

AbstractID: 9455 Title: Use of a clinically relevant digital PET chest phantom to investigate the threshold required to define a PET-based target volume

**Purpose:** To examine the relationship between the threshold required to segment PET-based target volumes placed in inhomogeneous background provided by a digital PET chest phantom.

**Method and Materials:** We placed four spheres of uniform activity and sizes ranging from 2-13ml in the lung, mediastinum and lung/mediastinum boundary in the chest of a digital PET phantom. The intensity of the spheres was adjusted to obtain different target to background (T/B) ratios and the threshold as a percent of the maximum image intensity required to get the true tumor volume was estimated. We also constructed a spherical target of non-uniform activity by placing a spatial Gaussian activity distribution in the larger (13ml) sphere and adjusting its intensity to obtain various T/B ratios.

**Results:** The results suggest that a threshold varying from 37-55% may be required to segment the true target volume depending on the location and size of the target. Smaller targets and ones placed in higher background activities (such as the mediastinum) require higher thresholds than larger targets or the ones placed in lower intensity background (such as the lung). Adding inhomogeneity in the intensity of the target results in lower thresholds required and smaller difference between the threshold required to segment targets in higher and lower image intensity backgrounds.

**Conclusion:** For the first time to our knowledge we present a study investigating PET-based threshold segmentation in a realistic situation, where the target's background activity is similar to what is seen in clinical cases. The most important finding of this study is the indication that lesions in the mediastinum require higher thresholds than the ones in normal lung or at the boundary between lung and mediastinum.