Purpose: The advent of CT iterative reconstructions in the clinic has posed an increasing challenge on the community in our ability to assess image quality due to increased non-stationarity and non-linearity of reconstructed images. The purpose of this study is to investigate the potential of a novel phantom aimed to enable a robust assessment of image quality of CT images including iterative reconstructions.

Method and Materials: A cylindrical phantom was built from a series of slabs with removable rings to simulate diffrerent patient sizes. The “noise slab” consists of a uniform piece of acrylic for the noise-power spectrum (NPS) measurement. The “resolution slab” consists of an array of spheres of various materials to simulate a range of contrast levels found in CT images. Each set of spheres can be used to measure the modulation transfer function (MTF) as a function contrast, dose, and location. The “dose slab” enables the incorporation of ion chambers, while the last slab contains cylindrical inserts for CNR measurements. The phantom was scanned on a 64 slice CT and reconstructed with filtered-back projection (FBP) and a model-based iterative reconstruction algorithm (MBIR). Images were used to derive the relevant image quality and dose metrics.

Results: The NPS measurement enabled the characterization of different textures between FBP and MBIR. Contrast and dose were found to have a significant impact on the MTF for the MBIR data. The task-based detectability index computed from the MTF and NPS agreed qualitatively with image quality and yielded quantitative estimation of dose reduction provided with iterative reconstruction algorithms.

Conclusions: Initial results showed that a phantom can be used to measure imaging performance of non-linear reconstruction algorithms. Results suggested that a task-based approach to system performance assessment may be essential to properly compare image quality between different protocols when employing iterative reconstruction algorithms.

Funding Support, Disclosures, and Conflict of Interest:

The authors have received funding support from GE healthcare.