AbstractID: 8674 Title: PET Imaging of Heterogeneous Tumors: An investigation of the influence of motion on recovered activity

Purpose:

As multi-day PET studies become part of targeted therapy planning and treatment assessment, it is important to characterize how positioning errors affect observed tumor heterogeneity. We have characterized the uncertainty in recovered-activity in PET-imaging of heterogeneous tumors as a function of axial position.

Methods and Materials:

Recovery coefficient (RC) is ratio of maximum activity-concentration to the true specific activity in an object. The uncertainty in RC was quantified by RC_{error}: the quotient $(RC_{max} - RC_{min})/RC_{mean}$. We measured RC_{errors} for a GE Discovery LS PET/CT scanner with an axial detector width of 4.25mm. A Heterogeneous-tumor phantom, containing three ^{18}F-filled spheres (15mm, 10mm, 5mm diameter), was scanned as the phantom was moved axially in 1mm intervals. RC_{error} of the spheres were determined in images reconstructed by iterative ordered subset expectation maximization (OSEM) and filtered backprojection (FBP) algorithms.

The clinical effect was investigated using head and neck cancer (HN) patients imaged on this scanner. ^{18}FLT-PET images of patients were thresholded into three levels of relative uptake, and segmented into connected sub-regions. We simulated multi-scan studies and calculated the changes in SUV that result from repositioning the patient.

Results:

OSEM reconstruction provided more accurate recovery of activity in the spheres when compared to FBP. However, uncertainty of these OSEM values was larger, as RC_{errors} were 27%, 8% and 4% for the 5mm, 10mm and 15mm spheres respectively. In contrast, RC_{errors} were 10%, 8% and 3% for FBP. The effects of RC_{errors} were examined in clinical images; a positioning error of 5-degree tilt caused 23% decrease in correlation within the tumor region of patient 1 and 12% in patient 2.

Conclusion:

Uncertainty in the RC depends on object diameter, reconstruction algorithm, and axial-displacement. However, heterogeneities in FBP images of consecutive PET studies would be less susceptible to errors related to the axial positioning of tumors.