AbstractID: 13252 Title: Proof-of-Principle Investigation of Computer-Controlled Couch Adjustments for Correcting Drift in Target Position during Radiotherapy

Purpose: Tracking and correcting for respiratory motion during external beam therapy is technically challenging, owing to rapid and irregular variations. This study investigates the feasibility of correcting for respiration-averaged drift in target position by means of couch adjustments on an accelerator equipped with such capability. This is particularly applicable to hypo-fractionated radiation therapy where high precision is required subject to longer treatment times. **Method and Materials:** We consider a treatment scenario consisting of repeated 10s sequences of dose delivery alternating with couch adjustments for a respiration-monitored patient. The motion period is computed at 1s intervals; averaging the motion signal over 3 periods yields a baseline representing target drift. Application of a Kalman filter, tuned from a set of 100 patient RPM signals (3-5 minutes), allows prediction of the baseline position 5s in advance and computation of couch corrections every 10s. A motion phantom is programmed to move according to a previously recorded patient respiration signal (Varian RPM). The phantom is monitored by an optical system whose signal is assumed to represent internal target motion. The couch corrections are programmed into the accelerator and synchronized with the phantom motion to evaluate the system's ability to correct for drift. **Results:** For 6 longer patient respiration signals (21-65 minutes) the Kalman-predicted correction reduced RMS baseline drift from 2.1mm without correction to 0.6mm. When the motion phantom was programmed with a breathing trace with 10mm drift over 140s, the drift was reduced to 3mm with couch corrections. **Conclusion:** A proof-of-principle is demonstrated for correcting drift in target position using periodic couch adjustments. Future machine capabilities will permit near-real-time couch correction computation and application. Preliminary results suggest Kalman-filter-based corrections at 10s intervals based on a 5s prediction window are effective at reducing drift. Research sponsored by Varian Medical Systems.