AbstractID: 9069 Title: Comparison of residual motion artifacts in phase- and amplitude-binned onboard 4D-CBCT imaging

Purpose: Linac-mounted 4D-Cone Beam CT (CBCT) imaging is an important tool for extending 3D IGRT techniques to respiration-motion synchronized treatments. Our purpose is to evaluate the effects of two different projection binning strategies, phase and amplitude binning, on the image quality of our recently implemented 4D-CBCT method using the Varian On Board Imager and RPM breathing motion surrogate.

Materials and methods: We have implemented a 4D-CBCT imaging procedure that adjusts the acquisition parameters to the breathing period. The Varian Real-time Position Management system (RPM) was used to establish temporal coincidence between the respiratory motion and the CBCT projections. Projections were sorted into 10 bins. For the projections sorted into each bin, the variances about the RPM amplitude and phase means was calculated and compared to the image quality achieved in CBCT images.

4D-CBCTs were studied with a phantom with irregular motion cycle. The phantom consists of two acrylic spheres and one cylinder on a motion platform to mimic the superior-inferior tumor motion mostly seen in patients.

Results: With breathing cycle period variation but not amplitude variation, we found that amplitude binning produced fewer blurring artifacts which was consistent with RPM analysis which showed significantly smaller amplitude variances for amplitude binning. For the patient subjects, the RPM amplitude but not phase variances were smaller for amplitude binning. However, image quality was significantly better when phase binning was used. We hypothesize that the under-sampling artifacts play a major role over the motion artifacts which is the case for amplitude binning, while the phase binning has a good control of aliasing artifacts. Residual motion artifacts persist in both phase- and amplitude- binning 4D-CBCT images.

Conclusion: Optimizing the binning strategies requires understanding complex interplay between residual motion in each bin and other factors such as uniformity and adequacy of angular sampling.

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