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4DCT-based assessment of regional airflow distribution in healthy human lungs during tidal breathing[1] JIWOONG CHOI, NARIMAN JAHANI, SANGHUN CHOI, ERIC HOFFMAN, CHING-LONG LIN, The University of Iowa — Nonlinear dynamics of regional airflow distribution in healthy human lungs are studied with four-dimensional computed tomography (4DCT) quantitative imaging of four subjects. During the scanning session, subjects continuously breathed with tidal volumes controlled by the dual piston system. For each subject, 10 instantaneous volumetric image data sets (5 inspiratory and 5 expiratory phases) were reconstructed. A mass-preserving image registration was then applied to pairs of these image data to construct a breathing lung model. Regional distributions of local flow rate fractions are computed from time-varying local air volumes. The 4DCT registration-based method provides the link between local and global air volumes of the lung, allowing derivation of time-varying regional flow rates during the tidal breathing for computational fluid dynamics analysis. The local flow rate fraction remains greater in the lower lobes than in the upper lobes, being qualitatively consistent with those derived from three static CT (3SCT) images (Yin et al. JCP 2013). However, unlike 3SCT, the 4DCT data exhibit lung hysteresis between inspiration and expiration, providing more sensitive measures of regional ventilation and lung mechanics.

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