AbstractID: 6998 Title: Automated Propagation of Region-of-Interest Contours between 4DCT Images using a Regional Deformable Model

Purpose: To develop a regional algorithm for contour propagation between difference phases of 4D CT and show its impact on 4D radiation therapy simulation.

Methods and materials: The ROI contours were manually delineated on a selected phase of 4D CT on one of the breathing phases by a physician. A narrow band encompassing the ROI boundary was created on the image and used as a compact representation of the ROI boundary. A free form B-Spline deformable registration was carried out to map the band to other phases of 4D CT. A Mattes mutual information function was used as the metric function and the limited memory Broyden-Fletcher-Goldfarb-Shanno algorithm (L-BFGS) was employed to optimize the multi-dimensional metric function. Upon successful registration, the deformation field was extracted and utilized to transform the manual contours to other phases. A bi-directional contour mapping method was introduced to evaluate the success of the proposed technique. Three
thoracic patients with 4D CT scans were used to test the proposed algorithm.

Results: A formalism of automated contour mapping has been developed based on a regional narrow band deformable registration. Application of the algorithm to three thoracic patients indicates that clinically satisfactory results are achievable with a spatial accuracy better than 2mm for ROI mappings between adjacent phase, and 3mm between opposite phase mapping. As compared to the conventional whole image-based registration, the computation here was found to be two orders of magnitude more efficient, in addition to the much reduced requirements in computer memory.

Conclusions: A regional deformable registration is an efficient and accurate way for contour mapping and should find widespread application in 4D simulation and treatment planning in the future to maximally utilize the available spatial-tempo information.