

EXACT POSITIONING FOR OSEM RECONSTRUCTIONS ON THE ATLAS DEPTH-OF-INTERACTION SMALL ANIMAL SCANNER



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In small animal PET imaging, the requirements of high and uniform spatial resolution and high sensitivity over a field of view appropriate to the size of the animal take on particular significance. These requirements have motivated the design of ATLAS, a small animal PET scanner that consists of 18 LGSO/GSO phoswich detector modules arranged in a ring. In order to achieve the full resolution potential of the ATLAS system, it is necessary to incorporate the depth-of-interaction (DOI) information provided by the dual crystal layers into the reconstruction algorithm. A naive attempt to reconstruct by first rebinning the coincidences into a uniformly sampled projection-space grid can lead to severe artifacts in the image.

We have recently developed OSEM-ExPo, an enhanced implementation of the OSEM algorithm that incorporates ATLAS DOI information explicitly via exact positioning of the coincidence lines in the system matrix. The radial resolution of OSEM-ExPo images, assessed from a reconstruction of point sources in a warm cylinder after 30 iterations, varies from 1.1-mm at the radial center to 1.2-mm near the radial edge of the field of view. In comparison, the 2-D filtered backprojection result has radial resolution varying from 1.8-mm to 2.6-mm. The inclusion of the back-layer coincidences improves the resolution by 4% to 11%. Contrast recovery was measured from a reconstruction of a hot disk source in a warm cylinder.

The incorporation of DOI information improves the contrast recovery coefficient by 3% to 14%. Noise is not significantly affected by the inclusion of back-layer events.