AbstractID: 7977 Title: A Novel Technique for Closed-Loop Feedback Real-time Tracking by Controlling Dose Rate : A Parametric Study

Purpose: We have developed a new technique called dose-rate-modulated tracking (DRMT) for closed-feedback real-time tumor tracking by changing the dose rate.

Method and Materials: DRMT uses pre-programmed MLC sequences that are generated using measured data for tumor motion obtained at an earlier time. Since the leaves move, their positions are programmed with schedules that are a function of the accumulated dose. The leaf trajectory on the time axis then can be changed during treatment by changing the dose rate. DRMT changes the dose rate to minimize the discrepancy between the scheduled MLC position and the target position or breathing signal on the day of treatment. If the monitored breathing is slower than that observed at simulation, the dose rate is lowered to slow down the movement of the MLC and *vice versa*, thereby maintaining synchrony. DRMT tumor-tracking power was tested with sinusoidalbreathing functions and patient-breathing signals (RPM, Varian). The tracking error (2σ) for each breathing signal was derived as a function of the system reaction time and the dose-rate correction period.

Results and Conclusions: DRMT simulation showed that for the sinusoidal-breathing signal with 2-cm peak-to-peak tumor motion, less than 0.2 cm tracking error was obtained if the system can react to a detected mismatch in less than 0.3 s and the dose rate can be adjusted in 0.36 s. Fourteen out of 26 patients were eligible for DRMT. The selection criteria were: (1) peak-to-peak breathing motion greater than 0.5 cm and (2) amplitude variation less than 20 % during the DRMT simulation. The tracking error for the patient data is expressed as a percentage of the motion amplitude. A tracking error of less than 20 % was achieved for 13 out of the 14 patients if the system can respond in 0 s.