AbstractID: 11860 Title: Quiet respiration breathing motion model parameters for free-breathing patients

**Purpose:** To determine the quiet respiration breathing motion model parameters for lung cancer and non-lung cancer patients.

**Method and Materials:** 49 free-breathing patient 4DCT image data sets (25 scans, ciné mode) were collected with simultaneous quantitative spirometry. A cross-correlation registration technique was employed to track the lung tissue motion between scans. The registration results were fed back to a lung-motion model: \( x = x_0 + \alpha v + \beta f \), where \( x \) is the position of a piece of tissue located at reference position \( x_0 \). \( \alpha \) is a parameter which characterizes the motion due to local air filling (motion as a function of tidal volume) and \( \beta \) is the parameter that accounts for the motion due to the imbalance of dynamical stress distributions during inspiration and exhalation which cause lung motion hysteresis (motion as a function of airflow). The parameters \( \alpha \) and \( \beta \) together provide a quantitative characterization of breathing motion that inherently includes the complex hysteresis interplay. The \( \alpha \) and \( \beta \) distributions were examined for each patient to determine overall general patterns and intra-patient pattern variations.

**Results:** For 44 patients, the greatest value of \( |\alpha| \) was observed in the inferior and posterior lungs. In three patients, \( |\alpha| \) reached its maximum in the anterior lung, while for two patients; \( |\alpha| \) was greatest in the lateral lung. The hysteresis motion \( \beta \) had greater variability, but for the majority of patients, \(|\beta|\) was largest in the lateral lungs.

**Conclusion:** This is the first report of the 3-dimensional breathing motion model parameter for a large cohort of patients. The overall \( \alpha \) and \( \beta \) maps varied smoothly as expected. The majority of patients exhibited consistent \( \alpha \) maps, and the \( \beta \) maps showed greater intra-patient variability. The motion parameter intra-patient variability will inform our need for custom radiation therapy motion models.

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