Title: Initial Results from A Novel and Low Cost Method For Measuring CT Image Quality

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Background: Accurate measurement of change in tumor size in Computed Tomography images is critical for lung nodule differential diagnosis. Standard CT scanner calibration phantoms and methods are routinely relied upon to ensure that image quality is generally sufficient for a wide range of imaging tasks. However, high precision medical imaging applications, such as RECIST and volumetric tumor change measurement, require much greater attention to maintaining consistently high image quality characteristics. A new ultra-low cost, and cloud based method has been developed to quickly assess the image quality of CT scanners and imaging protocols that provides both estimates of clinical task performance, such as lung tumor size measurement error rates, and fundamental image quality performance metrics. In addition, multiple large imaging organizations have made available lung cancer screening guidance documents indicating that CT slice thicknesses of <= 1.25 mm are either required or preferred.

Methods: To demonstrate the image quality site measurement capability a global challenge was launched during May and June of 2016 that allowed lung cancer screening sites to scan three rolls of 3M ¾ x 1000 inch Scotch Magic ™ Tape placed at increasing distances from iso-center on the CT table and using their standard low dose lung cancer screening protocol. Fully automated software detected the rolls of tape and estimated fundamental image quality parameters including CT linearity, 3D resolution, noise, and level of edge enhancement. In addition, metrics indicating the expected detection and volume change measurement performance for different diameter lung nodules were calculated.

Results: A total of 27 clinical sites participated in the challenge and provided CT imaging data on over 54 CT scanners representing 18 scanner models made by Siemens, GE, Philips, and Toshiba. 17 out of 27 (63%) clinical sites provided data with <= 1.25mm DICOM specified slice thickness. However, only 19% of sites used <= 1.25mm slice thickness and a reconstruction kernel that avoided excessive smoothing and avoided high levels of edge enhancement.

Conclusion: A new rapid, ultra-low cost, and cloud based method for assessing the quality of CT imaging studies has revealed poor adherence to recommended protocols and large levels of variation in fundamental image quality properties. Utilization of these new tools has the potential to help correct image quality issues in clinical studies.