AbstractID: 8754 Title: Image and Dose Processing for Image Guided Adaptive Radiation Therapy and Outcome Research

Purpose: To develop a general image processing and dose computation procedure that allows for the accumulation of accurate dose distributions for purposes of both outcome research and IG-ART (image guided adaptive radiation therapy). We applied the procedure to cone-beam CT head-neck cancer treatment cases, as well as Tomotherapy MVCT (mega-voltage CT) GYN and prostate cancer treatment cases.

Method and Materials: The image processing procedures include preprocessing, rigid and deformable registration, mesh- based structure contour propagation, and image volume composition for dose re-computation. The dose processing includes dose recomputation on the daily CT or the composed CT volume, deforming and register the daily dose to the planning dose space, dose accumulation, evaluating of the accumulated dose against the planned dose. Accuracy of image registration is very important for the entire procedure because it determines the accuracy of all later subsequent steps. In order to improve the accuracy, we preprocessed the CT images before the registration step by using various methods, including edge-preserving smoothing, Gaussian lowpass smoothing, contrast enhancement, window-level intensity transformation, and bowel gas pocket painting for abdominal regions. We used MI (mutual information) based algorithm for rigid image registration, and applied the Horn-Schunck optical flow algorithm for deformable image registration. We used a mesh-based algorithm for structure contour deformation, interpolation and smoothing.

Results: By applying these pre-processing procedures we were able to achieve improved image registration results. The computed image deformation fields were then used to propagate the structure contours from the kVCT to the current daily CT image, which could be used for dose deformation or re-computation.

Conclusion: We have developed a procedure of image processing and dose computation to support the accumulation of 'true' dose distributions. These methods could be used in both radiotherapy outcome research and adaptive radiotherapy applications. Partially supported by NIH R01 grant CA85181