

PET Scanner Performance: Quality Assurance and Acceptance Testing

Brad Kemp, PhD
Mayo Clinic,
Rochester, MN, US

Quality assurance of PET scanners must be performed on a regular basis to maintain and confirm proper scanner performance. These procedures should track system stability and be sensitive to changes in scanner operation. The quality control and calibration of a PET scanner includes detector and electronic characterizations such as adjustment of PMT gain, definition of crystal and energy maps and coincidence timing calibration. Briefly, the crystal map converts the analog position of the detected event to a specific crystal within the block detector, while the coincidence timing calibration adjusts for timing delays so events from each block are time stamped equivalently. These characterizations are applied to the PET data during acquisition.

Daily quality assurance should determine whether the scanner is suitable for clinical use. A uniform cylinder of activity or rod sources are a good source of quality control data. These scans can be used to monitor system stability and to determine which crystals, blocks and modules (buckets) are more (or less) sensitive than the respective system average.

The NEMA PET NU2-2001 standard should be followed for acceptance testing. This standard uses a polyethylene phantom of 700mm axial length with a 3.2 mm line source to measure scatter fraction, count losses and randoms. This phantom approximates the out-of-field activity distributions of whole body scans. The measurement of sensitivity is conducted with a line source surrounded by known absorbers, and the sensitivity with no absorbers can be found by extrapolation. The intent of the image quality measurement is mimic a whole body scan using a torso phantom containing hot and cold spheres of various diameters (representing lesions) in a warm background.

This presentation will focus on the calibrations and corrections required to maintain proper system performance. The presentation will also describe the rationale and methodology of the NEMA NU2-2001 performance standards.