AbstractID: 3904 Title: A probabilistic method for online treatment plan modification

Purpose:

To develop an IMRT treatment planning method that accounts for increased knowledge of tumor and normal tissue location gained from inter- or intra-fractional imaging.

Method and Materials:

Knowledge of tumor location in each fraction or sub-fraction is represented by a probability density function (pdf), $p(n,n',t)$, that describes the probability that a voxel at index n in the planning image will be located at voxel n' at a later time t. The pdf is changing as the new information becomes available. A set of beam profiles for each fraction or sub-fraction is then obtained by minimizing the quadratic objective function by accounting for probabilistic nature of the beamlet dose distribution: $\langle d \rangle_{n,t} = \sum_{n'} d_{n'} p(n,n',t)$. in each fraction. This optimization problem is set with the intention that the beamlets that have the highest risk of missing the tumor will not be delivered until adequate knowledge of tumor location becomes available. We apply this method to a case of a disk-shaped tumor inside a disk-shaped phantom with a tomotherapy beam geometry.

Results:

The method proved to deliver more conservative dose distributions at the beginning of treatment than at the end for both inter- and intra-fractional cases. For early fractions and sub-fractions, low-risk doses were delivered to regions where the probability was high that the tumor would be present during the treatment. As knowledge of tumor location improved, the remaining dose at the periphery of the tumor was filled-in.

Conclusion:

We showed that incorporating increased knowledge about tumor and normal tissue location, obtained by repeatitive on-line imaging leads to superior treatment plans.