AbstractID: 5726 Title: Automated Patient-Specific IMRT Quality Assurance using Exit Detector Data

Purpose: To develop tools for automatically evaluating IMRT treatments during delivery using exit detector data on a helical tomotherapy system.

Methods and Materials: Treatment delivery sinograms and exit detector data were obtained following 6 treatment delivery sequences. The delivery sequences included 1.) No known error and nothing in the path of the beam, 2.) No known error with the couch in the path of the beam, 3.) No known error with an anthropomorphic pelvis phantom in the path of the beam, 4.) 1% error with nothing in the path of the beam, 5.) 1% error with the couch in the path of the beam, and 6.) 1% error with an anthropomorphic pelvis phantom in the path of the beam. A modeling technique was developed that could learn the attenuation relationships involved with the compressed data, thus distinguishing MLC errors from patient attenuation. A principal component modeling algorithm was developed for this purpose, employing the Hotellling's T^2 statistic and the Q statistic. To develop the principle component model, the sinogram data were standardized, subtracted from one another and projected onto the model. A prospective analysis was also performed using the MLC delivery sequence to produce an expected detector signal with and without errors.

Results: The Q-statistic proved to be most useful for identifying errors in MLC openings, but correctly identified outliers and their contributing channel only when the model was trained with dissimilar (error-less and error containing) data sets. The T-statistic accounted for different attenuations present.

Conclusions: Overall, the algorithms for analyzing compressed and uncompressed data proved to be useful in identifying errors as small as 1% in the MLC sequence.