

Effective radiation treatment of a moving tumor requires an adequate understanding of the motion characteristics. Natural concepts such as motion amplitude, average exhale position and motion stability must be quantified both for pre-treatment planning and for on-line monitoring. To address this problem, we propose a new Hidden Markov Model (HMM) for off-line and on-line respiration motion processing. A single breathing cycle is modeled as containing three breathing states: inhale, exhale and end-of-exhale. A new online signal processing algorithm will produce exactly three line segments for each breathing cycle, one line segment for each breathing state. Our new online approach can capture the state information with high sensitivity and accuracy. The results of our segmentation methods can be used by various applications, including future position prediction, gross movement prediction, geometric/physiological correlation with tumor motions. Experiments on patient data with stable breathing patterns have been performed. The RMS error of the line segments, as compared to the original raw data, is less than 1% to the peak to peak motion.