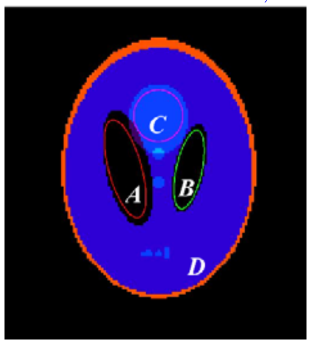
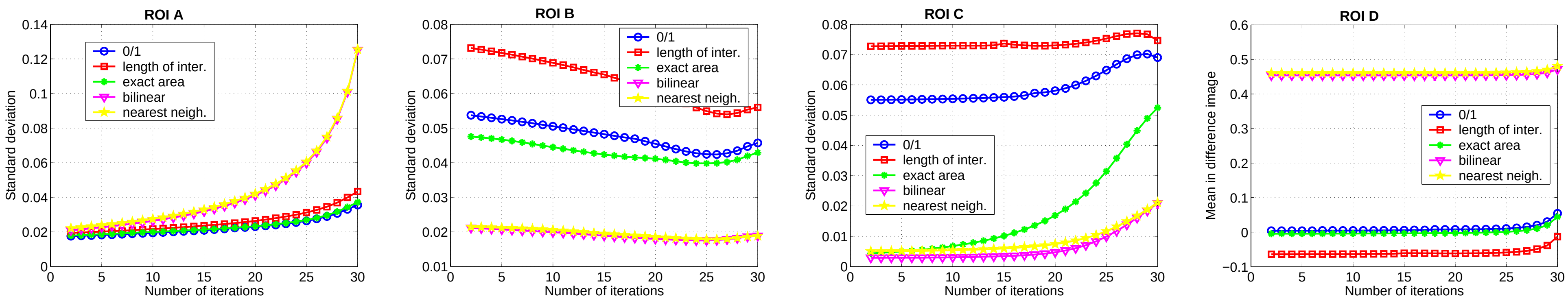
3 Results

A modified Shepp-Logan phantom generated with Matlab is utilised to evaluate the numerical accuracy of reconstruction made with different discretisation methods. Reconstructions are made with 2-D OSEM algorithm with MRP-filtering implemented in Turku PET Centre. The parameter combination utilised in the MRP-reconstructions is $\beta = 0.1$, mask dimension 5×5, four subsets and up to thirty iterations. Output image matrix is of size 128×128.

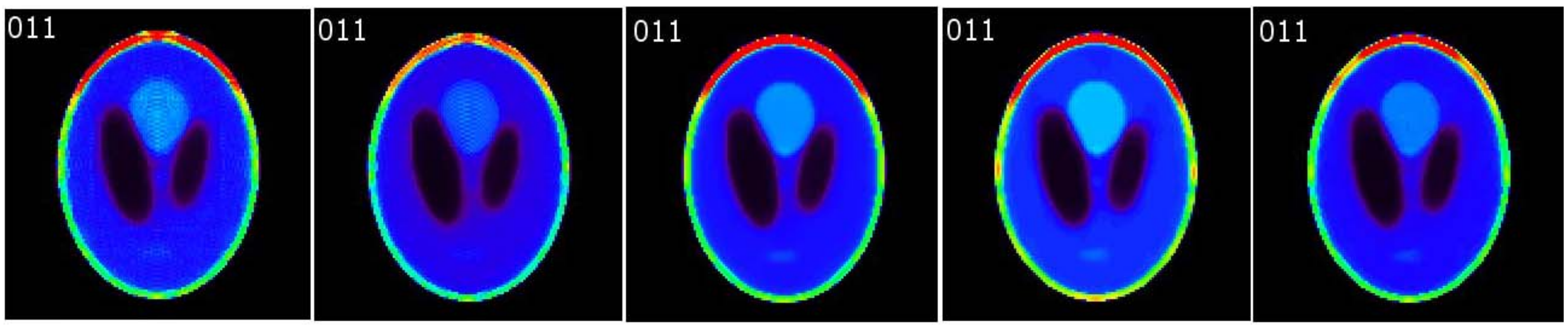


The Shepp-Logan phantom is transformed into the Radon domain (acquisition domain) using exact area discretisation method. Poisson noise was added to the sinogram to evaluate the applicability of different discretisation methods to the reconstruction from noisy PET data. The modified Shepp-Logan phantom with the ROIs to be used in the evaluation is shown on the left.

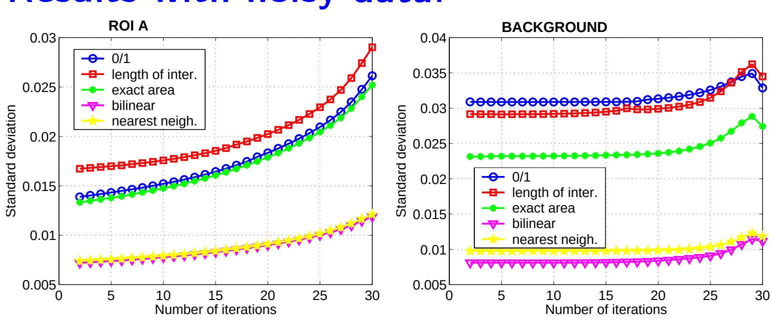
Results with noise free data. The reconstructions made with different discretisation methods are evaluated by calculating the standard deviation inside ROIs **A**, **B** and **C** drawn on the Shepp-Logan phantom shown above. ROIs are drawn on homogeneous regions. The mean of the absolute reconstruction error is computed from the difference image 'Shepp-Logan' minus 'Reconstructed image' inside the phantom (ROI **D**).



Figures above show that MRP-reconstructions made with any discretisation method from ideal input data introduce very little reconstruction artifact. Inside ROI **C**, where the mean is non-zero in the original Shepp-Logan phantom, the '0/1' and length of intersection discretisation methods introduce greater deviation in the values than other methods. This behaviour might be perceived in the reconstructions shown below. Discretisation methods from left to right are: '0/1', length of intersection, exact area, bilinear interpolation and nearest neighbour interpolation.



Results with noisy data.



The reconstructions made with noisy input data are evaluated on ROI **A** and on a ROI covering the background. It can be seen that the discretisation methods based on the image rotation approach manage the noise generally better than the scanner rotation methods.

Conclusion

Aim of our work was not to develop totally new methods for computational data acquisition, but rather to collect together and refine the known discretisation methods. Additionally our interest is to provide an efficient storage system for the sparse projection matrix.
Although our library does not include 3-D projection functions it may be used as a starting point in 3-D development. Projector library might also interest students or other beginners in PET image reconstruction development, who want to implement any (historical) 2-D reconstruction algorithms without having to rewrite the projector functions again. Advantages of different discretisation methods must be evaluated by the end-user.