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MediSPECT: Single Photon Emission Computed Tomography System for Small Field of View Small Animal Imaging Based on a CdTe Hybrid Pixel Detector

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We describe MediSPECT a newly developed system for SPECT studies on small animals with a small field of view (FOV) and high spatial resolution. The detection imaging system is based on a CdTe pixel detector (a 256x256 matrix of 55 micrometers square pixels) operating in single photon counting for direct detection of X-rays and gamma-rays with low and medium energy (e.g. I-125, 27-35 keV, Tc-99m, 140 keV). The hybrid detector is obtained by bump-bonding, pixel by pixel, the semiconductor detector to the Medipix2 read-out chip developed by the Medipix2 collaboration. The detection imaging system can be coupled to interchangeable tungsten collimators with very high resolution: a parallel hole collimator with circular holes of 100 micron and 70 micron septa; knife-edge pinhole collimators with a diameter of 0.35 mm, 0.78 mm, 1 mm and 2 mm (90° aperture); coded aperture masks with 70 micron and 80 micron holes for low energy imaging. At present, the useful FOV of the MediSPECT scanner ranges from 6.3 mm with the coded aperture mask (system spatial resolution 120 micron @ 27-35 keV) to 31 mm with 0.35 mm pinhole (system spatial resolution 1 mm @ 27-35 keV and 2.3 mm @ 140 keV). These features make MediSPECT an interesting system for in vivo imaging of small organs or tissue structures in mouse, e.g., brain, thyroid, heart or tumor.
A rotating gantry hosting the detector and a precise system for collimator alignment allows for 360° rotation around the horizontal animal bed with a radius of rotation ranging from 20 mm to 100 mm. At present we have tested the system only with one detector head, but it is also possible to mount a second detector/collimator unit for increasing sensitivity. MediSPECT is controlled by a dedicated software, to control the hybrid detector functioning, the tomographic head alignment and rotation, the animal bed movement and the image acquisition as planar projection for off-line SPECT reconstruction.
We show preliminary images obtained with point-like sources and sample phantoms (Cd-109 22 keV, I-125 27-35 keV, Tc-99m 140 keV) acquired with MediSPECT both in planar and tomographic configuration. A detailed description of the 3D image reconstruction algorithm is reported in a companion work presented at this conference.

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