AbstractID: 5476 Title: On the accuracy of a moving average algorithm for tracking respiratory motion during radiation therapy treatment delivery

Introduction: Real-time motion tracking (RTT) treatment delivery has several advantages toward the improvement of accuracy for radiotherapy. However, currently there are certain limitations to this technique. The purpose of this study was to investigate an alternative treatment scenario using a moving average algorithm (MA) for treatment which could potentially be approaching the accuracy of RTT.

Method: A comparison was performed between three different treatment scenarios

(1)RTT: $X_{est}(t) = X_{act}(t - RT)$;

(2)MA: $X_{est}(t) = mean[X_{act}(t - RT) : X_{act}(t - RT - n)]$;

(3)Static beam delivery (SB) $X_{est}(t) = mean[X_{act}(0) : X_{act}(n)]$

Where $X_{est}(t)$ and $X_{act}(t)$ are the estimated and actual position at time *t*, *n* in seconds is the averaging period (5-25 seconds range). The data used for this analysis was 331 respiration-motion traces from 24 lung-cancer patients acquired using three different breathing types (free breathing(FB), audio coaching(A) and audio-visual biofeedback(AV)). The metrics used for comparison were the group systematic error(M), the standard deviation(SD) of the systematic error(Σ), and the root mean square of the random error(σ). The averaging period was varied to study the effect on the various metrics. Margins were calculated using the formula by Stroom *et al*. *(IJROBP 1999;43(4))*

Results: M and Σ are negligible for both MA[$M \in$ (-0.01,0), $\Sigma \in$ (0,0.01)] and RTT[$M \in$ (0), $\Sigma \in$ (0)] compared to SB[$M \in$ (-0.15,-0.02), $\Sigma \in$ (0.05-0.20)]. MA(0.48-0.54) has a slightly reduced σ than SB(0.53-0.57). Negligible improvements were found by varying the average periods for M and Σ . σ was found to be insensitive to the different averaging periods(0.53-0.56 for A). From the margin calculations FB is most affected by the different treatment scenarios. (All values in cm).

Conclusions: MA has accuracy advantages over SB and practical advantages over RTT. MA significantly reduces M and Σ compared with SB. MA and SB require less margins for AV than that for FB and A. The margins required for RTT are independent of breathing training type. There is a group systematic error caused by intrafraction motion during FB.