

Panel Detectors in PET Imaging: Leveraging TOF-DOI for High-Quality Performance

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This work explores the potential of panel detectors in developing flexible, modular PET scanners that can be tailored to specific patient needs and imaging objectives. It aims to demonstrate that even a simple 2-panel configuration can produce image quality suitable for practical applications, while using significantly less detector material compared to conventional PET scanners. The flat panel detector design enables us to position detectors very close to the patient, with the intent to enhance both sensitivity and spatial resolution. This design approach leverages improved geometric coverage and reduced noncollinearity blurring, while the parallax error can be mitigated through the utilization of DOI information. A Monte Carlo study using GATE software and large HPC clusters evaluates the performance of these detectors, featuring TOF resolution down to 70-ps and DOI resolution down to 1.25-mm. Comparisons with various phantoms and the Siemens Biograph Vision PET/CT scanner validate the approach. Findings reveal that a relatively small 2-panel PET scanner can fulfill the roles of conventional scanners and produce distortion free images of the same quality. Additionally, its mobility and flexibility open doors to novel applications, including bedside imaging and ICU diagnostics. Moreover, the modularity of panel detectors creates an opportunity to construct a long axial FOV scanner while conserving the same amount of detector material as employed in current clinical scanners.

Field

Systems and applications

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