

AbstractID: 7479 Title: Estimation of the error in internal target volume (ITV) of lung tumor obtained from free-breathing cine-mode 4DCT: a simulation and comparison study based on dynamic MRI

Purpose: To quantitate the error of tumor internal target volume (ITV) as determined from simulated free-breathing cine-mode 4DCT using dynamic magnetic resonance imaging (dMRI).

Method and Materials: 8 healthy volunteers and 6 lung tumor patients underwent a 5-minute MRI scan in the sagittal plane to acquire dynamic images of lung motion. A MATLAB program was written to simulate the cine-mode 4DCT acquisition by segmenting and resorting the MR images. Maximum intensity projection (MIP) images were generated from both simulated 4DCT (sCT) and dMRI, and the errors in MIP-based ITV from sCT (ϵ), comparing to those from dMRI, were determined and correlate to the subjects' respiratory variability (v).

Results: MIP-based ITVs from sCT were comparatively smaller than those from dMRI in both digital-phantom studies ($\epsilon=-21.64\pm 8.23\%$) and lung tumor patient studies ($\epsilon=-20.31\pm 11.36\%$). The errors in MIP-based ITV from sCT linearly correlated ($\epsilon = -5.31v - 6.71$, $r^2=0.76$) with the subjects' respiratory variability.

Conclusions: Because of the low temporal resolution and retrospective resorting, 4DCT may not accurately depict the excursion of a moving tumor. Using 4DCT MIP image to define ITV may therefore cause under-dosing and increased risk of subsequent treatment failure. Patient-specific respiratory variability may also be a useful predictor of the 4DCT-induced error in MIP-based ITV determination.