AbstractID: 6415 Title: Tumor trailing strategy for IMRT in the presence of target motion: preliminary studies

Purpose: Previously proposed approaches to mitigate the effect of internal motion in IMRT include motion-correlated delivery (gating, tracking), and adaptive treatment plan optimization employing a probabilistic description of motion (pdf). We test "tumor trailing" strategy, utilizing the synergy of motion-adaptive treatment planning and delivery methods.

Methods: The target motion is a superposition of a "fast" cyclic component (respiratory) and "slow" aperiodic trends (exhale baseline drift). The trailing strategy employs real-time motion monitoring to identify "slow" shifts, and corrects for these by applying set-up (e.g., couch position) adjustments. Delivery does not track the target position exactly, but *trails* the slow systematic trend due to the delay between the time a shift occurs, is reliably detected and, subsequently, corrected. The "fast" cyclic motion is accounted for with robust motion-adaptive treatment planning, which allows for variability in motion parameters [Chan *et al. Phys. Med. Biol*. 51:2567-83 (2006)]. Motion-surrogate data from gated IMRT treatments were used to test algorithms that identified systematic shifts (based on observation of "running mean" position), and to provide pdf data for motion-adaptive planning. Test IMRT fields were delivered on linac to a programmable moving phantom. Dose measurements were performed with a commercial two-dimensional ion-chamber array.

Results: Detection of systematic shifts was possible with a delay of 12-15 seconds. Correcting for slow systematic shifts during delivery of motion-adaptive plans led to improvement in dose uniformity, conformity to target (vs. standard).

Conclusion: By reducing intrafractional pdf variability, trailing strategy enhances relevance and applicability of motion-adaptive planning methods, improves conformity of delivered dose to the target in the presence of irregular motion. In combination with respiratory gating, trailing can increase the duty cycle, account for residual motion within the gating window. It requires relatively minor modifications to software, equipment already in place for respiratory-gated treatments.
Supported by NIH (5P01-CA21239-25), MIT, DKFZ grants.