

AbstractID: 10891 Title: Comparison of retrospective phase sorting with real-time sorting methods for 4D CT images

**Purpose:** To study if the magnitude and frequency of artifacts in 4D CT images and the imaging dose for real-time image sorting methods will decrease compared to retrospective 4D CT sorting methods. **Method and Materials:** 4D CT image acquisition was simulated with current retrospective phase sorting (RPCT), and three real-time sorting methods: direction dependent displacement sorting (DDCT), simultaneous displacement and phase sorting (DPCT), and simultaneous displacement and velocity based sorting (DVCT). Respiratory signals and corresponding tumor positions were acquired with the Cyberknife Synchrony system for 58 motion data sets of 4 minutes each. **Results:** The mean artifact magnitude in the reconstructed 4D CT images for the real-time methods was at least a factor of 2 smaller compared to RPCT. The dose delivered during image acquisition was at least a factor of 2 less for DDCT compared to RPCT. Image acquisition time per couch position for the real-time methods increased by a factor of 2 to 3. With displacement tolerances of 0.5mm, artifacts > 2mm were reduced from 33% for RPCT to 8% for DDCT, while artifacts > 4mm were reduced from 14% for RPCT to 1% for DDCT. The maximum artifact magnitude was the smallest for DVCT and in most cases a factor of 2 smaller for DDCT compared to RPCT, up to a factor of 6 smaller in the extreme cases. **Conclusion:** This work showed that the frequency and magnitude of artifacts in reconstructed 4D CT images and the dose delivered during image acquisition can be reduced markedly if a real-time sorting method is used instead of RPCT. However, real-time sorting methods lead to 2-3 fold increases in image acquisition time. It is concluded from this work that DDCT is the better sorting method to use for 4D CT image reconstruction.