AbstractID: 10339 Title: Adaptive gating of radiotherapy treatment based on marker-less tracking of lung tumors with kV fluoroscopy

Purpose: We investigated using kV fluoroscopy for adapting the respiratory gating window prior to each radiation treatment fraction. The gate adaptation was based on marker-less tracking of the target and correlating the internal motion trace with the external breathing signal.
Method and Materials: A phantom study was performed with the on-board kV imager of the Novalis Tx machine. A dynamic chest phantom with a water-filled sphere placed inside a movable lung density insert was utilized. Breathing traces from patients that underwent lung SBRT were used to drive the target and external surrogate motion. The Varian RPM gating system was employed to obtain an external breathing signal, while acquiring kV fluoroscopy images. The moving target was tracked and an internal signal was generated. One kV acquisition was used for adapting the gating window based on the correlation of the internal and external signal and another one for verifying the gated position of the target. Gating at end-exhale is the most commonly used technique in the clinic, while gating at mid-ventilation makes it more likely that the tolerance window for residual motion includes the tumor during the entire breathing cycle. The two gating windows were investigated and the results were compared.
Results: No significant difference in the gated target position errors was observed between the two gating windows. The target was in the expected position about 90% of the time for each one. The maximum deviation outside the tolerance window for residual motion was 1.9mm for the end-exhale and 2.2mm for the mid-motion gating windows.
Conclusion: The adapt and verify procedure examined in this study, if applied in real-time, has the potential to improve the accuracy of lung cancer radiotherapy by facilitating the reduction of safety margins used for moving tumors.
Conflict of Interest: Varian Medical Systems, Inc.