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3D acquisition and reconstruction in positron emission tomography

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3D positron emission tomography (PET) refers to an acquisition geometry and reconstruction procedure that allows all coincidence events within the solid angle of the tomograph to be recorded and subsequently reconstructed. The reconstruction algorithm must consider the angle of each coincidence event relative to the central axis of the scanner. The aim of the technique is to maximise the sensitivity of the system by utilising all events that it is possible to record from the object. Conventional cylindrical 2D PET systems typically detect ~0.4%-0.5% of decaying nuclei within the field of view; with a 3D system this can increase to over 3%. Reconstruction in 3D using filtered-backprojection techniques has been developed and provides results that show little degradation of physical characteristics compared with 2D systems, apart from an increased scatter event rate. 3D techniques may be used to (i) improve data quality using currently acceptable doses of radioactivity and scanning times; (ii) extend the scanning period for short-lived tracers, especially ^{11}C-labeled ligands; or, conversely (iii) decrease injected doses of radiotracer or reduce scanning times to achieve similar results as those using current methods in 2D.

Key words: Positron Emission Tomography (PET), 3D reconstruction, instrumentation