AbstractID: 3659 Title: Automated Quality Assurance using Treatment Delivery Sinograms

Purpose:
Adaptive image-guided radiation therapy (IGRT) is a new treatment paradigm where 1.) Patients are positioned daily using CT-guidance and 2.) The delivery is adjusted daily to compensate for changes in the volume, position, and deformation of anatomy. Because the adaptation is performed while the patient is on the treatment table, it is impossible to perform quality assurance (QA) testing. This goal of this study was to develop new image analysis tools for the purpose of automating patient specific QA for adaptive IGRT.

Method and Materials:
Detector data in the form of sinograms were acquired during helical tomotherapy delivery using an arc-shaped detector array that consists of 738 xenon-gas filled detector cells. A software program was developed that analyzes tomotherapy sinograms by comparing one treatment delivery sinogram with a reference treatment delivery sinogram. At present, the software offers the following options: 1.) Analysis of ionization chamber entrance doses, 2.) Sinogram exit dose error detection, and 3.) Sinogram leaf error detection.

Results:
The first step in validating the QA system was to determine the threshold for error detection. Delivery sequences were modified by inserting MLC errors of known magnitudes. MLC errors that corresponded to 20, 10, 1, 0.1, and 0.01 percent errors in dose for 1 projection (*i.e. segment*) were purposely inserted into QA delivery sequences. The Automated QA tool was consistently able to detected errors of 0.01 percent or greater from the detector data at all tested data compression ratios. However, automated MLC leaf error detection would only function using uncompressed data.

Conclusion:
Multiple techniques have been developed for analyzing sinogram detector data during, and after tomotherapy treatment delivery. A combination of these error detection methods will be used to perform automated quality assurance for conventional and adaptive radiation therapy.

Conflict of Interest:
Research supported by TomoTherapy, Inc.