AbstractID: 2115 Title: Quantitation of the four-dimensional computed tomography process

The process of four-dimensional computed tomography (4DCT) uses multislice CT scans that have been sorted or gated using a metric, such as abdomen height or spirometry. A measured metric is required because breathing is not sufficiently reproducible to use time as the metric. Our technique uses a multislice CT scanner (1.5 mm slices) operated in ciné mode acquiring 12 contiguous slices in each couch position for 15 consecutive scans (0.5 s rotation). An important challenge in 4DCT is quantifying the reconstructed dataset quality and especially the level of correlation between the metric used relative to internal-object motion. This paper describes new techniques to evaluate the quality of 4DCT reconstruction by measuring the internal CT air content and comparing against the spirometry-measured tidal volume at the time the scans were acquired. Inspection of the CT-scan air content as a function of spirometry-measured tidal volume showed excellent correlations (typically $r>0.99$) throughout the lung volume. Because of the linear relationship, the ratio of internal air content to spirometry volume was indicative of the fraction of air change in each couch position. If the process worked correctly, the sum of these ratios would equal the ratio of room to lung air densities (1.05). For 11 patients, the value was 1.06 ± 0.06, indicating the high quality of the spirometry-based image sorting. This type of analysis highlights the value of using spirometry as the metric; there are no other metrics that could have been used to produce this quantitative result. Additional test results will be presented.