AbstractID: 7052 Title: APT4D, an integrated treatment planning platform for 4D radiotherapy

Purpose: To develop and implement an integrated treatment planning platform for 4D radiotherapy

Method and Materials: 4D CT images of a thoracic dynamic phantom were acquired and resorted into 10 respiratory phases. A software platform called Automatic Post-processing Tool for 4D treatment planning (APT4D) was developed using Matlab 6.5. Demons-based deformable registration was performed to map the end-exhale fixed phase (50%) to moving phases such as the end-inhale phase (0%). The quality of image registration was evaluated by calculating the correlation coefficient slice by slice. Contours were automatically propagated into other phases using the deformation field computed from the image registration. Two indices (the volume intersection and the volume difference) from the manual contour were used to assess the quality of the contour propagation. The dose distribution of the moving phase was transformed to the common fixed phase and averaged with equal weighting factor. The 4D DMLC pattern was written by APT4D ready for the 4D delivery according to the 3D DMLC pattern for each respiratory phase.

Results: The correlation coefficient ranged from 0.992 to 0.999 for the re-sampled deformed moving phase image against the fixed phase image. Volume intersections between manual and automatic contouring were about 97% and 96%, while volume differences were around 2.5% and 3% for GTV and PTV respectively. Compared with individual phase dose distribution, dosimetric reductions for the spinal cord and total lungs were found for the 4D dose distribution.

Conclusions: An integrated 4D treatment planning platform, APT4D, was developed and Preliminary test involving a thoracic dynamic phantom demonstrated that APT4D integrates the whole process of 4D treatment planning including deformable image registration, contour propagation, dose map transformation and MLC combination. The automatic functionality and feasibility can facilitate an increased workload for 4D treatment planning.