AbstractID: 5723 Title: Four-Dimensional MVCT Reconstruction using Temporal Re-binning

Purpose: To reconstruct 4D-CT images using temporal re-binning of sinogram projections from a slow-CT scan of an object simulating respiratory motion.

Methods and Materials: A slow-CT scan of a battery-powered motion phantom was taken using a helical tomotherapy machine. The motion phantom consisted of an elliptical disk with maximum diameter of 8.5-cm, mounted on a spindle offset from the center of the major axis of the disk. The rotating spindle created a wobble in the disk's motion that simulated respiration. Atop the motion phantom, a CT resolution plug rested on a platform that moved vertically 1.5-cm with a rotational period of 7 seconds. The plug was made of water equivalent material with seven holes of with diameters ranging from 2.00-mm to 0.5-mm. The vertical motion of the resolution plug was measured using a real-time respiratory gating system. The CT image sinogram obtained from the machine detector was reconstructed using a program from the manufacturer of the helical tomotherapy machine. A program was written to shuffle sinogram projections, producing reconstructed slices over a range of movement (bin). The sorted slices were compared to the original CT images of the resolution plug. Not every bin contained a full gantry rotation of projections, and missing projections were replaced. Three replacement methods were used to obtain the best possible slice reconstructions.

Results: The reconstructed CT slices showed improvement in resolution over the CT image of the plug in motion over the entire range of bins examined. Smaller bins with fewer missing projections had similar resolution to the static CT image of the plug. It was shown that bin enlargement showed the finest resolution of the projection replacement methods examined.

Conclusions: Temporal re-binning of slow-CT sinogram projections can reduce motion artifacts and improve image resolution, but methods must be devised to accommodate for missing data.