AbstractID: 12967 Title: Correction for the 'Black Hole' Artifact in Cone-Beam Computed Tomography

Purpose: An artifact typically seen in axial cone-beam computed tomography (CBCT) reconstructions is a dark region or 'black hole' situated beneath the scan isocenter. We have traced the cause of the artifact to scattered radiation coming from the patient table. The artifact is most severe for offset-detector scans and is especially significant in image-guided radiotherapy (IGRT) where patient tables have flat tops and are larger than those used for diagnostic radiology. To address this problem, we have developed a hybrid scatter kernel superposition (SKS) method designed to correct for scatter from both the object-of-interest and the patient table.

Method and Materials: The proposed algorithm uses separate kernels to estimate scatter from the patient table and the object-of-interest. For each projection image, the location of the shadow cast by the patient table on the imager is determined. The region not shadowed by the table is processed using asymmetric kernels that best model scatter transport through body-like objects. The patient table region is processed using a combination of the asymmetric kernels and slab-derived symmetric kernels. The composition of these hybrid kernels is projection-angle dependent. To test the algorithm, pelvis phantom and patient data were acquired using the Varian On-Board Imager (OBI) and processed. Artifact intensities and HU accuracies were assessed.

Results: The hybrid kernel algorithm produced substantially better scatter estimates than previous SKS methods. HU non-uniformities in the pelvis phantom were reduced from 97HU to 29HU. In the *in vivo* scan, the black hole artifact was reduced by 128HU and anatomical details were made more visible.

Conclusions: Radiotherapy patient tables can produce significant scatter-related artifacts. The proposed hybrid SKS algorithm effectively addresses this problem. Scatter from both the object-of-interest and the patient table was accurately estimated, and image uniformity and HU accuracy were greatly improved.

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