

**Purpose:** To develop a functional imaging technique that can simultaneously detect changes in lung ventilation and lung perfusion using 4D-CT. This high-resolution functional information can be incorporated in a treatment planning to minimize the dose to highly functional areas of the lung, and can also be used to assess the efficacy of treatment post radiation therapy.

**Methods:** Recently, a technique was presented to estimate lung ventilation using 4DCT by detecting the changes in CT characteristics of the pulmonary parenchyma. We go a step further and develop the theory to extract not only regional fractional changes in ventilation but also fractional changes in mass that may be indicative of blood flow. Changes in lung ventilation are estimated by applying a mass correction that is estimated using the ratio of the global inhale-mass and end-exhale mass. Changes in lung perfusion are indicated by changes in “apparent mass”. Changes in “apparent mass” are estimated by applying a volume correction that is estimated using the ratio of global inhale volume and end-exhale volume. In both the cases a subtraction of the corrected images is performed by spatially matching the images at each phase of the respiratory cycle. Spatial matching is carried out using a deformable image registration algorithm.

**Results:** Preliminary studies indicate a linear relationship between the mass-corrected fractional changes in volume and global measurement of tidal volume changes (slope = 1.01, R-square = 0.97). A similar slightly linear relationship is observed between the volume-corrected fractional changes in “apparent mass” and global measurement of mass (slope = 1.21, R-square = 0.75).

**Conclusions:** The technique presented above can extract both changes in ventilation and “apparent mass” that maybe indicative of perfusion simultaneously from a single set of 4DCT images. It however remains to be shown that these changes correspond to perfusion (future studies).