

AbstractID: 1959 Title: Experimental and Monte Carlo Characterization of Positron Range Artifacts in PET near Body Cavities

PET/CT imaging has a rapidly growing role in defining the tumor target volume in radiation therapy (RT). However, the high precision of modern RT techniques imposes greater demands on PET imaging accuracy. Confidence in PET images is poor near tissue-air and tissue-lung interfaces. This is particularly true when the PET signal appears to come from inside an air-cavity. We investigate experimentally and by Monte Carlo simulations the perturbing effect that the increased positron range in lower density media may have on PET images. We performed PET/CT scans (GE Discovery LS scanner) of FDG sources adjacent to air and cork (as a lung tissue equivalent) interfaces inside a water phantom. These phantom scans were simulated with the Monte Carlo toolkit GATE (GEANT4 Application for Tomographic Emission), which allows the nearly exact simulation of the PET scanner detector ring, and all phenomena related to the propagation of positrons and the generation and detection of annihilation photons. For a high sensitivity 2D PET scan, within both the air and lung (cork) cavities the measured PET signal drops below 30% within ~3 mm from the activity-cavity interface. Simulations indicate that annihilations occurring inside or on the opposite wall of the cavities are less than a few percent and will not be visible in PET images. Thus, positron range effects near cavity interfaces are small compared to PET resolution, PET/CT registration errors, and motion artifacts.

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