

AbstractID: 5472 Title: Impact of fiducial marker placement for the purpose of phase definition of the respiratory cycle for 4D-CT image reconstruction

Purpose: Most 4D-CT acquisition methods rely on an externally measurable quantity proportional to the breathing cycle (e.g. chest wall excursion), for 4D-CT image reconstruction. Typically, the position of a single reflective marker placed on the patient's chest is monitored. The marker location is often chosen primarily to maximize the measurable motion irrespective of proximity to tumor location. We examine the behavior of motion of multiple markers, at different locations, placed on the patient surface during 4D-CT acquisition and evaluate the impact of marker location on respiratory cycle phase definition for 4D-CT reconstruction and its subsequent application to radiotherapy planning. **Method and Materials:** An infrared guided positioning system (iGPS), capable of tracking multiple reflective fiducials in 3 dimensions, has been adapted to provide respiratory phase information for 4D-CT reconstruction. Data for 3-5 marker positions, placed at different locations on the patients chest, from 10 patients receiving 4D-CT was examined.

Results: For most patients (9/10) motion of 3-5 markers is reasonably well synchronized suggesting no significant effect of the fiducial location. For one patient, we observed a marker on the abdomen switch from being completely in-phase to being completely out of phase relative to a marker on the center of the chest. This dramatically illustrates that the phase of a specific external marker may not correspond to the motion, external or internal, near the volume of interest.

Conclusions: The position of a fiducial marker may affect not only the amplitude of motion but also the observed phase for some patients. The importance of this phase shift depends on how the resulting 4D-CT is ultimately applied to radiotherapy planning. In particular, if specific phases (e.g. extremes) are selected for radiotherapy target definition, special attention should be paid to the location of the fiducial marker and its role in image reconstruction.