AbstractID: 4746 Title: The Use of CT Density Changes at Internal Tissue Interfaces to Monitor Respiratory Induced Lung Tumor Motion

Purpose: To describe a non-invasive method to monitor the motion of internal organs affected by respiration without using external markers or spirometry, to apply the method to construct 4D-CT datasets, to test the correlation with external markers, and to calculate any time shift between the datasets.

Method and Materials: Ten lung cancer patients were CT scanned with a General Electric Fast 4-Slice CT scanner operating in ciné mode. An external signal was also acquired simultaneously using the Real-Time Position Management (RPM) Respiratory Gating System (Varian Medical Systems). We retrospectively reconstructed the raw CT data to obtain consecutive 0.5s reconstructions at 0.1s intervals to increase image sampling. We defined regions of interest containing tissue interfaces that move due to breathing on each axial slice and measured the mean CT number as a function of respiratory phase. We constructed 4D-CT data sets by retrospectively sorting each image set based on the respiratory phase determined by the mean CT number curve. The external marker and tumor motion were directly correlated using the sample coefficient of determination, r^2. Any time shift between the two data sets was calculated by shifting the tumor motion curve until r^2 was maximized.

Results: Only three of the ten patients showed correlation higher than r^2=0.80 between tumor motion and external marker position. However, after taking into account time shifts (ranging between 0s and 0.4s) between the two data sets, all ten patients showed correlation better than r^2=0.8.

Conclusions: 4D-CT acquisition using an internal method improves the temporal registration of CT images affected by respiratory motion without the need for external markers or spirometry. A non-invasive method to directly correlate the motion of external markers and internal organs can be used to help guide decisions regarding the validity of the RPM system for respiratory gated radiotherapy on a patient-specific basis.