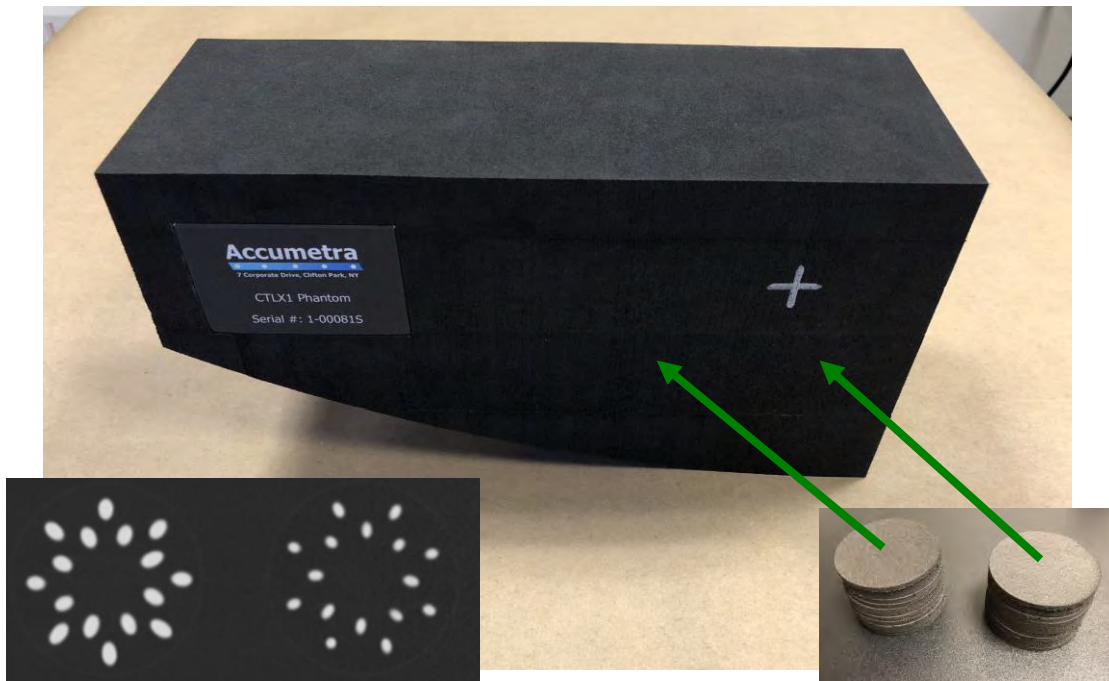
| CT Scanner Manufacturer | Models     | Recommended Reconstruction Kernels |
|-------------------------|------------|------------------------------------|
| Canon/Toshiba           | All        | FC05                               |
| General Electric        | All        | STANDARD                           |
| Philips                 | All        | F, L                               |
| Siemens                 | Force      | Br40                               |
|                         | All Others | B40, I40                           |

We Also Plan To Prepare Similar Guidance For Combined CT Lung Screening and COPD Imaging



# Resolving High Nodule Software Bias

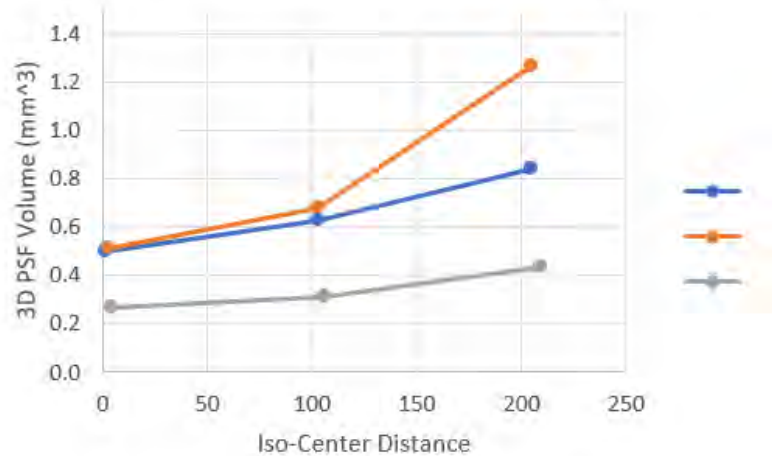
- The CTLX1S Contains 80 Acrylic Ellipsoids Ranging In Size From 6mm To 10mm
- Scanning And Measurement Using Two Software Systems Revealed High Bias



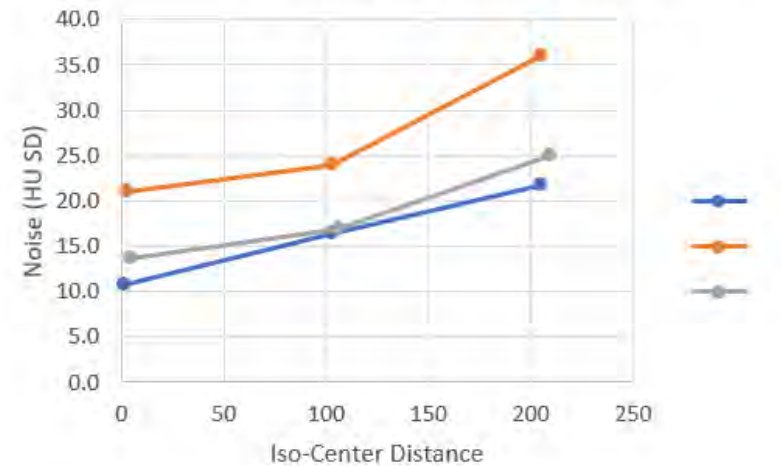
# Sites Would Like To Use Different Scanners/Protocols



Resolution vs Iso-Center Distance

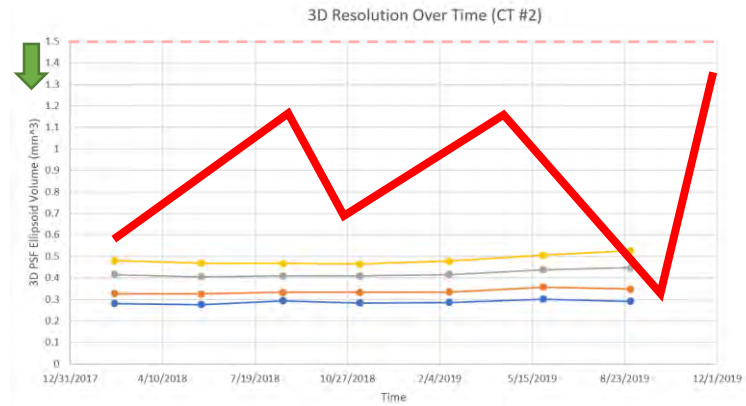


Noise vs Iso-Center Distance

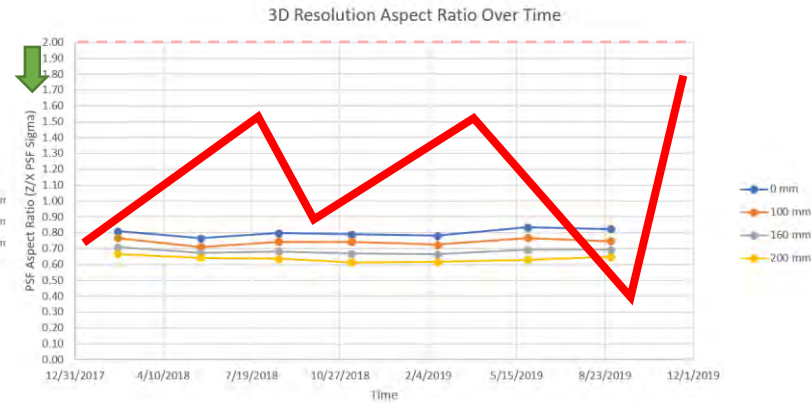


# Requiring Image Quality Stability Over Time

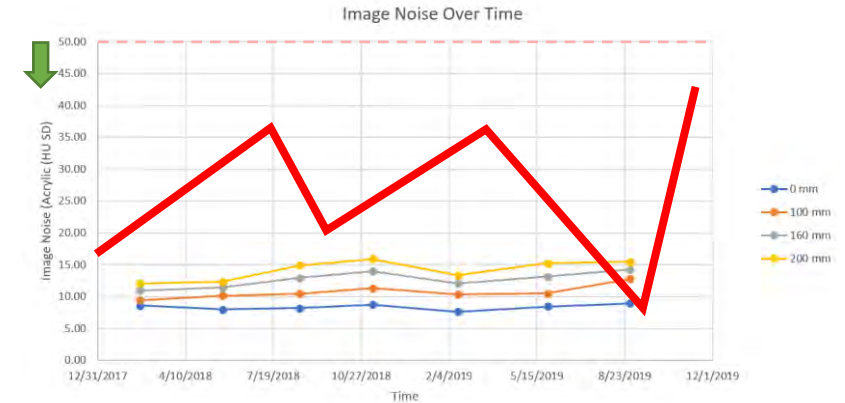
## 3D Resolution



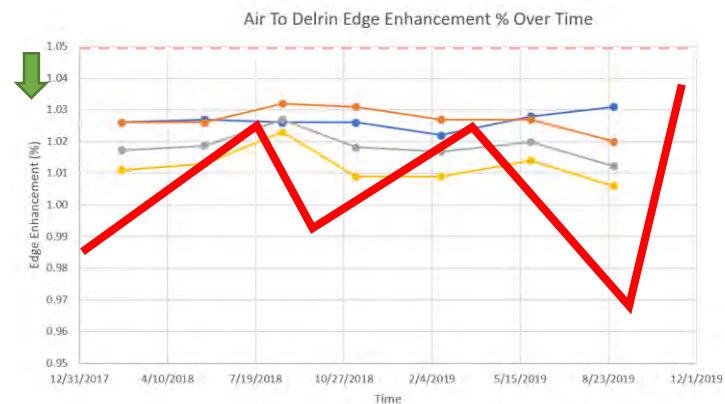
## 3D Resolution Aspect Ratio



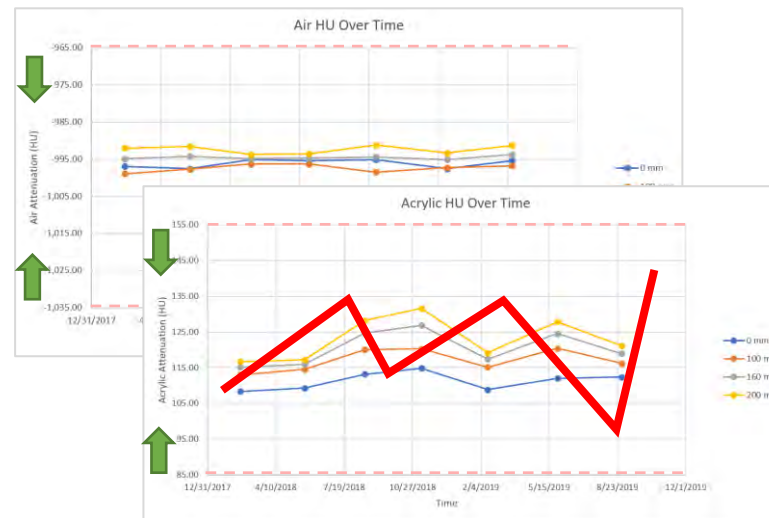
## Image Noise (Acrylic)



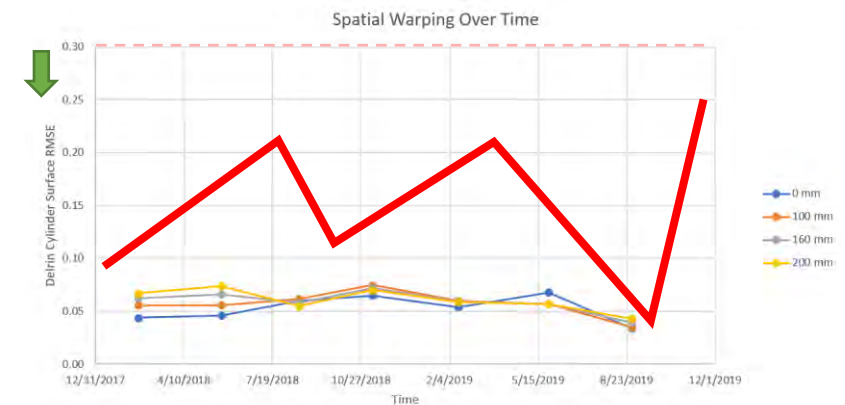
## Edge Enhancement %



## HU Bias (Air & Acrylic)

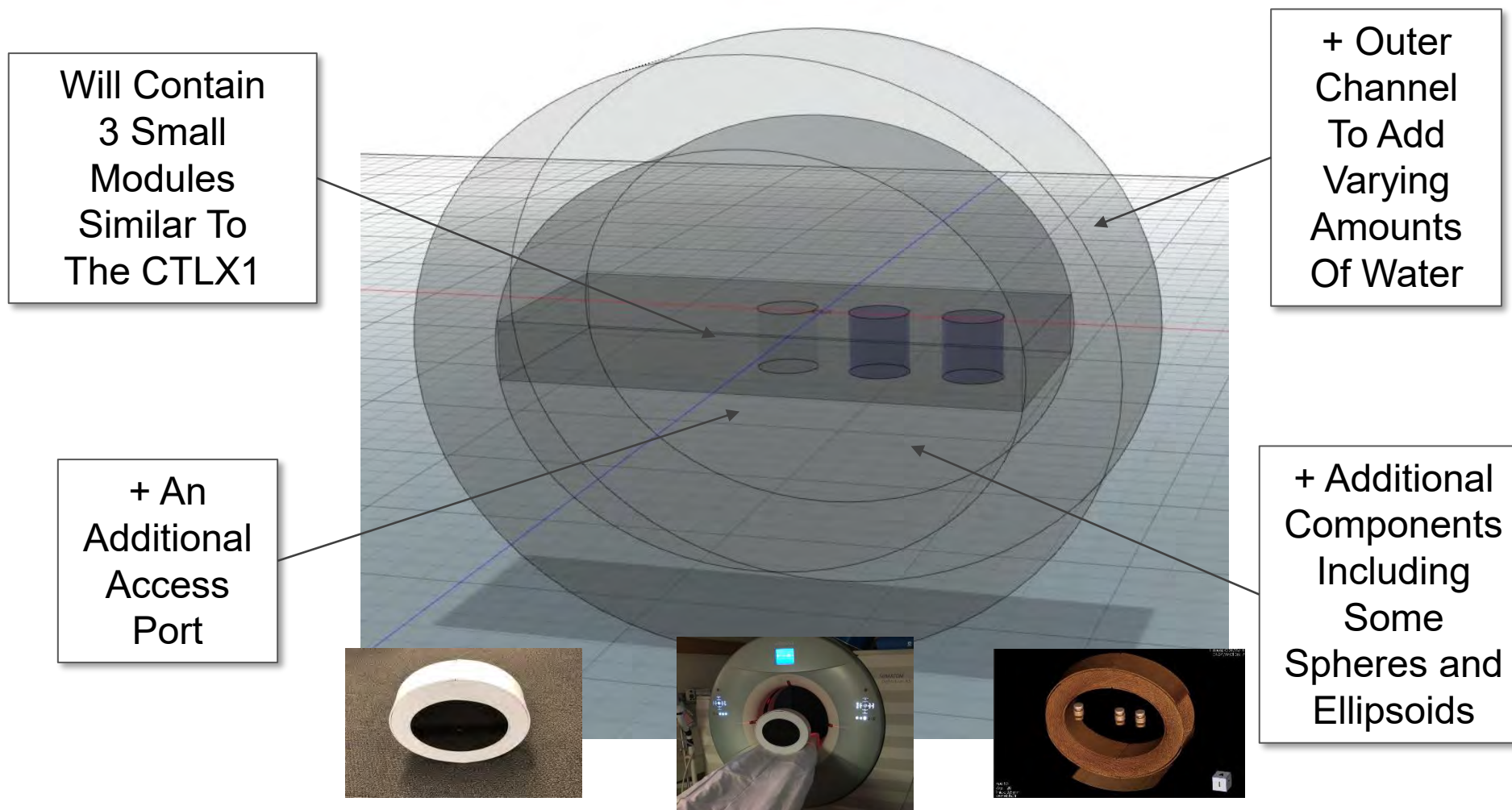


## 3D Spatial Warping



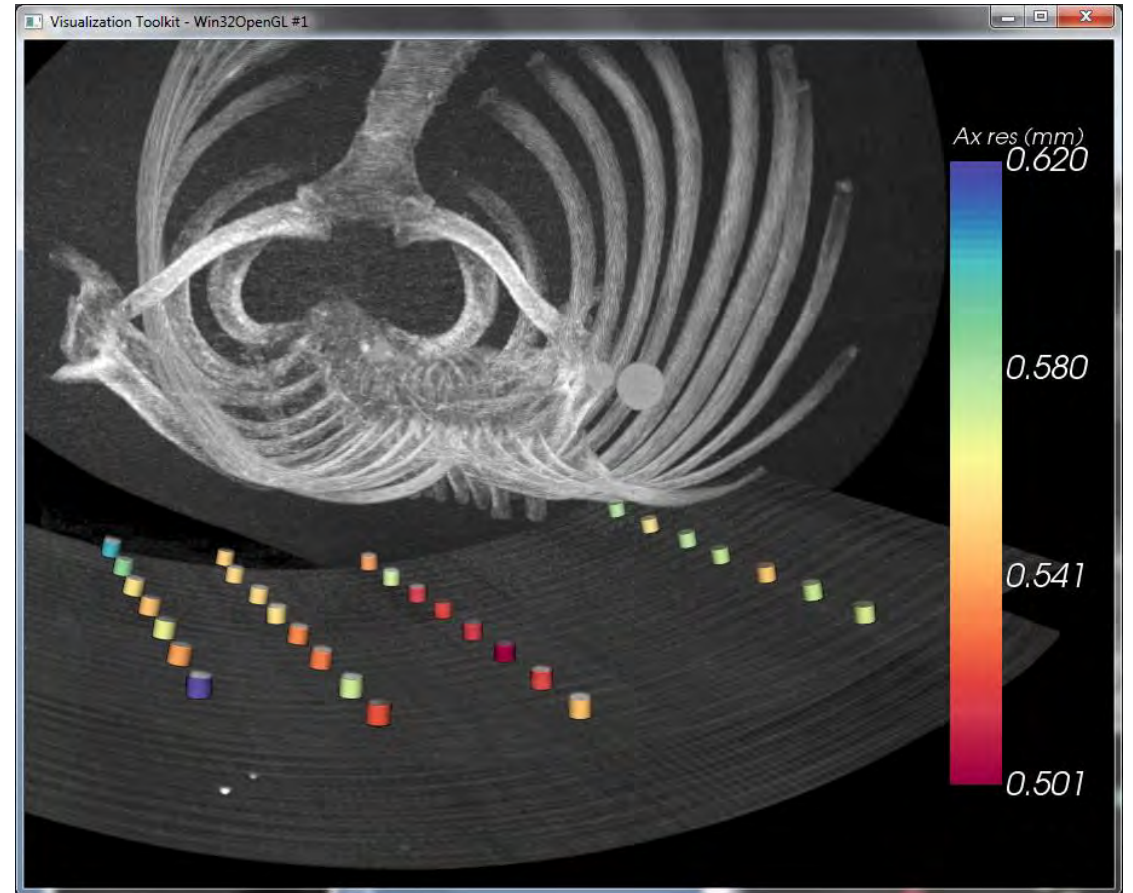
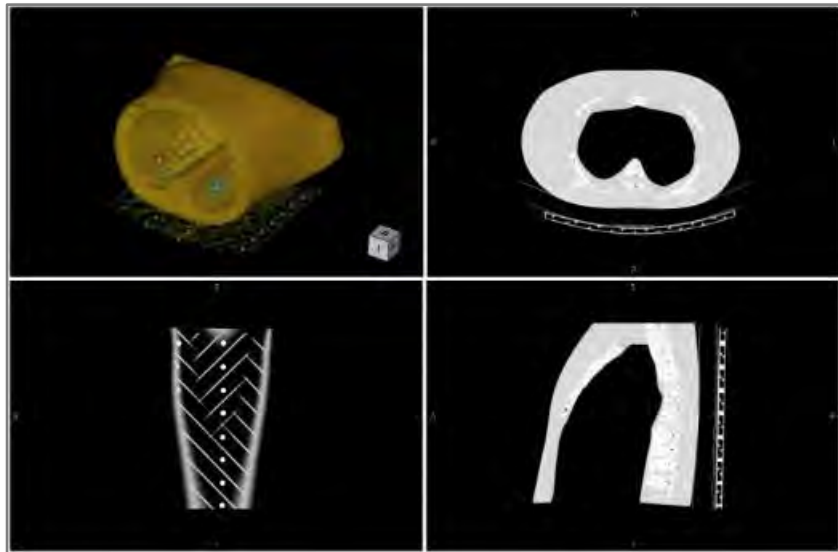
# CTLX2 Phantom

## Supports Dose vs Image Quality Analyses



We Will Soon Have 20 CTLX2 Phantoms Distributed In the Poland, US, and Italy

# CT Table Phantom



Provide CT Image Quality Guidance  
In Real-Time And For Every CT Slice

# Potential Areas of SLN Profile Improvement

1. Resolving Large Software Bias Measurements
2. Support Sites Using of Different Scanners
3. Recognizing Stability of Image Quality
4. New Capabilities of the CTLX2 Phantom
  - Optimizing Dose vs IQ Tradeoffs
  - Portal to Insert Objects (Synthetic Nodules)
5. Real-Time Table Phantom Guidance
6. Add Guidance For Part-Solid Lung Nodules
7. Others Candidates?

**Thank You**