AbstractID: 5386 Title: Validation of non-linear image registration-based correction method for motion artifacts in 4D-CT

Purpose:
Motion artifacts in CT can be reduced by using 4D-CT acquisition techniques where image slices are retrospectively binned according to breathing phase as determined by a breathing trace. However, motion artifacts may still occur due to breathing irregularities. Such artifacts affect organ delineation and lead to complications when using 4D CT data for dose calculation and accumulation. We propose a method for correcting such artifacts by temporal interpolation using non-linear image registration.

Method and Materials:

The ANIMAL non-linear image registration algorithm was used to determine the transformation between artifact-free phases adjacent to the phase containing the motion artifacts. The weighting factor which, when applied to the transformation, most closely reconstructs the anatomy at the phase to be corrected was determined. CT values in regions of the image containing the artifacts were then replaced with the corresponding CT values from the reconstructed image. The accuracy of the temporal interpolation method was evaluated by simulating motion artifacts resulting from different breathing amplitudes using the NCAT numerical breathing phantom for which the artifact-free image is available by definition. The reconstructed image was compared to the artifact-free image. The temporal interpolation method was applied to correct motion artifacts in patient 4D CT data and the corrected images were compared to physician-delineated contours.

Results:

Correlation between the NCAT phantom images with and without artifacts was improved from 0.971 to 0.992 after correction of the artifacts by temporal interpolation. The quality of the patient 4D CT data was improved after temporal interpolation and the reconstructed anatomy was consistent with manual contours.

Conclusion:

We have developed a method for reconstructing anatomy on 4D CT images in the presence of motion artifacts. The temporal interpolation method was demonstrated to reduce the appearance of these artifacts and therefore improve the accuracy of organ delineation and dose calculation.