AbstractID: 11350 Title: A 4D IMRT Planning Method Using Deformable Image Registration for Lung Cancer

Purpose:

4D CT is increasingly used to define the ITV, the envelope of the CTV as it moves during breathing, and PTV (ITV + set up margin). IMRT plans are designed to provide uniform dose to the PTV. We propose a planning method to design true 4D IMRT plans in which the PTVs of the individual phases of the 4D CT as well as the conventional PTV may receive non-uniform doses, but the cumulative doses to the PTVs of individual phases, computed using deformable image registration (DIR), are uniform.

Methods:

The non-uniform dose prescription for conventional PTV was obtained by solving linear equations by requiring motion-convolved 4D dose to be uniform to the PTV for the end exhale phase ($PTV_{50\%}$) and by constraining maximum inhomogeneity to be 30%. A plug-in code to Pinnacle was developed to perform the IMRT optimization based on this non-uniform PTV dose prescription. The 4D dose was obtained by summing the mapped doses from individual phases of the 4D CT using DIR. This 4D dose distribution was compared with that of the ITV method. The robustness of 4D plans over the course of radiotherapy was evaluated by computing the sum of the 4D dose distributions for each weekly CT mapped to the planning 4D CT using DIR.

Results:

The 4D dose distribution provided additional lung sparing by 5% for V5, V10, V20 and V30 compared to the use of the ITV method. The dose volume histograms of $PTV_{50\%}$, CTV, lung, spinal cord, and heart for the cumulative dose over the course of IMRT were similar to those for 4D dose at the time of original planning.

Conclusion:

The proposed 4D planning method may increase lung sparing compared to the ITV method used commonly in the clinics and is robust against inter fractional set-up and anatomy changes.