

AbstractID: 9246 Title: Automatic Detection of Delivery Errors Using Autoassociative Kernel Modeling

Purpose: The purpose of this work was to evaluate exit detector data for patients treated with helical tomotherapy. A novel technique was developed for automatically evaluating exit dosimetry using autoassociative non-parametric modeling, which has the ability to learn complex detector data relationships.

Method and Materials: The tomotherapy detector array collects and stores exit dosimetry data during treatment delivery in the form of sinograms, which contain a record of the radiation that exits the MLC and passes through the patient during each treatment. Autoassociative Kernel Modeling (AKM) is a non-parametric technique that makes parameter estimates by calculating a weighted average of a set of historical data called memory vectors. The memory vectors are contained in what is called a memory matrix, which are used to make predictions. Errors between predicted and test values were calculated using the sum of squared errors, which were used to identify faulty projections within each sinogram.

Results: A total of 121 delivery sequences were evaluated from 5 patients (*4 Prostates and 1 Head & Neck*). Major errors were detected in at least one fraction over the course of treatment for each patient in the study. Other detected errors, while smaller in magnitude, could still be an indication of machine faults. Readings from the ionization chambers located in the head of the accelerator can help classify the type of error, whether they are major anatomical misalignments, MLC positional errors, or machine output errors.

Conclusions: The key to the model is determining at what cutoff threshold to set so that all significant errors are detected while keeping reducing the number of false alarms. The results show that the model has the ability to detect errors in the exit dosimetry data. They also suggest that AKM modeling can be a useful tool in monitoring the reliability of radiation delivery.