AbstractID: 6792 Title: Real-time compensation of breathing motion in radiotherapy

We have studied the respiratory motion of tumors and associated landmarks in order to develop methods that can be used to compensate for respiratory organ motion in radiotherapy and body radiosurgery applications. Breathing patterns of healthy subjects were studied for up to 20 minutes using optical surface monitoring of chest and abdomen, strain gauge transducers, and spirometry. We also studied tumor and external landmark motion fluoroscopically in a small group of lung and pancreatic cancer patients. The cancer patients had gold fiducials implanted in their tumors, allowing direct observation of the tumor motion simultaneously with the motion of other landmarks. We found that over an interval of 10 to 20 minutes, the average person's breathing pattern can be stable enough to allow real-time detection and correction for tumor motion. For those patients observed fluoroscopically, the tumor motion was always strictly in phase with the motion of external chest landmarks. However, the correlation between internal and external markers was not always linear. Over fifteen minute intervals the healthy subjects tended to pass in and out of transient states, resulting in occasional loss of accuracy in modeling the breathing pattern. We sometimes observed transient phase differences between two different synchronized measurements of healthy subjects' breathing, which disappeared once the subject settled into a steady state of quiet breathing. We thus conclude that real-time gating and/or beam-pointing corrections for respiratory motion are feasible. However, the successful respiratory compensation system must detect and accommodate breathing that is not strictly periodic and stable.