Simultaneous PET and SPECT Imaging

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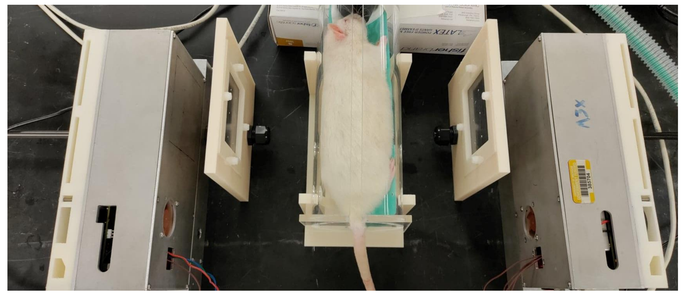
Introduction and Motivation

To advance multi-modality gamma-ray imaging capabilities of 3-D position-sensitive CZT detectors for future nuclear inspection and medical imaging applications. Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) are performed simultaneously using arrays of 3-D CZT detectors to image distributions of multiple radioisotopes inside an object. This work is to improve image resolution and reduce artifacts.

Technical Approach

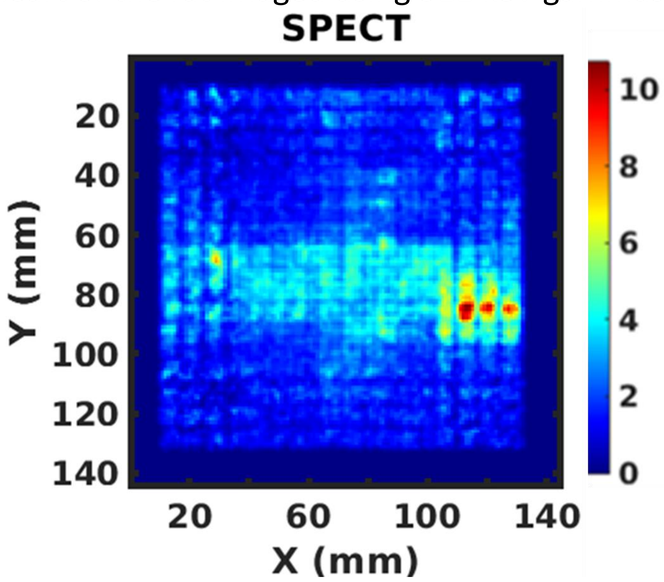
Two identical detectors are used in the experiments. Each detector has a 3 x 3 array of CdZnTe crystals with each crystal having an 11 x 11 pixelated anode array with a 1.72 mm pitch. The SPECT imaging utilizes a 1.19 mm thick lead mask that has a 3 x 3 array of 2 mm pinholes. The PET imaging relies on coincident 511 keV gamma rays from annihilations of electrons & positrons inside the object. As a test object, a rat is injected with Tc-99m (emitting 140 keV gammas) and FDG (positron emitter) to allow for PET-SPECT combined imaging.



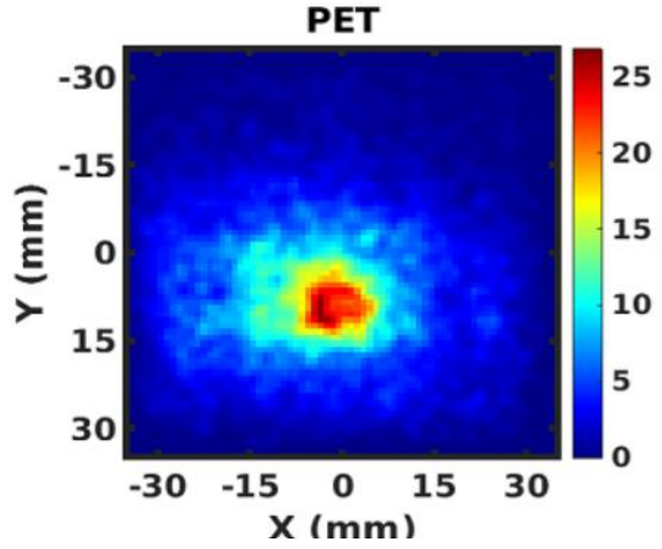
Experimental setup used for simultaneous PET and SPECT imaging.

Results

The results for SPECT and PET imaging can be seen below. In the SPECT image the upper spine is imaged using emitted 140 keV gammas. The PET image shows the heart of the rat imaged using 511 keV gammas.



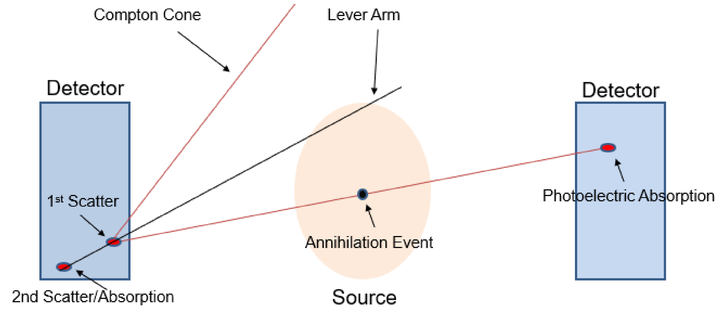
SPECT image result showing the spine for a rat injected with Tc-99m.



PET image result showing the heart for a rat injected with FDG.

Impact/Next Steps

In coincidence PET imaging the most important interaction in a multi-pixel event is the first one. This is because line of response imaging is used. The below method is being implemented to improve the sequencing of events to better pick off the first gamma-ray interaction. This work improves imaging resolution and speeds up measurement times.



Imaging technique for rejecting false sequencies in multipixel events for coincidence PET imaging

Conclusion/MTV Impact

This work has shown the ability to combine different imaging techniques to image multiple types of gamma-emitters simultaneously. This work will also allow for elongated sources such as holdup in piping to be better characterized. The MTV consortium has facilitated in learning from other universities and national labs by hosting conferences where novel work and results are presented.

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