AbstractID: 8712 Title: Low-contrast Detectability for X-ray Computed Tomography

Low-contrast-detectability (LCD) is one of the important performance parameters for computed tomography (CT). Often LCD is determined by visual inspection of low-contrast phantom images. The testing process is gated not only by limitations of existing LCD phantoms, but also by the subjective nature of the evaluation methodology. Although statistical LCD methods were proposed, these methods often unfairly favor post-processed images, since they measure mainly the noise characteristics in uniform portion of the phantom and do not consider the impact on LCD objects.

In this paper, we present a measurement methodology that incorporates the LCD objects as part of the testing process. To overcome limited availability of low-contrast phantoms in terms of object size and contrast level, computer simulated objects are inserted into the reconstructed uniform phantom images prior to the post-process filtering steps. These test objects are obtained by convolving the ideal disc shaped objects with the point-spread-function (PSF) of the system. We also propose a LCD index that incorporates the object contrasts and noise levels of the LCD images. The index is defined as the ratio of the measured object contrast over the standard deviation of means measured over a region equal to the LCD object size. This index overcomes the shortcomings of the previously proposed statistical method in which the visibility of post-processed low-contrast objects are over-estimated.

Extensive phantom tests were conducted. Existing statistical-based LCD measure was compared with the proposed LCD index, and both were judged against visual inspection of experts. Phantoms vary over different contrast, object size, scan techniques, and reconstruction kernels. Test results have shown that the proposed LCD method outperforms the existing method and correlates well with human observers. Future extension of the algorithm includes the refinement of the LCD object shape and the non-stationary characteristics of the PSF and noise in CT systems.