

AbstractID: 11494 Title: Evaluation of Internal/External Correlation with Missed Volume

Purpose: Reliable correlation between internal tumor and external marker motion is important for effective radiation treatment based on external signal, such as external gating and the CyberKnife Synchrony System. This study is to analyze the internal/external correlation stabilities by calculating the missed tumor volume.

Methods and Materials: Internal tumor and external marker motion of eight patients with multiple fractions were acquired simultaneously at 30Hz. Internal signal is the 3D tumor motion and external signal is the 1D motion of abdominal surface. The internal/external correlation was constructed using the first 3 breathing cycles. The correlated tumor position was calculated based on this correlation model with external signal. The missed tumor volume was calculated based on the distance between the internal and the correlated positions at each acquired data point. The inter-patient, inter-fractional, and intra-fractional variations of the missed volume percentage were analyzed.

Results: The results of a solid sphere tumor with different sizes were performed based on the true patient motion data. For a sphere tumor with 20mm diameter, the average missed volume percentage averaged over all treatment fractions of one patient was between 5.14% and 15.3%. The percentages changed from one fraction to another. The daily percentages varied from 3% to 6.5% for the patient with the smallest average patient-wide missed percentage. The intra-fraction motion changed from one breathing cycle to another. In one fraction of a patient, the average cycle percentages changed from 6% to 26%. Even within the same breathing cycle, the missed percentages changed greatly from one breathing state to another, with larger values (~30%) at the inhale and exhale states and smaller value (~3%) at the end-of-exhale state.

Conclusions: Strong correlations between internal and external motion exist but change overtime. Verification and updating the correlation in real-time delivery is required for effective treatment.