

AbstractID: 5339 Title: Synchronized Dynamic Dose Reconstruction

Purpose: To present a dose accumulation method that explicitly incorporates real-time target volume motion, and real-time machine configuration, MLC motion and fluence state.

Method and Materials: Effects of inter- and intra-fraction motion on dose distributions delivered to a target volume are typically estimated by statistical methods that rely on idealized assumptions such as constant random and systematic errors, and constant offsets, periods and amplitudes of motion over the entire course of therapy. In addition, implementation and delivery related issues such as leaf sequencing limitations, spatial interplay between MLC leaf and target volume motion, and temporal interplay of the fluence state in IMRT, are assumed to average out during treatment. To include these effects, a dose accumulation technique is proposed which explicitly incorporates real-time target volume motion data, and real-time treatment machine data. Several technologies are becoming available to continuously monitor (10-30 Hz) the patient position, organs-at-risk, and the target volume during therapy. Likewise, real-time (20 Hz) machine configuration, leaf position and fluence state data, is currently available in the Varian DynaLog files. These datasets are synchronized at the beginning of each beam; and the Monte Carlo method, which inherently accounts for time dependence, was used for dose calculations.

Results: By synchronizing target volume position, machine configuration, leaf positions and fluence state, with sub-second resolution, the dose delivered by each beam, may be accumulated. Such accumulated dose distributions reflect the interplay between target volume motion, MLC leaf motion and other machine-related delivery effects based on real-time, patient specific, measured data. The delivered dose distribution to date may then be compared to the planned dose distribution to provide input for dynamic refinement of treatment planning and delivery.

Conclusion: Delivered target volume dose may be reconstructed using real-time motion and machine data, and serve as a basis for dynamic refinement of treatments.