AbstractID: 13994 Title: Evaluation of Dose Uncertainties Introduced by Dose Mapping Process Implemented in a Commercial 4D Treatment Planning System

Purpose: To evaluate dose uncertainties introduced by dose mapping process implemented in a commercial 4D treatment planning system by evaluating integral dose conservation in common volumes between unmapped and mapped images.

Method and Materials: CT images corresponding with the peak-of-exhale (T0) and peak-of-inhale (T5) from a lung patient are used. Physician drawn regions of interest (ROIs) of the rightlung, GTV, spinal cord and heart on T0 are propagated via the surface landmark-based deformable image registration algorithm built into the commercial software to generate deformation vector fields (DVFs). An IMRT treatment plan on T5 and dose distribution on T5 is calculated, and the $DVF_{T0\rightarrow T5}$ is used to map the dose from T5 to T0. Cubic ROIs with volumes of 1, 2, 4 and 8 cm^3 are selected on T0 and mapped to T5 using bitmaps to evaluate dose uncertainty as follows: let M_0, E_0, and M_5, E_5 be the mass and integral dose within the T0 and T5 ROIs. Dose uncertainty, defined as $\Delta\bar{D} = \partial\bar{D}/\partial E \times \Delta E + \partial\bar{D}/\partial M \times \Delta M = (E_5 - E_0)/M_0 - (M_5 - M_0)/M_0^2 \times E_0$, is evaluated for each ROI. The mean dose uncertainty, defined as $\Delta\bar{D} = E_0/M_0 - E_5/M_5$, is also evaluated. The mean dose, DVH and Dose-Mass-Histograms (DMHs) for critical organs are also compared.

Results: The average dose uncertainties detected are: 5.56%, 5.03%, 4.18% and 3.72% for the 1, 2, 4, and 8 cm^3 volumes respectively. The average mean dose uncertainty detected are 3.7%, 3.6%, 3.1% and 3.1%. The largest dose uncertainty points are close to the boundary of tumor.

Conclusion: Dose uncertainties introduced by the dose mapping process implemented in a commercial 4D treatment planning system are evaluated. Though the average dose uncertainty is small, some large dose uncertainties are observed. More test cases are needed. (Work supported by NIH P01CA116602).