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Digital signal processing for improved signal/noise in PET imaging.

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Conventional positron emission tomography (PET) scanners use a front-end analogue acquisition pipeline to determine position, energy, and time of arrival for each event. The pipeline operates in real time with processing and event selection occurring at MHz rates. Although this linear approach scales well to large arrays of detectors operating in parallel, much of the available information is discarded prior to readout and the short duration for signal processing limits possibilities of algorithmic or iterative approaches to event reconstruction.

Using a digital based (listmode) data acquisition system enables increased flexibility in event processing and reconstruction. We demonstrate the use of digital data acquisition applied to different generations of block detectors used for PET, which typically consist of a segmented scintillator crystal viewed by four photomultiplier tubes. Event parameters (position, energy, time) are resolved in the digital space and advanced processing techniques are explored. These approaches lead towards developing methods to discriminate against signal and noise events occurring within a single detector block based on their signal characteristics. To this end, an in-depth analysis of event positioning within the crystal has been employed.

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