AbstractID: 5158 Title: A computer simulated study of dose optimization based on lung tumor probability function obtained from long time dynamic MRI scan of human subject

Purpose: To minimize normal lung dose by probability distribution function (PDF) based treatment planning for lung tumors.
Method and materials: PDFs were obtained from 5 minute dynamic MRI scans of healthy volunteers. The reproducibility of the PDF was validated by repeat scans two to four weeks later. A blood vessel in the lung was identified as "clinical target volume, (CTV)" and tracked automatically to acquire motion trajectories, which were converted to the PDF. The PDF was then incorporated into the objective function of the optimization, which was weighted by the probability of detecting the CTV at a given position. The optimization was performed for a computer simulated phantom with CTV embedded in a cylindrical lung and sequential tomotherapy delivery with beamlet size of 1×2 mm. A series of dose distributions were generated based on different optimization priorities of lung tissue.
Results: PDF based optimization produced apparently inhomogeneous dose distribution along the CTV motion axis with a peak of 160% of the prescription dose at the low probability end of CTV motion. However, in the moving coordinate, the CTV dose volume histogram failed to show substantial heterogeneity. Compared with conventional optimization, the volume of lung receiving 20% prescription dose was decreased by 44% and the mean lung dose was reduced 9.5% without compromising the CTV dose.
Conclusions and Discussion: Our optimization algorithm based on a reproducible sequential long dynamic MRI respiratory model reduces both mean lung dose and the volume of lung receiving less than 20% of the prescription dose, which are two of the best predicators of radiation-induced lung toxicity. However, very high dose delivery resolution is required for implementation that for tomotherapy may require a two pass dose delivery strategy with different jaw widths.