AbstractID: 2876 Title: A method for acquiring PET images without breathing motion artifacts

Purpose:
PET images typically require many minutes to acquire, so breathing motion can cause the tumor shape to be inaccurately reconstructed. Using a multislice PET/CT scanner to quantitatively acquire 4-dimensional computed tomography (4DCT) and gated PET, a breathing motion-artifact free PET image study can be generated achieving statistical precision as if the patient underwent breath-hold throughout the PET-scan procedure.

Method and Materials:
The motion of lung structures, including tumors, is mapped by 4DCT as a function of tidal volume using our novel 5-dimensional breathing motion model. The PET scan is performed using spirometry-measured tidal volume and the PET data is stored using list mode. The user selects the phase of breathing for which the PET image is to be reconstructed and the corresponding list-mode data is extracted to reconstruct an image. The gated-CT scans provide quantitative attenuation correction that is accurate with respect to breathing phase. This process is repeated for all breathing phases and using the trajectory maps the reconstructed images are deformably mapped to a reference-breathing phase. This process was tested using a computer-controlled phantom moving in a motion pattern mimicking breathing motion. Three target spheres (1cm, 2cm, 3cm diameters) filled with ^{11}C solution were embedded into a cylindrical phantom filled with ^{18}F solution to provide a series of relative target-to-background activities.

Results:
Without gating, the target spheres were deformed and the low target-to-background small-target image was lost in the background noise. These problems were alleviated when the images were mapped to a common motion “phase”.

Conclusion:
The phantom data showed that motion artifacts can be quantitatively removed yielding a high statistics image dataset without compromising PET acquisition time or patient dose. This process will provide the radiation-oncology clinician with PET images having unrivaled spatial resolution and sensitivity for target definition in the thoracic and abdominal regions.