AbstractID: 6827 Title: The development of a realistic digital PET lung phantom for the evaluation of tumor volume segmentation techniques

Purpose: A problem encountered in the development of novel tumor volume segmentation techniques for PET images is the lack of a reliable method for evaluating their performance on clinical scans. We have developed a digital lung phantom to address this problem.

Method and Materials: The three main components in the creation of the digital phantom were the voxel-based Zubal anthropomorphic phantom, the simSET package for PET simulations and the creation of digital lesions. The Zubal phantom was used as input to the simSET software to obtain PET simulated projections and then the separately created digital lesions were fed as input to simSET to obtain lesion projections. Those were added to the Zubal phantom projections, which were then reconstructed to obtain the simulated abnormal PET lung scans. In order to test the accuracy of the digital phantom in representing real situations, the results were compared both qualitatively and quantitatively with real clinical scans. We compared image intensity histograms and statistical measures from regions of interest (ROIs) taken from the lung, the mediastinum and the tumors of both clinical and simulated cases.

Results: The visual comparison of the image intensity histograms from different regions showed no significant differences in the appearance of the image intensity distributions. This was confirmed by comparing measurements of fractional standard deviation and skewness from the different regions. Adding more inhomogeneity to the digital lesions resulted in more realistic appearing lesions.

Conclusion: Our results suggest that the constructed digital phantom can closely model real clinical scans. The full control over the lesion's size, shape and intensity and the activity in normal anatomy that this digital phantom offers, along with improvements that can come from the addition of motion and more inhomogeneity can make this phantom a powerful tool in the evaluation of PET segmentation methods.