AbstractID: 7715 Title: Estimation of dose variations during prostate radiation treatment due to elastic deformations of soft tissues.

Objective: The true dose distribution is subject to change due to organ shifts and also deformations. The goal of this work is to estimate the effect of the elastic organ deformations on the dose distribution for the average prostate IMRT treatment.

Methods: A prostate patient was surveyed during the radiation treatment (IRB approved). The original treatment plan was created based on the planning CT. On-board cone beam computed tomography (CBCT) images were taken before treatments for the first 5 days and once a week therafter. The prostate, seminal vesicles (SV), bladder and rectum segmented on each CBCT were deformably registered against the planning CT. The analysis was conducted with the help of C++ ITK image registration and segmentation package. Initially, a volume (e.g., prostate and bladder) segmented on the planning CT scan was aligned against corresponding volume on the daily CBCT scan using a translational filter. Then, the aligned volume on CBCT was elastically deformed (Finite Element elastic deformation method), and the computed deformation vector field was used to propagate the true delivered radiation dose distribution to the original CT-based volume of the patient.

Results: For the plan with a planning target volume (PTV) defined as a combination of both prostate and SV with a 5-mm margin, the DVH parameters fluctuated as follows (Vx denotes percent volume above x% of the prescription dose): prostate mean V100 76%, mean V95 97%, compared to the original prostate 98.15% and 100%, rectum and bladder mean V50 49% and 75% correspondingly, compared to the original rectum and bladder 50% and 29%.

Conclusions: This study shows that some deviations from the planned dose may occur due to elastic distortion of soft tissue geometry. The developed suite of applications can be used to monitor actual delivered dose to the targets and critical structures.