AbstractID: 8626 Title: Partial volume correction of PET-imaged tumor heterogeneity using expectation maximization

Purpose: Due to the limited spatial resolution of PET imaging, small objects experience partial volume effects which impact the quantification and spatial distribution of imaged tumor heterogeneities. This study examines the ability of an iterative partial volume correction (PVC) method to restore imaged heterogeneity to an object heterogeneity map using expectation maximization.

Method and Materials: Treating PET as a linear system, images obtained through the convolution of a true object's radioactivity distribution and the system's point spread function (PSF) may be used to uncover the true object's activity distribution. The presented method uses iterative expectation maximization with the measured system PSF to determine the true object activity distribution. The three-dimensional spatially dependent PSF was obtained by Gaussian fitting point objects imaged on a Discovery LS PET/CT scanner radially in single plane. The technique was tested on dual-tracer heterogeneity phantoms using spheres of 10 and 15 mm diameter as both hot and cold heterogeneities relative to the phantoms' uniform tumor activity. The method was also applied to clinical studies to observe the impact of quantitative changes.

Results: The observed PVC showed dependencies on heterogeneity size and contrast with surrounding regions. This PVC technique successfully recovered phantom heterogeneities hotter than uniform tumor activity, but experienced difficulty with cold heterogeneity. Quantitative image accuracy was restored as heterogeneities experienced shifts of 25 and 35% for diameters of 15 and 10 mm, respectively. Using changes in the image correction matrix proved a successful stopping criteria for determining the optimal number of iterations for PVC in phantoms. Changes as large as ±20% were frequently observed in patient heterogeneities.

Conclusion: The expectation maximization PVC method successfully recovers tumor heterogeneity lost through PET imaging. Inclusion of PET information into treatment planning or treatment assessment would greatly benefit from the quantitative accuracy gains shown in this PVC method.