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Technical advances from pre-clinical to neuro-PET imaging

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Spatial resolution is a key factor in preclinical and neuro-PET imaging. By minimizing the partial volume effect, and the resulting spillover from/to surrounding tissues, the accuracy for quantifying the radiotracer concentration in small structures can be significantly enhanced, therefore mitigating the need to maximize the sensitivity for increasing the contrast-to-noise ratio in target tissue. The technology to image small animals in pre-clinical studies has been developed and improved over the years to achieve sub-mm (or sub-μL) spatial resolution, close to the physical limit imposed by the positron range and the annihilation photon acollinearity. Recent dedicated small animal PET scanners, such as the LabPET II, now enable the quantification of regional radiotracer concentration in the brain and other organs of rats and mice. However, little progress was made during the last two decades to improve the spatial resolution of dedicated brain PET scanners, even though the achieved state-of-the-art is far worse than the theoretical limit. While the detection technology developed for pre-clinical scanners would allow the theoretical limit to be reached in brain PET, it is generally not adapted and too costly for larger scanner designs. With the improvement of manufacturing processes, the large scale integration of front-end electronics and the development of a modular and scalable detector design, it is now possible to implement the LabPET II detector technology in a dedicated ultra-high-resolution (UHR) brain PET scanner approaching the theoretical physical limit of resolution at 1.25 mm FWHM (˜2 μL). The initial imaging performance of the partial UHR scanner will be presented.

Topic Selection

Technical Advances in brain imaging

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