Purpose:We propose a half blocker-based approach, in conjunction with a Feldkamp-Davis-Kress (FDK) algorithm, to correct scatter-induced shading artifacts by simultaneously acquiring image and scatter information from a single-rotation CBCT scan.
Methods:A custom beam blocker, comprising of finely spaced lead strips, was mounted to the kV x-ray source of the Varian TrueBeam OBI system in a novel manner that enables image data acquisition on one side of the projection data and scatter data measurement on the other half side. Using the scatter distributions on strips, interpolation and extrapolation are applied to arrive at patient specific scatter information for the CBCT scan. The estimated scatter is subtracted from the image data of projection image acquired at the opposite view. To suppress the noise level produced by geometric errors between two opposed projections and interpolated scatter information, total variation regularization is applied by the minimization procedure based on the steepest gradient decent optimization. With half regions of all projections where subtraction and regularization steps are completed, a FDK algorithm based on cosine weighting function is performed to reconstruct CBCT volume. The experimental studies using Catphan504 phantom were carried out to evaluate the performance of the proposed scheme.
Results:The scatter-induced shading artifacts were markedly suppressed in CBCT using the proposed scheme. Compared with CBCT without a blocker, the mean relative error and CT number errors in the regions of interest were significantly reduced to 2% and less than 20. Also, the proposed approach showed the contrast-to-noise ratio with spatial resolution comparable to images reconstructed with scatter-free projections acquired from narrow x-ray collimation.
Conclusions:A half blocker-based FDK reconstruction algorithm has been established. The proposed scheme simultaneously reduces imaging dose at shaded regions and leads to complete volumetric information from current CBCT acquisition protocol without additional requirements such as prior images, dual scans, or moving strips.

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