AbstractID: 11152 Title: Uncertainty in GTV and ITV Delineation with 4DCT Imaging

Purpose: To determine geometric uncertainties in GTV and ITV delineations using RPM sorted 4DCT images for radiotherapy treatment planning. **Methods and Materials:** Three targets have been embedded within a cork block (to simulate lung tissue) and attached to a programmable motion controller to simulate lung/tumor motion. We input several breathing patterns including ideal sine waves with varying amplitudes, and realistic patient breathing patterns. The cine slices were reconstructed using RPM signal. The three targets (of known dimensions) were contoured and their dimensions were measured in the direction of motion in the 4DCT images. We measured GTV dimensions reconstructed in the phase-binned images (10 phases) and ITV dimensions reconstructed in the CT MIP and CT average images. **Results:** ITV measured in CT MIP images is superior to all other techniques used in our study, with errors < 2 mm in all cases except one, and on average 1.1 mm. The reconstruction is accurate even in cases of irregular breathing and varying amplitudes, with dimensions along the direction of motion within 9% of the expected values. For each set of phase-binned CT images, the GTV is not consistently greater or less than the actual target dimension. The errors for individual targets were maximized at large input amplitudes with the largest uncertainties at 15 mm. At phase 0 and 50 %, the measured errors were minimum. **Conclusions:** We have performed a comprehensive evaluation of the limitations of 4DCT image reconstruction and its use in treatment planning for target delineation. Specifically, we observed that a general trend of increased GTV delineation uncertainty is seen in phase-binned CT images with increasing breathing amplitude. However, CT MIP images allowed consistent ITV delineation with minimal uncertainties for all input amplitudes. This study may be useful in guiding clinical judgments in 4DCT and gating procedures.