

AbstractID: 2781 Title: A new cone-beam CT repositioning technique through deformable registration

Purpose: To develop a novel technique to fully utilize the 3D anatomic information provided by cone-beam CT (CBCT) on-board imager for automated patient repositioning and quantitatively evaluate its performance by comparing with the existing CBCT-guided positioning techniques.

Method and Materials: A pelvis phantom consisting of bladder, prostate, rectum, and bony structures, was constructed and scanned using a GE Discovery-ST CT for treatment planning. After applying a deformation, it was scanned again with both Varian Trilogy on-board CBCT and the regular GE CT. The internal movement of the prostate was studied by using a BSpline deformable model. With the deformable registration, the displacement of each point in the prostate-target was obtained, and the repositioning parameters were subsequently calculated by minimizing the least-square distance of all the target points between the two setups. The method was compared with the currently used positioning methods including bony anatomy alignment and minimizing CT-number difference (MCD) via rigid transformation.

Results: Both the proposed and the MCD method showed differences from bony anatomy alignment, reflecting the fact of independent internal organ motion. Discrepancy between the proposed and the MCD method was also observed: 12mm in x-, 9mm in y-, and 5mm in z-axis, respectively. The proposed method presented a better overall accuracy for the target localization as judged by the least-square distance. When regular CT was used instead of CBCT for positioning, consistent result was obtained by the proposed method, while the MCD method generated different positioning parameters.

Conclusion: With the proposed CBCT-guided repositioning technique, the uncertainty of soft-tissue target localization could be greatly reduced, ensuring conformal dose distribution to be precisely delivered as planned. This also allows implementation of conformal radiotherapy with smaller margins than currently applied, leading to less complications and improved outcome of the treatment.