

AbstractID: 5237 Title: Evaluating lung motion variations in repeated 4D CT studies using inverse consistent image registration

**Purpose:** To evaluate lung motion variations in repeated, amplitude-based 4D CT studies using inverse consistent image registration.

**Method and Materials:** Three patients with lung cancers were scanned twice with our 4D CT protocol. A 4D CT dataset was reconstructed using the amplitude and direction of an external respiratory signal. A thresholding-based method was used to segment the lung. An inverse consistent image registration was used to estimate the intrafraction motion within each 4D study and the interfraction motion between two studies. This diffeomorphic registration jointly estimates the forward and reverse transformations providing more accurate correspondence between two images. We evaluated the lung motion variations in repeated 4D studies.

**Results:** On average, the mean respiratory period changed by 11.5%, and the mean peak to peak amplitude changed by 6.8% for the three patients. The consistent image registration generated dense displacement vector fields which represented physiologically reasonable lung motion. In one patient, we observed that the motion patterns are similar in the inferior and posterior parts of the lung, but are different at the superior and anterior parts of the lung. In the other two patients, we observed less variation in lung motion patterns between the two studies. The interfraction motion at end of exhalation is generally small ( $< 3$  mm).

**Conclusions:** The results suggest that lung motion variation may be large for some parts of the lung in some patients. An updated 4D CT study may be needed on a treatment day for some patients. For other patients, one may use the 4D model built on a planning day to estimate lung motion with an external respiratory signal. Quantitative evaluations are under investigation.