AbstractID: 10786 Title: Accuracy of using deformable image registration to map computed dose distributions from treatment planning CT to individual phase CTs

Purpose: Current clinical practice assumes the treatment planning dose distribution is representative of the delivered dose distribution despite organ motion. We investigate the effect of respiratory motion on calculated four-dimensional dose distributions, accuracy of only computing dose on a reference free-breathing (FB) CT, and whether dose distributions mapped through deformable image registration (DIR) using a reference computed dose distribution can replace individually calculated dose distributions.

Method and Materials: Data for this study was chosen from those patients undergoing radiation therapy for lung cancer, and accompanying 10-phase 4DCT datasets. Two patients exhibited tumor motion >0.5cm, while two exhibited motion <0.5cm. Dose distributions were calculated on each phase of the 4D dataset. The Juggler DIR algorithm was used to calculate deformation vectors between the FBCT and each phase of the 4DCT for each patient. This vector field was then applied to the FB dose distribution to deform it onto each of the phases.

Results: For individual phase dose distributions compared to their respective FB dose distributions, average agreement between dose voxels of 54.6%, 73.6%, and 84.7% were observed for 2%, 5%, and 10% dose difference thresholds. Differences between average calculated dose and average deformed dose ranged from 73.6%-78.5% dose voxels agreement for 5% dose difference, and 83.8-87.5% for 10% dose difference. Differences between average calculated dose and FB calculated dose ranged from 66.7%-79.6% for 5% dose difference, and 77.1%-89.1% for 10% dose difference.

Conclusion: The accuracy of using the dose distribution computed on the FB CT only, which represents the standard clinical practice, as opposed to the ideal case of using the dose calculated on each individual phase is of the same accuracy as using DIR to remap the FB dose distribution onto individual phases. Accuracy of DIR for dose mapping was insensitive to range of tumor motion.