AbstractID: 7297 Title: A unified framework for planning uncertainty and delivery uncertainty in inverse planning

Purpose:

For radiation therapy, two kinds of uncertainties exist. The first is planning uncertainty, the uncertainty of identifying tumor from the diagnostic images. This uncertainty may come from tumor's microscopic spread, the image distortion, etc. The second is delivery uncertainty. This includes setup errors, patient intrafraction and interfraction motions. The ICRU adopted a simple solution to the problem, adding hard margins to GTV to form CTV, ITV, and PTV. Margin improves tumor coverage but increases dose to OAR. Attempts have been made to discard the hard margin around CTV and incorporate the delivery uncertainty into the inverse planning and let the optimizer to decide what the best is for patient. However, the planning uncertainty was still handled with hard margins. In this work, we developed a framework that integrates both effect in the same model.

Methods:

We establish our study in the dose delivery coordinate system, each voxel has certain probability being tumor, and certain probability being OAR. This probability can be a result of setup error, organ motion/deformation, microscopic spread of tumor, or a combination of all the effects. For each voxel receive certain amount of dose, we calculate its contribution to objective function as tumor weighted by the probability of it being tumor and its contribution as OAR weighted by the probability of it being OAR. This objective function is used for inverse planning.

Results:

We proved that our framework is equivalent to previous approaches in handling motion uncertainty. Furthermore, our framework is more computationally efficient than previous approaches.

Conclusion:

We developed a unified framework to handle planning uncertainty and delivery uncertainty inside the inverse planning process. This framework allows us to determine the optimized plan for patient with the consideration of all uncertainties. It is a better approach than simply adding a predetermined hard margin.