

AbstractID: 5295 Title: Investigating factors affecting weight selection for safe delivery of four dimensional weighted radiotherapy (4D-WRT)

Purpose: We have developed a 4D weighted radiotherapy (4D-WRT) method based on 4D-CT imaging to reduce respiratory motion margins. Here we discuss the issues related to weighting factor selection for this method to incorporate both patient breathing variability and machine performance limitations.

Method and Materials: The Varian Real Time Position Management System (RPM) was used to measure patient respiratory motion. Free breathing was assessed based on extent of motion, breathing period, and drift of the mean breathing amplitude. Motion was also evaluated based on average marker trajectory as a function of phase for the entire breathing session. Measurements of machine limitations were conducted using a moving phantom to emulate tumor motion. The MLC motion was synchronized with the phantom motion to simulate 4D-WRT. By examining log files and film dosimetry we assess MLC motion accuracy, dose rate fluctuations, synchronization errors, and tolerance selection.

Results: The analysis of the average marker trajectory shows that the end-inhale position is more variable than the end-exhale position, and patients spend more time at end-exhale. The average extent of motion, period, and drift for these patients was 1.01cm (0.14-1.15cm), 3.80sec (2.30-7.42sec), and 0.50cm (0.14-1.15cm), respectively. There was a correlation between the standard deviation of the period and that of the extent of motion. In the log file it was found that there is a phase delay between the actual and planned MLC position of 50msec, the period of motion was greater by 1% and the amplitude was greater by 0.05cm. It is estimated that a total phase difference of about 0.2sec exists due to delays in the communication, MLC motion, and dose rate stabilization. An appropriate tolerance should be selected to prevent beam hold-off due to MLC velocity limitations.

Conclusions: Quantification of patient breathing variability and machine limitations is necessary for safe delivery of 4D-WRT.