

### Purpose:

The regional lung pulmonary function can be calculated by computing the Jacobian of image registration deformation field. Radiation-induced pulmonary function changes are assessed by comparing pulmonary function before and after radiation therapy (RT). Due to the probably different breath pattern and effort, uncertainties from 4DCT imaging and registration error, we need to first establish the measurement reproducibility. We also introduce gamma comparison method to compensate space disalignment in two distributions.

### Methods:

Two repeated 4DCT data sets scanned with 30 minutes interval before RT from two patients are used in this study. Tissue volume preserving nonrigid registration algorithm with Laplacian regularization constraints was applied to register the maximum exhalation image to the maximum inhalation image for the calculation of local lung expansion as a measurement of regional pulmonary function in two scans. We compared the two pulmonary functions and analyzed the pulmonary function ratio map. Gamma comparison method is introduced to tolerate possible error in image acquisition and image registration. Mean and standard deviation of pulmonary function ratio map and gamma pass percent are calculated to measure reproducibility.

### Results:

The registration accuracy analysis indicated our registration error is on the order of 1.0 mm. Most lung tissue has a reproducible pulmonary function. Reproducibility near the diaphragm is worse than other regions. The standard deviation of function ratio map is respectively 0.0352 and 0.0495. The gamma comparison pass percent is respectively 84% and 87%. Further plots suggest most of the lung function is reproducible in 2 scans.

### Conclusions:

We analyzed the reproducibility to measure regional pulmonary function using 4DCT and image registration. We compared the regional lung function in two repeated 4DCT scan and discussed the function ratio map. We also introduced a gamma comparison method to quantify reproducibility.

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