

AbstractID: 3733 Title: Quantification of 4DCT determined lung tumor motion based on image registration

Purpose:

To examine the feasibility of rigid-body image registration for tracking lung tumors and to determine motion characteristics of these tumors.

Method and Materials:

Respiratory correlated 4DCT scans for 55 GTVs in 50 patients were obtained using a commercial 4DCT (Discovery ST, GE Healthcare, Waukesha, WI) which generates 10 CT datasets sorted by respiratory phase. Tumor displacements were measured with an image registration software package which uses a cross-correlation algorithm to track tumors across the 4DCT datasets, assuming rigid motion. The reference template of each tumor was determined from the physician-contoured GTV on the patient's expiratory scan. The automatic registration was validated by visually comparing the shifted GTV contours to the image of the tumor across the 4DCT datasets. The diaphragm motion was also extracted from the 4DCT images.

Results:

In 96% (53) of the cases, automatic registration of the tumors agreed with the observed tumor motion. We found that 53% (29) of tumors moved more than 0.5 cm, among which 13% (7) moved more than 1 cm with the largest observed motion being 1.7 cm. For tumor displacement along each principal axis, we found 47% (26) of tumors moved more than 0.5 cm in the SI direction. In contrast less than 2% of the tumors moved more than 0.5 cm in the lateral and AP directions. We were able to correlate tumor motion with diaphragm motion only for tumors less than 150 cc in the lateral 45% of the lung (correlation coefficient=0.83, p=0.004).

Conclusion:

Image based rigid registration is appropriate for tracking tumors moving with respiration. Motion quantification is critical in lung cancer as, per this study, half of all tumors move significantly (>0.5 cm) and this motion is non-isotropic. A strong correlation between tumor size, location and motion was only found for a small fraction (<25%) of tumors.