AbstractID: 11792 Title: Iterative Image Reconstruction for CBCT Using Edge-Preserving Prior

Purpose: To improve the image quality of low-dose cone-beam CT (CBCT) using an iterative image reconstruction algorithm with an edge-preserving prior.

Method and Materials: We reconstructed CBCT image by minimizing the objective function based on the penalized weighted least-squares (PWLS) criterion with an anisotropic quadratic penalty. The penalty or the prior constraint is applied on neighboring voxels in the image domain, where the gradient of image intensity controls the degree of smoothness in the reconstructed image. For neighbors associated with large gradient, such as the region around sharp edges, equivalence between them will be discouraged. CBCT projection data of a quality assurance phantom was acquired by a Varian Acuity simulator (Varian Medical Systems, Palo Alto, CA). Contrast-to-noise ratio (CNR) and modulation transfer function (MTF), which characterizes the spatial resolution of the reconstructed image, are used to quantitatively evaluate the proposed algorithm.

Results: At matched spatial resolution, CNR of a low-contrast region-of-interest in the image reconstructed by the proposed algorithm is 2 times higher than that in the corresponding image reconstructed by the analytical FDK algorithm. Compared with the projection domain smoothing algorithm, the iterative image reconstruction algorithm based on the image domain PWLS criterion produces higher resolution image at matched noise level. Comparison studies with conventional isotropic quadratic penalty and Huber penalty also show that the proposed anisotropic penalty generates images of better spatial resolution at matched noise level.

Conclusion: CNR in the low-dose CBCT image can be significantly improved without loss of spatial resolution by using the proposed iterative image reconstruction algorithm. Imaging dose of CBCT can be lowered using statistical image reconstruction algorithms.