

JUNIOR INVESTIGATOR COMPETITION

Purpose: Due to the complicated technical nature of gated RT, electronic and mechanical limitations may affect the precision of delivery. The purpose of this study is to investigate the temporal, dosimetric, and geometric accuracies of gated RT.

Method and Materials: A Varian Trilogy, equipped with a RPM system, is used to examine the accuracy of both un-gated and gated deliveries. Data recorded using radiographic films and EPIDs allow extraction of geometric and system response accuracy. The dosimetric precision of each segment making up a step-and-shoot IMRT treatment plan is individually recorded and analyzed using ionization chamber methods.

Results: The time required from when the target object enters the specified phase to when the radiation beam is actually turned on is approximately ~ 0.15 s. This time error is systematic and is the same for both normal and SS-IMRT gated deliveries. Dosimetric data from 50+ repetitions of a fixed segment dose for both un-gated and gated deliveries are obtained. At higher dose rates, the dosimetric errors are seen to become greater in the gated case. A geometric comparison of the un-gated to gated RT delivery show clear positional inconsistencies in the thicker outer MLC leaves in the non-gated case. These leaf positional discrepancies are attributed to motion of the thicker outer leaf pairs while the radiation beam is on.

Conclusion: A system response time of ~ 150 ms is obtained using a simple moving phantom procedure. Dosimetrically we have found that gating negatively effects dose accuracy by interruption of the “overshoot” effect. This interruption could lead to large dosimetric errors, especially for plans consisting of a large number of small MU segments that are delivered at high dose rates. Geometrically very little error for both un-gated and gated deliveries are seen, provided that a well-defined leaf tolerance is used.