

AbstractID: 4949 Title: Evaluation of Image Quality in 4DCT and Improving Temporal Accuracy

Purpose: To assess the effect of incorrect assignment of respiration phases and irregular breathing on 4DCT image quality. Artifacts are manifested as deformations in the reconstructed images and quantitative effects are measured along with qualitative evaluations. Modifications to the current 4DCT implementation are recommended.

Methods and Materials: For the evaluation of image artifacts, we used a motion simulation platform and simulated the respiration patterns of real patients. Artifacts due to inaccurate phase sorting are quantitatively evaluated by comparing differences in the volumes of spherical phantoms with and without the presence of phase assignment problems. Artifacts due to irregular breathing are demonstrated using 4DCT and recommendations are made for modifying the standard acquisition mode to enable gating for motion reproducibility. The advantage of this modified acquisition is proved using an electronic portal imager.

Results: Review of clinical 4D scans performed in our clinic showed discrepancies in the phase assignments for about 45% of the cases when compared to our independent check. Significant image artifacts are also observed and measured as a function of the respiration motion amplitude and target size. Volumetric inaccuracies of up to 43% are measured. For the evaluation of irregular breathing, our proposed technique of gated imaging for the reproducibility of the respiration proved to yield superior image integrity when compared to standard acquisition mode.

Conclusions: We identified two sources of quality degradation factors associated with 4DCT images and performed quantitative evaluations of associated artifacts. We conclude that for improved image reconstruction, an independent check of the sorting procedure should be performed for each clinical case; also we recommend a modification to the 4DCT acquisition technique to include gating of the x-rays for the reproducibility of the respiration pattern.

Conflict of Interest: Research supported by GE Medical Systems.