AbstractID: 3638 Title: Feasibility of Deformable Structure Registration Towards Calculation of Cumulative Dose Distributions

Purpose:
Cumulative dose distribution in fractionated radiation therapy is one means to evaluate the risk of complications. Yet the calculation of the distribution is highly challenging due to inter-fraction change in anatomic geometry. This work presents an algorithm for deformable image registration of bladder and cumulative dose calculation in the setting of HDR brachy-therapy for vaginal cylinder treatment.

Method and Materials:
CT scans were obtained on 20 patients with gynecological cancer who received fractionated high dose rate brachy-therapy to the vaginal cuff, with the vaginal cylinder in situ. As part of an IRB approved study, the patients' bladder filling status was intentionally different for each fraction. The bladder was manually contoured for each treatment fraction and its surface was extracted for input to a biomechanical deformable registration algorithm, which models the structure surface as a thin elastic sheet. Three anatomic correspondence points were identified for each fraction. In three patients we observed additional identifiable landmarks against the bladder wall. These extra markers as shown in each fraction were compared with their predicted location based on both the affine and deformable registration.

Results:
Compared to the bladder volume at the time of the first fraction, the ratio of the bladder volumes for later fractions ranged from 30 to 300%. Rigid and affine registration of the bladder showed poor correlation of the landmark locations. The deformable registration algorithm significantly improved the accuracy of the correlation. While validation was possible for only three patients, eight independent tests were done for different fractions.

Conclusion:
The deformable registration algorithm provides a means of tracking points on structures despite significant change in size and shape. While further validation is needed, this approach provides a means to calculate cumulative dose distributions that were not previously feasible.