AbstractID: 11130 Title: An improved phase-based 4DCT reconstruction using local breathing variation without RPM

Purpose:
To develop a 4DCT sorting method based on the 2DCT breathing volume variation.

Method and Materials:
Current 4DCT techniques require an external surrogate (e.g., the Varian RPM system) to retrospectively sort 2DCT slices. Artifacts are often observed due to the imperfect correlation between the RPM and breathing motion. Our new method uses local breathing volume variations at each scan position as a surrogate. Six patients with severe 4DCT artifacts based on RPM sorting were retrospectively studied. These patients acquired 22-26 scans per couch position using a 16-slice CT scanner operated in Cine mode. For each couch position, the patient body contour was segmented using thresholding and region growing. The number of the pixels inside the body contour was counted as breathing volume, indicating the current breathing phase. For each scan position, standard respiratory phases were generated based on the nearest breathing volumes. 4DCT sorting was accomplished using CT images at the standard breathing phases.

Results:
For 6 patients studied, 4DCT images sorted from the RPM and our method were reviewed by experts. Most artifacts observed in RPM based 4DCT were removed by our method especially near the diaphragm and regions where the RPM signal was less correlated. For one patient, the RPM showed irregular breathing for one slice position resulting in severe artifacts in reconstructed 4DCT. However, local volume variation indicated regular breathing and the reconstructed 4DCT images were artifact free using our new method. For some scan positions where large irregular breathing occurred, our method, as well as the RPM method, did not work well and a rescan was recommended.

Conclusion:
The proposed sorting method provides a highly correlated individual respiratory signal for each scan position. The proposed method has the advantages of (1) significantly reduced 4DCT artifacts, (2) without RPM and (3) without complex organ segmentation.