AbstractID: 8832 Title: Accuracy in the localization of thoracic tumors using respiratory displacement, velocity, and phase

Purpose: Current 4D CT reconstruction techniques are retrospectively based on phase or displacement of the respiratory signal. Both have known limitations. The aim of this work was to evaluate the reproducibility of tumor position as function of displacement, phase, and velocity of the respiratory signal, respectively, in order to determine the optimum combination of parameters for real-time 4D CT image sorting. **Method and Materials:** Estimated tumor centroid position and respiratory signal data were acquired with the Cyberknife Synchrony system for 26 patients (52 fractions) thoracic radiotherapy patients. A reference respiratory cycle was calculated for each patient. This reference cycle was used to calculate displacement, phase, and velocity of 10 image bins. The tumor position was then sorted into these bins if the phase, displacement (inhale and exhale separately), simultaneous displacement and phase, or simultaneous displacement and velocity of the respiratory signal were within tolerances of 0.5 mm and 0.5 mm/s for displacement and velocity corresponding to the bins, respectively. For phase sorting, phase closest to the reference phase for each bin was chosen. **Results:** The mean of the standard deviations of tumor positions over all bins and all fractions for the superior-inferior direction were: 1.65 ± 0.74 mm for phase sorting, 1.00 ± 0.59 mm for displacement sorting, 0.98 ± 0.52 mm for simultaneous displacement and phase sorting, and 0.91 ± 0.53 mm for simultaneous displacement and velocity sorting. The same trend was observed for the anterior-posterior and left-right directions. **Conclusion:** This study illustrates that position of a tumor can be determined more accurately if displacement and velocity are used simultaneously as sorting parameters. A real-time displacement and velocity based 4D CT image sorting method may therefore produce smaller artifacts in 4D CT images than current retrospective sorting methods. **Conflict-of-Interest:** Research supported by 1P01CA116602.