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Automatic Estimation of Measurement Error on CT Imaging

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Background

There has been increasing recognition that lung nodule measurement on CT scans is imprecise and that an understanding of the extent of this imprecision is necessary when trying to determine whether actual change in volume has occurred. The various factors that influence this are numerous with two of the most prominent being the overall quality of the CT scan (including all of the adjustable parameters) and the size of the nodule.

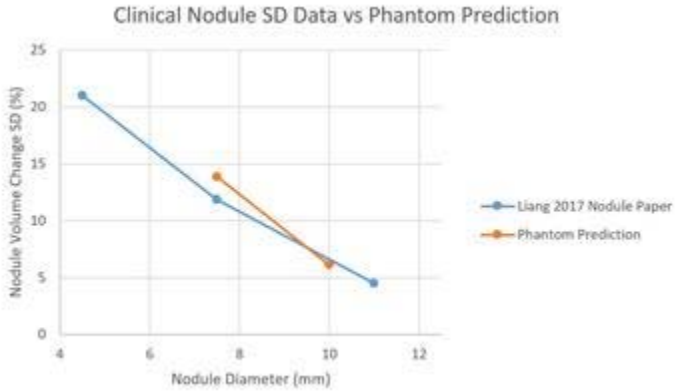
Method

We have developed an automated system whereby a calibration device is scanned on a given scanner with a given protocol and then the system can automatically predict the extent of measurement error for a given size solid nodule. We compared this approach to empirically derived results obtained from a database of 117 screen-detected stable nodule ranging in size from 2.2 to 18.7 mm that were scanned twice on the same CT scanner using the same protocol. Automated volumetric analysis was performed using commercial software. This allowed us to determine the relationship between standard deviation of the measurements versus nodule size. We then scanned our calibration device using the same scanning protocol as was used on those nodules to automatically calculate the size and standard deviation relationship.

Result

Predicted solid nodule volume standard deviation compared with empirically derived values across a range of nodule sizes was within 20% (see figure)

automatic estimation fig.jpg



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Conclusion

Results from our automated approach were highly correlated with results obtained from scans obtained in actual clinical practice. The ability to predict extent of error specific to a given scanner and scanning protocol is an essential step in understanding whether change has occurred and has implications for both diagnosis and therapy assessment, including predicting when a follow up scan should be obtained. This type of information will ultimately become a necessary component of all quantitative imaging programs.

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