

AbstractID: 6783 Title: Reproducibility of Intra-fractional Lung Motion Probability Distribution Function (PDF) using Dynamic MRI: Statistical Analysis

Purpose: To investigate the statistical reproducibility of probability distribution function (PDF) of intra-fractional lung motion using dynamic magnetic resonance imaging (MRI).

Method and Materials: 9 healthy subjects and 3 lung tumor patients underwent two continuous 5-minutes MRI scans in the sagittal plane, repeated 2 weeks apart. Three pulmonary vessels from different lung regions (upper, middle, and lower) in healthy subjects and the lung tumors in patients were selected for tracking, and the displacement PDF reproducibility was evaluated as a function of scan time and frame rate.

Results: In all 9 healthy subjects, the PDF reproducibility errors at 5-minutes (mean 0.15, range 0.05 - 0.30) were significantly ($p < 0.0001$) reduced compared to those at 5-seconds (mean 0.41, range 0.25 - 0.70). In 3 patients, the PDF reproducibility errors at 5-minutes (0.19, 0.10, 0.09 respectively) were also largely reduced from those at 5-second (0.96, 0.41, and 0.24 respectively). PDF stabilizing time constants showed great variability among subjects (range 8 s - 374 s). 8 of 9 healthy volunteers and all 3 lung tumor patients were observed to reach PDF equilibrium state within 5 minutes. PDF reproducibility showed less sensitivity to frame rate when it is greater than 2 fps.

Conclusions: A statistically significant improvement in the PDF reproducibility was observed with prolonged scan time among 12 healthy volunteers and patients with lung tumors. The improved knowledge of PDF reproducibility is a vital part of the validation of probability based inverse treatment planning for stereotactic radiosurgery of lung cancer.