

AbstractID: 3098 Title: Feasibility study of dose compensation in image-guided radiotherapy (IGRT) of prostate cancer

Purpose: In image-guided radiotherapy (IGRT), volumetric information of patient anatomy at treatment conditions is made available with in-room imaging devices such as cone-beam CT. Planning margin can therefore be reduced significantly through online guidance. However, uncertainties such as organ deformation and intra-fraction motion cannot be considered this way. The purpose of this study is to investigate the use of offline dose compensation to further reduce the margin safely.

Method and Materials: In IGRT, CT scan of patient is performed at each fraction. Setup error and inter-fraction rigid motion are corrected online through couch translation and collimator rotation. The regions of interest are registered offline between treatment and planning CTs using a finite element method to account for non-rigid motion. Cumulative dose distribution is calculated and compared with the prescribed one. The discrepancy, if significant, is repaired using dose compensation technique, in which the cumulative dose distribution is incorporated in adaptive planning for future fractions. Both 3DCRT and IMRT can be used for the boost. One patient with one planning CT and 15 treatment CTs was used in this simulation. Four-field box was used in the plan where CTV was prostate itself. Zero margin from CTV to PTV was chosen to demonstrate the technique.

Results: Due to the aggressive margins, severe underdose was observed in anterior portion of CTV. The size and magnitude of underdose was reduced substantially with online guidance but was still significant. Both 3DCRT and IMRT boost were able to compensate the dose deficit without any CTV to PTV margins. Dose compensation using 3DCRT caused hot spots in CTV.

Conclusion: We have demonstrated the effectiveness of offline dose compensation technique in IGRT. It complements the online guidance by compensating for other uncertainties that cannot be reduced online. The use of dose compensation allows further margin reduction in IGRT.