AbstractID: 7039 Title: Latency Measurements and Demonstration of a 4D Electromagnetic Localization System for LINAC Beam Gating

Purpose:
The Calypso® 4D Localization System uses electromagnetic fields to localize and track Beacon® transponder implants. In this study, we used the Calypso® System to perform real-time beam gating based on transponders mounted to a dynamic phantom. The system's latency was studied in conjunction with a Varian linac to determine feasibility of enabling gated radiation therapy delivery for respiratory applications.

Method and Materials:
An acrylic transponder holder with three embedded Beacon® transponders was placed 6 cm from the center of a rotating disk on a dynamic phantom. Film measurements were made with a 2 cm by 2 cm field delivered in a static, dynamic-gated, and dynamic-non-gated fashion. A linear gating window with a 2 mm width was used for the film demonstration. Latency measurements compared an in-volume / out-of-volume signal obtained directly from the dynamic phantom to the target-current signal from the linac. The target signal represents the measured current in the MV electron beam, and is directly correlated to the presence (or absence) of the treatment beam. The investigational prototype gating system does not used predictive modeling; the linac beam is enabled when the transponder is within the gating window based solely on the last position estimate of the transponder.

Results:
Film measurements demonstrated that signals from a prototype electromagnetic gating system can be used to effectively trigger the beam on/off state of a linac. The combined, motion-triggered latency of the localization system and linac was 65 msec to disable the beam and 75 msec to enable the beam.

Conclusion:
Use of wireless electromagnetic implanted transponders has the potential to enable real-time linac beam gating with the latency and update rates required for respiratory applications without the use of predictive algorithms.