

AbstractID: 11430 Title: Assessing the impact of partial volume correction on dose painting

Purpose: Tumor heterogeneities identified by PET imaging suffer from partial volume effects (PVE) due to the scanner's limited resolution. This study establishes the necessity for including partial volume correction in dose painting prescriptions.

Method and Materials: A previously reported iterative partial volume correction (PVC) method, specific to heterogeneous tumors, was applied to 15 tumors exhibiting heterogeneous uptake of [Cu-61]Cu-ATSM, a hypoxia surrogate marker. Dose painting prescriptions were generated from PET images using two techniques: a linear transformation converting SUV to dose, and a threshold method creating boost regions for SUVs greater than 3. All prescriptions implemented minimum tumor dose constraints of 50 Gy. Continuous prescriptions linearly redistributed dose about the mean tumor SUV, yielding a mean tumor dose of 70 Gy. Thresholding prescribed an additional 20 Gy to the boost region. Doses were optimized for each prescription using an in-house helical tomotherapy planning system.

Results: PVC images exhibited redistribution of mid-range SUVs to higher/lower SUVs with heterogeneity uptake differences of $\pm 25\text{-}30\%$. However, average dose differences for linear transformation dose painting were $\pm 5\text{-}10\%$, due to the transform's ratio of base dose to boost dose. The average dose differences for threshold transformation dose painting were dependent on threshold level and the tumor SUV distribution. In cases where the mean tumor SUV was approximately equivalent to the threshold SUV, PVC increased and decreased boost volumes in equal amounts. However, with mean or max tumor SUVs below threshold values, PVC significantly increased boost volumes, creating boost regions where none previously existed.

Conclusion: PVC alters the volume and magnitude of regions receiving redistributed boost doses. PVC frequently reveals tumor heterogeneities where none were previously observed due to PVE, which should be included in dose painting prescriptions. Institutions intending to implement PET-based dose painting should understand and correct for partial volume effects prior to generating prescriptions.