Improving the Impact of the QIBA CT Small Lung Nodule Profile

Rick Avila
rick.avila@accumetra.com

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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.

<table>
<thead>
<tr>
<th>Nodule Diameter</th>
<th>Diameter Change %</th>
<th>Volume Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0</td>
<td>17%</td>
<td>59%</td>
</tr>
<tr>
<td>7.0</td>
<td>14%</td>
<td>49%</td>
</tr>
<tr>
<td>8.0</td>
<td>13%</td>
<td>42%</td>
</tr>
<tr>
<td>9.0</td>
<td>11%</td>
<td>37%</td>
</tr>
<tr>
<td>10.0</td>
<td>10%</td>
<td>33%</td>
</tr>
</tbody>
</table>

**+1mm Max Diameter Increase**

**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

- **Fundamental CT Image Properties**
  - 3D Resolution:
    - 3D PSF Ellipsoid Volume <= 1.5mm$^3$
  - 3D Resolution Aspect:
    - PSF Z/X <= 2.0
  - Linearity Bias:
    - Air and Acrylic Bias < 35 HU
  - Image Noise:
    - Acrylic Noise <= 50 HU SD
  - Kernel Edge Enhancement:
    - Air to Delrin Enhancement <= 5%
  - 3D Spatial Warping:
    - Delrin Cylinder RMSE <= 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

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

$250$
RSNA/QIBA Conformance Certification Pilot Project
Using Cloud-Based Computing Services

http://accumetra.com

Check Each Time Scanner or Protocol Changes and Once Per Year

Upload

Email

Optimize

+ Performance Prediction
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 1st 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
Large and Growing CT Image Quality Database
QIBA COVID-19 CT Imaging Guidance

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

T1

Δ

T1 + 90 days
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

Will Contain 3 Small Modules Similar To The CTLX1

+ Outer Channel To Add Varying Amounts Of Water

+ Additional Components Including Some Spheres and Ellipsoids

+ An Additional Access Port

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