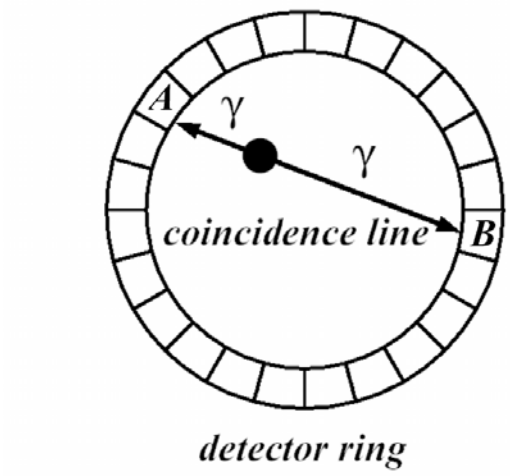
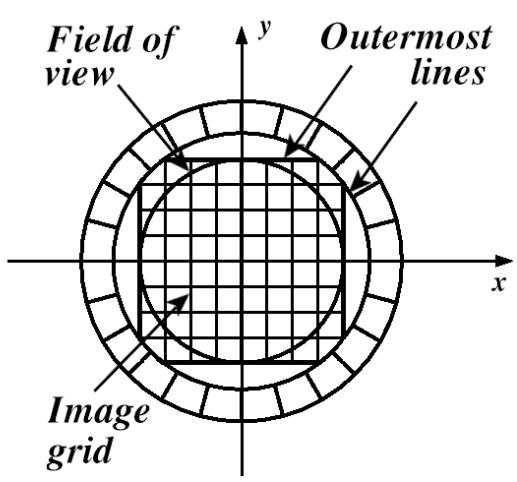
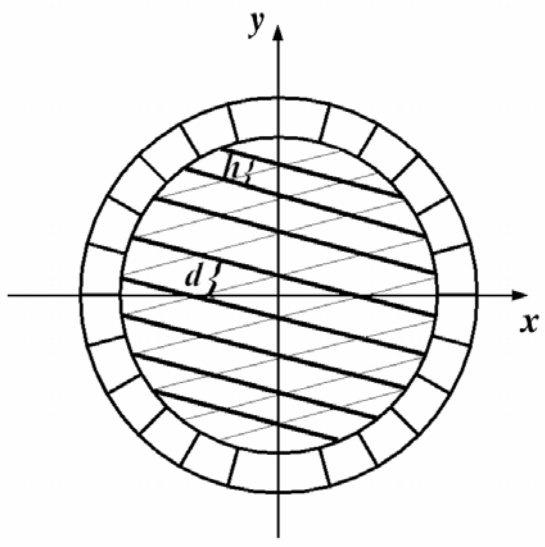
2 Methods

2.1 System Model

Figures below illustrate a cylindrical PET scanner and how the coincident γ-rays are detected by a pair of detectors **A** and **B**. Figure on the middle describes how the virtual image grid is fixed to the scanner. The field of view is the maximal circle drawn inside the square defined by the outermost coincidence lines depending on the scanner model. The stantard, not zoomed, image grid is the minimal square that covers the field of view.



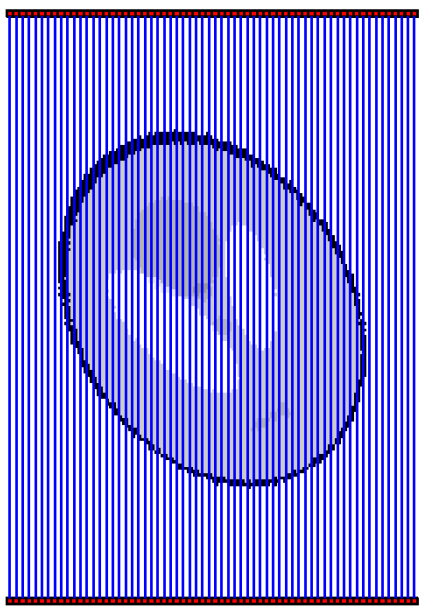


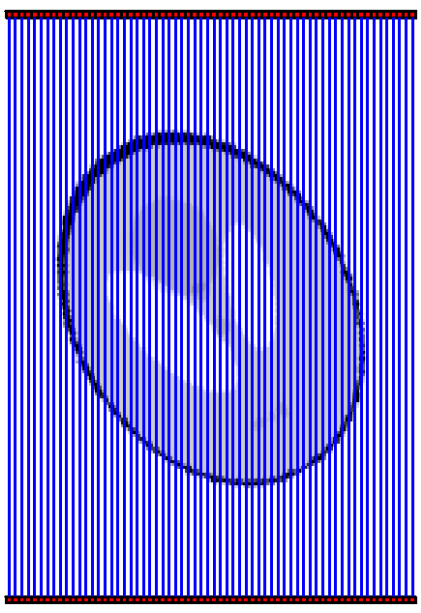


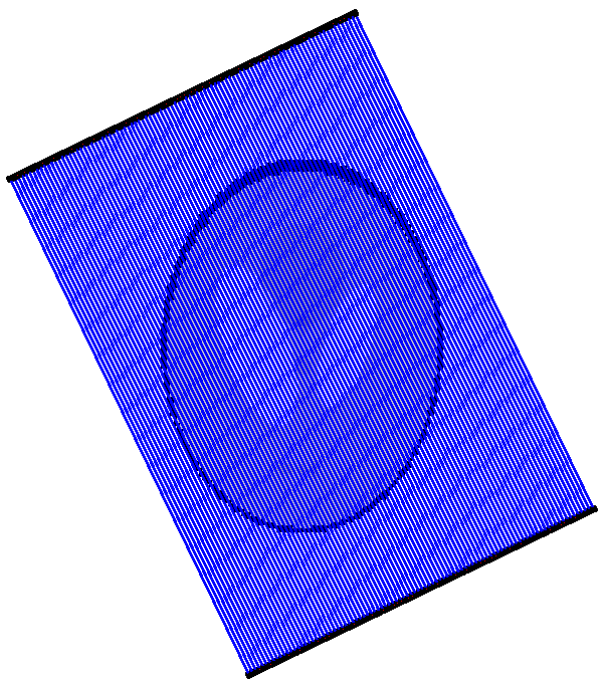
A helpful assumption to make is that the distance between all parallel lines is constant, which is not necessarely the case as shown in the right most figure, i.e $h < d$. Another assumption is that the number of angular positions is divisible by four, that is, we can partition the set of angular positions in four subsets of equal size.

2.2 Discretisation Methods

As we have assumed that the parallel lines are in equal distance from each other, and we have fixed the image grid in the center of the field of view we can illustrate the virtual scanner as shown in the next figures.







The first two figures show the idea of the image rotation, or *pixel-driven*, approach and the last figure the scanner rotation, or *ray-driven*, approach to the computational data acquisition.

In the image rotation approach the set of parallel coincidence lines is kept fixed and the image is rotated to each angular position. We have utilised two interpolation methods in image rotation, nearest neighbour (left) and bilinear interpolation (middle). In the conventional implementation of the image rotation approach the number of coincidence lines in each angle (bins) is assumed to be equal to the number of columns in the image grid. This assumption accelerates the computation as every coincidence line cuts exactly one column of pixels in the image grid, thus the weighting coefficient is one for every pixel in the same column and zero everywhere else. Although this assumption weakens the generality of our algorithm, it is made for the sake of efficiency.

In the scanner rotation approach the image grid is kept fixed and the scanner is rotated to each angular position. The scanner rotation approach does not require image interpolation as the image is kept fixed, but the problem is to find the pixels cut by every single coincidence line.