

AbstractID: 3038 Title: A comparison between amplitude sorting and phase sorting using external respiratory measurements for 4D CT

Purpose: To compare amplitude sorting and phase sorting techniques using external respiratory measurements for 4D-CT for patients undergoing quiet breathing.

Method and Materials: We have developed a 4D CT technique for mapping respiratory motion in radiotherapy treatment planning. A 16-slice CT scanner was operated in ciné mode to acquire 25 scans consecutively at each couch position. The scans were sorted into 12 respiratory-windows based on the amplitude and direction (inhalation or exhalation), and on the phase (0-360°) of a synchronized external respiratory measurement. An air content measure (the amount of air in a 16-slice CT segment, used as a surrogate for internal motion) was correlated to the respiratory amplitude and phase throughout the lung. Images reconstructed based on the two sorting techniques were displayed for a qualitative comparison. Also, the variations in the amplitude of the respiratory measurement during the entire scan session were compared using 8, 12, 24, and 48 respiratory windows.

Results: The air content showed a higher correlation with the respiratory amplitude than with the respiratory phase for most cases. Images reconstructed based on the amplitude sorting technique displayed fewer artifacts, especially at the lung-diaphragm boundaries, than images reconstructed based on the phase sorting technique. The variations in the respiratory amplitude were much smaller with amplitude sorting than those with phase sorting. These variations decreased significantly with finer amplitude respiratory windows while showed insignificant changes with finer phase respiratory windows.

Conclusion: The amplitude sorting was generally better than phase sorting, especially for patients whose breathing was less reproducible. The use of finer respiratory windows did not improve the consistency for phase sorting.

Keywords: 4-D CT, respiratory sorting, motion, radiotherapy