AbstractID: 13734 Title: Deformations in tumor volumes and high uptake sub-volumes observed with 4D FDG-PET

Purpose: In lung cancer radiotherapy biologically image guided dose painting is a promising new technique. Correct localization of tumor sub-volumes remains a major challenge. The purpose of this work was to investigate tumor deformations as observed with 4D PET.

Method and Materials: A total of 17 lesions were identified on the 4D FDG-PET/CT scans from 13 patients. The data were binned in five phase bins using the AZ-733V gating system. On each one of the five phases of the 4D scan a classification algorithm was applied to obtain the region of highest uptake and segment the tumor volume. We looked at the shape deformation of both the high uptake sub-volumes and the corresponding segmented tumor volumes. We examined the dependence of shape deformation on the amplitude of motion and the variation in the volume estimate. The effect of motion was minimized by registering the volumes of phases 20-80% with the 0% phase (inhale). The Overlap (O) of the volumes was measured and the shape deformation was defined as 1-O. The variation in the volume estimate between the different phases was measured by the standard deviation of the % difference from the average volume.

Results: The shape deformation of the high uptake sub-volumes was on average 169% larger than that of the full tumor volumes; a statistically significant difference. The shape deformation of the high uptake sub-volumes was moderately correlated with that of the tumor (0.75) and the amplitude of motion (0.55). The inhale-to-exhale phase (20%) resulted in the largest shape deformation.

Conclusions: There is a complex relationship between the behavior of tumor volumes and high uptake sub-volumes. In cases where advanced therapy techniques such as dose painting based on biological sub-volumes, are being employed, a close examination of a 4D PET scan should be considered.