AbstractID: 9400 Title: Streaking Artifacts Reduction in Four-dimensional Cone-Beam Computed Tomography

Purpose: In order to track tumor motion for patients with lung cancer four-dimensional CBCT (4D CBCT) techniques have been introduced to deal with respiratory motion by gating projections into several phases. However, due to the limited gantry rotation speed, fewer than 100 projections are available for the image reconstruction at each phase. Thus, severe undersampling streaking artifacts plague 4D CBCT images. In this presentation, we propose a simple scheme to significantly reduce the streaking artifacts.

Method and Materials: A prior image is first reconstructed using all of the cone-beam projection data without gating. This image volume is then reprojected to generate a synthesized projection data set. The difference projections generated from these two data sets are then gated and reconstructed to generate a difference image for each respiratory phase. The difference image is added back to the prior image to generate the final 4D CBCT image volume for each phase. A home-made motion phantom was built and scanned on a Varian Trilogy system. Projection data were retrospectively gated based on the phase information.

Results: For a given phase, only ~12 projections were selected (i.e. one projection for each respiratory cycle) to reconstruct the 4D CBCT images. The fidelity of stationary objects was preserved and descent reconstructions of moving objects were obtained. Streak artifacts were significantly reduced in the reconstructed images. A figure of merit to characterize the streak artifacts strength was introduced and about 70% streak artifacts reduction was achievable compared with traditional FDK reconstruction.

Conclusions: An algorithm has been proposed to reduce undersampling streaking artifacts in 4D CBCT. In physical phantom studies, we demonstrated that the streaking artifacts were effectively mitigated (70% reduction compared with FDK reconstruction). This correction scheme enables gating of the 4D CBCT data in a very narrow window (12~95ms) which significantly improves the temporal resolution.