Proposing A National Infrastructure For Implementing Quantitative Imaging Quality Processes

Lung Cancer Workshop XIII
June 13, 2016
Long-Term Vision

Automated Data Transfer
- “Push” 3D Series
- Send back IQ Report with personalized feedback

Protocol Scans

Patient Scans

Continuous Guidance
- Published Reports
- FAQs
- Web Calculators

Verify
National Image Quality Monitoring Proposal

• We have a highly efficient and scalable image quality monitoring infrastructure up and running
  • Ultra-low cost CT phantoms requiring <= 5 min to scan
  • Web-based Calculator(s)
  • Running on the Amazon Web Services (AWS) cloud

Phantom Cost < $50
AWS Cost < $0.05
SW Dev & Maintenance Will Be Largest Cost
Data Collection

**Fundamental Image Quality Metrics**

- **CT Linearity**
  - Air, Acrylic, Delrin, Teflon

- **3D Gaussian PSF**
  - X, Y, Z Sigma

- **Sampling Rate**
  - X, Y, Z Distance

- **Image Noise**
  - Tape HU SD
  - Other Noise Measures

- **Edge Enhancement**
  - Max Mean Edge HU / Mean Tape HU

**Estimated Clinical Task Metrics**

- **Small Nodule Detection**
  - 3, 4, 6, 8 10 mm ellipsoids

- **Small Nodule Change Measurement**
  - 4, 6, 8, 10 mm ellipsoids

- **COPD Metrics**
  - Emphysema metrics
    - 1, 2, 3 mm airway wall

- **Cardiac Calcification**
  - 1, 2, 3 mm ellipsoidal calcifications

- ...

All Metrics As a Function of Distance From Iso-Center

Can Add Software Performance Testing As Well
Procedures

• Sites scan a calibration phantom each time they modify a quantitative imaging protocol
  • Each site receives personalized feedback on protocols including fundamental metrics, how well the protocol is performing for each relevant clinical task needed, and how well their scanner/protocol is performing with respect to similar equipment

• Sites also optionally send some percentage of de-identified scans corresponding to a certified protocol to collect additional data with a patient in the gantry.
Site Benefits

• Upon Joining Sites Will Be Able To Quickly Converge On Globally Verified Protocols For Specific Scanners

• The System Will Find Calibration Issues That Local Physicists Will Need To Investigate – Reducing # of Poorly Performing Patient Scans

• The Site Will Have Access To Many Online Guides, Resources, Datasets, and Calculators
Global Benefits

• For The First Time We Will Have A Detailed View of The Quality of Population Scanning And Be Able To Longitudinally Track Global Performance Trends

• Best Practices Will Take Hours To Days To Disseminate

• Researchers And Study Sponsors Will Be Able To Much More Carefully Control The Quality of Imaging Studies

• The Quality of All Imaging Research Publications (That Leverage These Resources) Will Increase