Evaluation of Siemens SOMATOM CT-Simulator Reconstruction Space And Correlation Of Physical And Clinical Image Quality

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I. Spatial Resolution

\[ M_{IB} = \frac{S_2 - S_1}{S_2 + S_1} \]

\[ N_{IB} = \text{line bar ROI}_{4th} \text{ percentile value} \]

II. ROI Contrast

\[ C \% = 100 \frac{S_2 - S_1}{S_2 + S_1} \]

III. ROI Noise

\[ N \% = 100 \frac{\sigma_1 + \sigma_2}{\sigma_1 + \sigma_2} \]

IV. Contrast-Noise Ratio

\[ M_{IB} = \frac{S_2 - S_1}{S_2 + S_1} \]

The Siemens SOMATOM Definition Edge CT-Simulator, like many other simulators, comes with a variety of scan reconstruction capabilities. Some of these settings are proprietary algorithms that handle raw scan data in undisclosed manners or of minimal vendor description.

The purpose of this project was to evaluate the impact of CT-simulator reconstruction settings on image quality, focusing on spatial resolution, contrast, noise and contrast to noise ratio. Reconstruction settings that were varied included

- Reconstruction kernel
- Slice thickness
- Strength of the Sinogram Affirmed Iterative Reconstruction (SAFIRE) setting.

A secondary objective was to determine if the results of reconstruction settings would translate from a phantom image set to patient image sets.

Methods

A CatPhan 504 phantom was scanned on a Siemens SOMATOM Definition Edge CT. The raw image data was reconstructed with each unique combination of Slice Thickness [0.5, 1, 1.5, 2 mm], SAFIRE Strength [0, 1, 3, 5], and Reconstruction Kernel [Br38, Bv66, Hr38, Hv49, Qr40, Qv43] (96 in total).

Image sets were evaluated with DoseLab Pro v6.80 for:

- Spatial Resolution
- ROI Contrast
- ROI Noise
- Contrast-Noise Ratio

For the CatPhan images, there were clear differences in the image quality parameters between the various reconstruction combinations. Spatial resolution and contrast remained nearly constant for reconstructions of the same kernel. Slice thickness and SAFIRE strength settings had minimal influence on these image quality parameters. The improvement in noise was also reflected in the reconstructed clinical image sets supporting the idea that a phantom can serve as a surrogate to systematically analyze reconstruction settings.

Conclusions

This work can serve as a framework for analysis of other kernels available on the Siemens Definition Edge CT-Simulator. Additionally, other anatomical sites should be evaluated for mean HU and noise level impacts. An inter-machine comparison of physical and clinical reconstruction image qualities is warranted to further support trend consistency and overall fidelity of this data set.

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References

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