AbstractID: 13899 Title: Evaluation of Lung Dose Using Deformable 4DCT Registration Method

Purpose: To evaluate the effect of breathing cycles on lung dose calculation using deformable 4DCT lung registration techniques.

Method and Materials: A Philips Big Bore CT scanner was used to obtain CT images for ten lung cancer patients. Both regular planning CT images and 4D CT images were obtained for each patient. With the planning CT images, lung volume was segmented into different regions of interest, i.e. superior, middle, and inferior; mean doses of these ROIs were calculated from IMRT plans based on the same CT images. 4D CT images were divided into ten phases. Using deformable registration method, each phase of 4D CT data was registered with respect to the planning CT images, and those ROIs were transformed into corresponding volumes associated with image sets of each 4D CT phase. The doses to the new transformed ROIs were calculated after applying the same IMRT beams generated from regular planning CT. Averaged over ten phases, the resulted mean lung doses for ROIs were compared with those calculated from planning CT images.

Results: The lung dose calculation based on 4DCT images, taking into account of volume and density changes during the breathing cycle, results in a more accurate dose estimate. Without considering the lung movement presented in the 4DCT images, conventional lung dose calculation based on static planning CT could under-estimates as much as 14.4% of mean dose compared with that obtained from 4D CT in lung regions experiencing larger breathing movement. It was found that exhale phases of breathing cycle could bring more lung mass into the radiation field, and thus contribute a higher mean dose to the lung.

Conclusion: Deformable 4DCT lung registration can be used to calculate lung dose for radiation therapy. It provides more accurate dose estimates in lung regions with large breathing motion.