AbstractID: 13075 Title: Dose-volume histogram comparison between deformable and rigid motion registration in four-dimensional planning for moving targets

**Purpose:** Four-dimensional (4D) dosimetry is necessary for accurate treatment planning of moving tumors. Full 4D dosimetry involves deformable image registration for 4D dose accumulation.. However, these algorithms are computationally intensive and may fail if significant artifacts are present in 4D CT images. An alternative 4D dose accumulation method is introduced as an approximation of full 4D dose calculations.

**Method and Materials:** In our method, the deformable motion is approximated by the rigid motion. Deformable image registration is avoided in 4D dose calculation, reducing the computational time significantly. The motion magnitude and direction of each region of interest (ROI) is determined by the center-of-mass (COM) displacement. Dose matrices are registered using the COM motion vectors between respiratory phases. The dose-volume histograms (DVH) generated based on the rigid motion 4D dose calculations, $DVH_{rig}$, are compared with the ones generated by the full 4D dosimetry method, $DVH_{4D}$, and the original 3D plans, $DVH_{3D}$. A total of 6 lung cancer patients with various tumor sizes and motion ranges were randomly selected and studied retrospectively.

**Results:** For target volumes and normal structures, $DVH_{rig}$ is always closer to $DVH_{4D}$, the gold standard in this study, than $DVH_{3D}$ is. The differences depend on the volume, motion range and dose homogeneity of the original plans. For the target volumes, $DVH_{rig}$ often shows a better approximation to $DVH_{4D}$ than it does for the normal structures.

**Conclusion:** Using rigid motion in 4D dose calculation eliminates the deformable image registration process. The DVH comparison shows that it is a good approximation to the full 4D dose calculations. This approximation not only makes an alternative 4D planning method possible when artifacts are significant in 4D CT images, but also reduces computation time significantly. This could potentially simplify practical clinical implementation of 4D treatment planning.