EFFECT OF MISALIGNMENTS IN SMALL ANIMAL POSITRON EMISSION TOMOGRAPHY SCANNERS BASED ON ROTATING PLANAR DETECTORS

M. Abella, J. Vaquero, E. Vicente, J. Ãlvarez, E. Lage, M. Desco
Hospital GU Gregorio Marañón, Madrid, SPAIN.

Introduction: Technological advances have improved the assembly process of positron emission tomography (PET) devices, resulting in quite exact geometric parameters. However, in high sensitivity and high spatial resolution systems, even minimum misalignments (submillimetric) of the detectors may result in a noticeable degradation of the image resolution.
For this reason, in such systems an exact characterization of misalignments is critical for a good reconstruction quality. While this subject is widely studied for computed tomography (CT) and single photon emission computed tomography (SPECT) systems based on cone beam geometry, it seems that this is not the case for PET scanners based on rotating planar detectors. The purpose of this work is to analyze misalignment effects in these systems and to define a protocol for geometric characterization. Materials and methods: The effects of misalignments have been simulated and the results have been validated with data from a real scanner (rPET, SUINSA), using both phantom and rodent studies.

Results and conclusions: The effects of detector misalignments are presented. A testing protocol for detecting and measuring misalignments in the three axes in PET scanners based on rotating planar detectors is proposed. This protocol uses simple phantoms and is robust and easy to perform. Implementation details are given for the high-resolution animal rPET scanner. The results show the importance of detector alignment: for instance, a misalignment of 0.8 mm in one detector resulted in an increase of 14% in tangential FWHM of a point source in the center of field-of-view (FOV). The correction performed with the proposed protocol provided a significant improvement in resolution.