AbstractID: 2934 Title: Deformable Fusion of 4D PET Images

Purpose:
PET images are useful in defining treatment targets. Removing distortion from respiratory motion in the PET images is of importance for gated or 4D radiation treatments. We developed a deformable fusion method to sum up the PET images at different phases. The motion-blurring-free PET images are obtained without the sacrifice of signal to noise ratio (SNR) or increase of scanning time.

Method and Materials:
A GE Discovery CT/PET scanner was interfaced with Varian's RPM breathing tracking system. 4D CT and 4D PET images were correlated according to the breathing phases. Full exhalation phase was used as the planning phase. Deformable image registrations of the 4D CT images yielded the displacement maps of the lungs relative to the planning phase. PET images at each breathing phase were then warped into the planning phase using the displacement maps. Motion-blurring-free PET images were obtained by summing the warped PET images.

Results:
Gated PET images at each individual phase are very noisy. The uncertainty from intensity fluctuations compromises the motion reduction by gating the scan. PET images are too fuzzy to be directly used in elastic registration. Instead, we registered the 4D CT images. With regular patient breathing patterns, 4D CT images correlate with 4D PET images. Consequently, the displacement maps from registration of the 4D CT images can be used in warping the 4D PET. Image warping removed the motion distortion in the PET images. The summed images have reduced motion blurring and the same SNR as that of non-gated PET images.

Conclusion:
Deformable fusion of 4D PET images reduce the motion distortion in PET image and retain the SNR without increasing data acquisition time. The resultant PET images can be used in more accurate target definition in gated or 4D radiation treatments.