AbstractID: 9172 Title: Reduction of motion artifacts occurring at the lung/diaphragm interface using 4D-CT attenuation correction on 4D-PET scans: Implications for radiation therapy planning

Purpose: For PET/CT the fast CT acquisition time can lead to errors in attenuation correction, particularly at the lung/diaphragm interface. Gated 4D-PET can reduce motion artifacts, though it is not always attenuation corrected with a similarly acquired 4D-CT. We performed phantom studies specifically designed to evaluate 4D-PET images using three different methods for attenuation correction: a single 3D-CT (3D-CTAC), an averaged 4D-CT (CINE-CTAC), and a fully phase matched 4D-CT (4D-CTAC).

Method and Materials: A phantom was designed with two density regions corresponding to diaphragm and lung. An 8ml vial loaded with FDG was used to represent a lung tumor and background FDG was also added with an 8:1 ratio. Imaging was performed with a GE Discovery DVCT-PET/CT scanner. Periodic motion of 2 cm amplitude was used and the image data was reconstructed into 10 phase bins over the motion cycle. Image data was analyzed using a GE image processing workstation and in-house developed software. Values of activity within the target for each relative phase were corrected for decay and compared to those derived from a 3D PET scan with no motion present (3D-STATIC).

Results: Activity values derived from 4D-CTAC corrected PET images are generally closer to 3D-STATIC images with no motion present. Mean activity over the known target volume over the motion cycle, normalized to the activity for 3D-STATIC, was 93%, 101% and 98% for 3D-CTAC, CINE-CTAC and 4D-CTAC images respectively with corresponding standard deviations of 6%, 10% and 3%.

Conclusion: Compared to other attenuation correction methods, 4D-CTAC corrected 4D-PET images correspond more closely on average to similar 3D-STATIC images. Using CINE-CTAC for correction resulted in mean activity values slightly closer to 3D-STATIC, but with much greater variation over the motion cycle. We believe these results have implications for the use of 4D-PET imaging for radiation therapy target definition.