AbstractID: 4809 Title: A Novel PET Respiratory Gating Algorithm to Reduce Lung Tumor Blurring using the 4D NCAT Phantom

Purpose: Develop and validate a PET gating algorithm based on the amplitude of respiration to correct for abnormal respiratory cycles.

Method and Materials: Using the 4D NCAT phantom model, 3D PET images were simulated in lung and other structures at different times within a respiratory cycle. To compare the amplitude gating algorithm with time gating, NCAT phantom was used to simulate a case with 5 different respiratory periods. We generated 6-10 frames over one respiratory cycle (corresponding to 3-5 s respiratory periods) and summed the results to mimic clinical imaging. Images were reconstructed with and without respiration motion. Comparison was performed for gated and un-gated images, and for the new amplitude binning algorithm with the time binning algorithm by calculating the mean number of counts in the ROI. Lesion-to-background ratios were 2.5, 5 and 8. Lesion diameters were 6 mm, 8.5 mm, 10 mm and 20 mm. Simulated images were created using a Gaussian distributed random number generator. Blurring due to the finite PET image resolution was simulated by the convolution of each slice with a Gaussian filter with FWHM of 1.6 pixel.

Results: As both the L/B ratio and lesion size decreases, image degradation due to respiration increases. The greater benefit for smaller diameter lesion and lower L/B ratio indicates a potential improvement in detecting more problematic lesions. Little improvement is gained for large lesions with high L/B ratios. But these are relatively easy to diagnose and gating is probably not necessary.

Conclusion: From the study made using 4D NCAT simulation, it was observed that in each selected ROI, the relative activity values in four cases are: Ideal PET images (without respiratory motion) > Amplitude Gated PET images > Time Gated PET images > Un-gated PET images, here greater value means better and more accurate lesion detection.