AbstractID: 13619 Title: An analytic cone beam CT reconstruction algorithm for double-orbit axial acquisition

Purpose: Linac-mounted Cone Beam CT (CBCT) imaging is an important tool for IGRT. However, the limited longitudinal coverage hinders its application in the radiation oncology. We describe a FDK based analytic image reconstruction algorithm to reconstruct images from projections of two axial gantry rotation orbits.

Materials and methods: We have implemented a procedure to extend the longitudinal coverage of our Varian Trilogy OBI/CBCT system consisting of two sequential single-orbit data acquisitions separated by a pre-defined superior-to-inferior (SI) shift. The CBCT image sets of these two acquisitions overlap in the SI directions due to x-ray beam divergence. Our reconstruction algorithm is derived from the FDK method using a specific weighting scheme that is applied to backprojected rays from this overlap region. The weight of ray passing through an overlap voxel is a function of its distance from the central plane of its acquisition orbit. The sum of weighting factors is unity for any pair of complementary rays from different orbits that intersect the same voxel. Unity weights are assigned to all rays intersecting voxels that arise from the non-overlapped region. As the weighting scheme is implemented on the backprojection process for each voxel in each view, our algorithm is more CPU intensive than standard FDK reconstruction.

Results: The reconstruction algorithm produces a seamless image volume with smooth transition to the non-overlapping volume from the two single orbit projection datasets. The weighting scheme properly manipulates the overlapping region where the voxels are sampled twice.

Conclusion: Our analytic reconstruction algorithm provides maximum dose efficiency using the detector data for image formation. However, the algorithm does not suppress the artifacts due to patient motion or physiological changes occurring during data acquisition.

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