AbstractID: 8861 Title: A Surface Reconstruction and Smoothing-based Re-contouring Algorithm for Target Volumes in Radiotherapy Treatment Planning

Purpose: To develop an automatic re-contouring approach for tumor volumes via surface reconstruction and smoothing. The method overcomes the limitations of traditional methods used in 3D volume reconstruction which can be quite irregular, leading to non-physical beam intensities during inverse-planning.

Method and Materials: Stacks of contours are extracted from DICOM RS files which are exported from the treatment planning system. Surface models are generated from the contours via a surface reconstruction algorithm. The surface reconstruction algorithm contains two steps. First, contours are triangulated and medial axes are computed. Then, contours on adjacent cross sections are joined to create a surface. Gaussian and other surface smoothing operators are applied to the surface models. The smoothed models are re-sliced with CT planes to produce new contours.

Results: The Gaussian surface smoothing operator is an excellent smoothing tool but suffers from the volume shrinkage problem. To circumvent this problem, a volume-preserving surface smoothing operation is implemented (Taubin's surface smoothing algorithm), which uses a non-shrinking variant of the Gaussian smoothing algorithm. As noted in the figures, the method, applied to prostate volumes, shows good correspondence between the smoothed and original volumes. The mean 3D vector distance between the smoothed and original surfaces was 0.6 mm (RMS = 0.8 mm) for an example case.

Conclusions: The proposed surface-based reconstruction algorithm produces more physically realistic, smooth target volumes in 3D while maintaining the overall structure of the original volume. Future work will include the implementation and evaluation of other surface smoothing operators as well the incorporation of the smoothed 3D volumes into treatment planning to assess the impact on inverse-planned fluence maps and IMRT dose distributions.