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NEMA Standard Measurements in Pre-clinical PET Imaging

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NEMA (National Electrical Manufacturers Association) Standard Measurements are used for evaluating the performance of the positron emission tomography scanners used in animal imaging. There are various measurements, including spatial resolution, scatter fraction, sensitivity, and image quality.
In this study the effects of varying the testing procedures of the NEMA NU4-2008 standard for measuring sensitivity and image quality for a small animal PET scanner were examined. In the current NEMA NU4 2008 standard, the sensitivity is measured by stepping a Na-22 point source through the field of view of the scanner along the central Z axis. In some scanners it is not possible to automate the collection of this data, making it very tedious, if not impossible, to acquire the necessary data. As an alternative method, we explore using a long uniform line source extended beyond the field of view in the axial direction and validated this method by comparing our results with those obtained from the standard method. Two line sources were imaged, the first a 70-cm long plastic tube filled with 6 MBq of F-18 (NEMA line source for clinical scanners) and the second a standard 20-cm long Ge-68 sealed line source (0.90 MBq). Point source data were sorted and analysed following the NEMA NU4-2008 method to calculate sensitivity profiles to be plotted as a function of axial distance relative to the center of the field of view. Line source data were analyzed in a manner analogous to the NEMA NU2-2001 method for calculating sensitivity for clinical PET systems. The results from the F-18 and Ge-68 are in good agreement with those from a Na-22 point source (0.93 MBq) using the NEMA standard methods. The difference in absolute sensitivity between Na-22 and the line sources are 0.90% for F-18 and 1.7% for Ge-68 line source. These results represent the equivalence of the sensitivity measurements using a line source or a point source.

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