

AbstractID: 6931 Title: Exit Dosimetry Treatment Verification using Auto-Associative Kernel Regression

Purpose: The purpose of this work was to develop a novel technique for automatically evaluating exit dosimetry on tomotherapy systems using auto-associative modeling that is robust and has the capability to learn complex detector data relationships, even with detector data with a low temporal resolution and beam attenuation from the patient.

Method and Materials: Delivery sequences from 3 patients were used in this study. Each delivery sequence was modified by reducing the opening time for random individual MLC leaves by random amounts. The error and error-free treatments were delivered with different phantoms in the path of the beam. Multiple auto-associative kernel regression (AAKR) models were developed and tested by the investigators using combinations of the sinogram data sets. AAKR is a non-parametric model that is used to predict correct values when supplied a group of sensor values that is corrupted. Models were tested using the data containing errors. However, models were never developed with data which had the same object in the path of the beam as the dataset it was testing. This allowed the testing of the model's error detection capabilities in the presence of attenuation.

Results: The results show that the model correctly distinguished the MLC positional error from changes in attenuation. The model identified errors in compressed detector data that had been summed over 94 frames. Generally, errors greater than 7 milliseconds were visually discernable. Some smaller errors could be detected, but it depended on the position of the erroneous leaf in the projection and the actual projection shape.

Conclusion: The results presented suggest that AAKR modeling could be used to monitor and eventually improve the reliability of radiation delivery. This method has the potential to play a noteworthy role in determining and possibly correcting for the types of machine-related errors that occur during actual patient treatments.