



Contribution ID: 78

Type: poster

Study of randoms-induced artefacts in several small animal PET scanners

Tuesday 9 May 2006 14:00 (1 hour)

The design of current small animal PET tomographs, with open geometries and extended field of view (FOV), tries to optimize sensitivity, what makes them to be particularly prone to random coincidences. Particularly in 3D mode, random counts are an important contribution to measured events.

The effect of accidental coincidences in the noise equivalent counts (NEC) of an acquisition is well known, but the appearance of artifacts in the images due to them is not so well established. For instance, we have observed that block-based scanners may show streaks in images reconstructed from uncorrected data, corresponding to the edges of the detectors.

We have investigated the artifacts induced from random coincidences in real PET scanners of different geometries. Some scanner configurations are shown to be particularly sensitive to these effects, and the quality of the images from high activity sources, is clearly deteriorated by these artifacts.

These results show the importance of developing accurate methods to estimate random contributions and of correcting the measured signal or the system model, not only in order to increase the signal-to-noise ratio or to obtain quantitative images, but to avoid undesirable artifacts as well. This is especially important in some PET scanners configurations.

We present the effect of random coincidences for different simulated scanner designs, and how the artifacts introduced depend on the scanner geometry, the shielding of the detectors and the ratio between FOV and detector size. Some designs optimized to reduce random-induced artifacts are proposed.

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Session Classification: Poster Session :Simulation, Modeling, Reconstruction

Track Classification: • System simulation, design and implementation