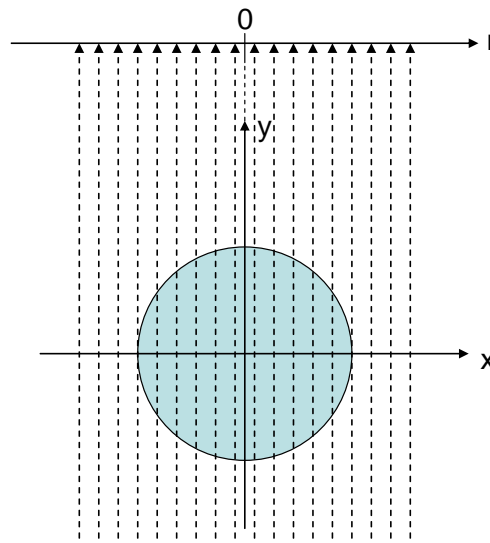


1. Implement the filtered backprojection algorithm and compare the results to simple backprojection imaging (i.e., the laminogram). You will apply both reconstruction approaches to a set of sinogram (i.e., collection of projections). The imaging geometry you will consider is presented below, where  $\theta = 0$  projection is shown.



The reconstructed image should be 128x128 pixels with a pixel size of 4x4 mm. The number of detector samples is 128, with  $\Delta r = 4\text{mm}$ . The detector samples are symmetrically placed as shown above. Note that the detector samples are at  $R = \pm \Delta r/2, \pm 3\Delta r/2, \pm 5\Delta r/2, \dots$ . The angular sampling covers almost 180 degrees, i.e.,  $\theta_k = \pi k / N_\theta$ , where  $N_\theta$  is the number of angular samples. Note that the last angle is not at exactly 180 degrees, but rather  $180 - 180 / N_\theta$  degrees.

A template (HW4\_Spring2022\_template.m) is provided for this homework. At the top of this template, a test phantom is loaded from the provided MATLAB data file - ImData.mat. With the provided test phantom, please answer the following questions.

- (a) Show the image of the test phantom and produce its corresponding sinogram with correct axis labels.
- (b) Produce the laminogram (i.e., the image reconstructed from the sinogram using only backprojection without prior filtering)

- (c) Filter the sinogram in spatial frequency domain using the appropriate filter discussed in class. Produce and show the filtered sinogram.
- (d) Produce the complete reconstructed image using the filtered sinogram with backprojection (i.e., filtered backprojection - combining your algorithms in (b) and (c))
- (e) Compare your results in (b) and (d). In particular, contrast the spatial-resolution characteristics in the two sets of images.
- (f) Reconstruct point spread function (PSF) images using backprojection and filtered backprojection and then estimate -6 dB spatial resolution for both. Elaborate your findings and use the findings to explain the results you obtained in (e).
- (g) Discuss the effect of “view” and “ray” on the reconstructed images and PSFs. You may reduce number of views and number of rays of the sinogram, respectively, reconstruct the image using the filtered backprojection, and then discuss what change you observe.

**Notice:**

1. Please hand in your solution files to the LMS elearning system, including your word file of the detailed solutions, the associated Matlab codes, and all the related materials. It would be nice that you can put your codes with comments side by side along with your answer in the word file.
2. Name your solution files “BioMedImg\_FinalHW\_StudentID.doc” and “BioMedImg\_FinalHW\_StudentID.m”, and archive them as a single zip file: BioMedImg\_FinalHW\_StudentID.zip.
3. The first line of your word or Matlab file should contain your name and some brief description, e.g., % EE 441000 王小明 u9612345 Final HW 06/23/2022
4. Please include “figures” and “reference sources” in your word file