AbstractID: 3444 Title: Model-based Probabilistic Prediction of Tumor Respiratory Motion

Purpose: The effectiveness of radiation therapy is degraded by respiratory motion, especially in the thoracic and abdominal regions of the body. Precise tumor localization, motion characteristics, and motion prediction are essential for accurate radiation dose delivery in real-time image-guided radiation treatment. To address this problem, we propose a model-based probabilistic solution for prediction of tumor respiratory motion.

Method and Materials: By analyzing the historical motion data based on a finite state model, two probability distributions are proposed for knowledge discovery of tumor moving status. These probabilities can be used to determine the current motion state and capture transitions from one state to another. They are dynamically built and used in real-time motion prediction. Two prediction problems are studied for beam tracking and respiratory gating. The first requires continuous prediction of the exact tumor position, while the second requires predicting when the tumor will be IN or OUT of the gating window during radiation treatment.

Results: Three metrics are used to evaluate the accuracy of the prediction results: 1) the root mean square (RMS) error, 2) the gating duty cycle, and 3) the gating failure rate. Experiments on real patient data have been performed. Our model-based probabilistic prediction approach results in smaller RMS error, higher gating duty cycle, and lower gating failure rate than linear prediction. The same pattern has been observed for different patients, and with different latency.

Conclusion: A probabilistic model-based approach can be used to characterize and predict tumor motion, and offer better prediction accuracy than linear prediction.

Conflict of Interest (only if applicable):