

Purpose: Two methods to generate ITV on 4DCT images are explored: direct contouring on MIP images and combining GTV contours on individual phase images. We compared these two methods on multiple 4D data sets from the same subjects.

Methods: 42 simulation and image guidance 4DCT data sets, for 9 SBRT patients treated 3-5 fractions each, were retrospectively analyzed. Two sets of ITV contours were generated from the raw 4DCT cine data for each patient scan: MIP image set [ITV(MIP)- direct contouring on MIP] and 10 phase-binned image sets [ITV(10phase)- Boolean OR of GTVs contoured on 10 phase image sets]. A single operator segmented all ITVs using a semi-automated approach with the ITK-SNAP 3D segmentation tool.

Results: The mean volumetric ratio of ITV(MIP) to ITV(10phase) across all patients was 1.02 (Range 0.56 - 1.77; 1 = ideal). The distance between the Center Of Mass of the two sets of ITVs, across all patients, had a median of 1.3 mm (range 0.1 - 7.5 mm), thus indicating that both volume and location of the ITVs generated by these two methods agree well on average across all patients, but can differ non-trivially for select cases.

Interestingly, we observed large variations between the two contouring methods for repeated scans of the same patient. For example, one patient demonstrated excellent agreement for the first (simulation) scan (agreement ratio=1.02), but then poor agreement for three subsequent scans (agreement ratios = 0.85, 1.11, 1.15).

Conclusion: ITVs generated by the two methods of MIP, and combination of 10 phases on 4DCT, agreed well on average, but differed non-trivially for select cases. In particular, we observed the potential for large variation within the same patient, when multiple 4D scans of the same patient were evaluated. This is likely attributable to daily breathing pattern variations.