AbstractID: 3498 Title: A novel respiratory gating method based on automated analysis of ultrasonic diaphragm motion

Purpose: Most of the current respiratory gating systems monitor the abdominal wall movement for lung cancer radiotherapy. These systems make the assumption that this motion and that of the lung tumor are correlated. Diaphragm motion is also correlated with lung tumor motion. Research shows there is a phase shift between the abdominal wall and diaphragm motions. Previous studies used fluoroscopy to evaluate diaphragm motion. We developed a method to extract a respiratory gating signal by automatically analyzing ultrasonic diaphragm video.

Method and Materials: Volunteers were examined in a supine position and their right diaphragms were imaged with B-mode ultrasonography using a standard unit (Siemens Sonaline Prima). The analog video signal was captured with a standard pc video card (RADEON 9600XT, ATI Technologies Inc.) at a rate of 30 frames per second to decompose the video stream into frames. To reduce computation time and complexity, the region encompassing the diaphragm motion was segmented from all frames. The mutual information and correlation coefficient between a selected reference frame and all others were calculated and normalized. Diaphragm motion information was extracted for use as a respiratory gating signal.

Results: Plots of either the mutual information or correlation coefficient vs time (frame number) are periodic and match the respiratory cycle. The periodicity is independent of the selected reference frame and the shape shows only minor variations. Thus, this method provides a robust signal of respiratory motion that could be used to trigger the radiation beam.

Conclusion: A novel respiratory gating system is proposed for lung cancer therapy based on ultrasound imaging. The method is noninvasive, nonionizing, and specific, thus has the potential to be a useful respiratory gating system.

Conflict of Interest (only if applicable):