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Screen 05 - iPET - Current developments and improvements of preclinical PET scanners based in easyPET technology

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The iPET prototype, based on the EasyPET technology, is an affordable preclinical PET scanner capable of real-time high quality in-vivo images. While the high price of preclinical PET scanners makes them unaffordable to many research centers, easyPET-based systems, using an innovative scanning method based on two rotation shafts for the movement of detector arrays, reduce the overall costs without compromising image quality.

High and uniform spatial resolution over the whole field of view (FoV) is achieved, by minimizing scattered events and parallax errors due to depth of interaction (DoI) uncertainty. Setting the detector modules very close to the subject, favouring sensitivity, is possible by software. Full body mouse imaging is possible using only a small number of detector elements, capable of scanning billions of lines of response (LoRs) in few minutes.

The prototype uses two arrays of 300 detector cells (1.5 x 1.5 x 20 mm3 LYSO scintillators coupled to SiPMs), covering up to 100 mm diameter × 80 mm long FoV. A dedicated frontend board processes the coincidence signals based on a fast dual channel ADC (200 MHz) and FPGA for data acquisition. The system can digitize the full pulse waveform and perform the pulse height measurement and coincidence sorter on computer. Multiplexing Anger logic is used for readout to simplify electronics and 511 keV events flood map shown for a group of 25 detectors.

LoRs are organized in a List-Mode format and processed by a dedicated algorithm based in Maximum-Likelihood Estimation Methods (LM-MLEM), running in GPU CUDA kernels, delivering results in few seconds -10^{11} updated voxels/second. This speed gain allows real-time visualization of the reconstructed images during in-vivo PET scanning, with multiple advantages such as the possibility of identification and correction of mispositioning of the animal in the scanner FoV.

GATE simulations using MOBY phantom are shown, where activity was distributed in four regions (kidneys, heart and thyroid) and with background activity, demonstrating the preclinical capabilities using a few number of detectors.

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