ASSIGNMENT

This assignment will help you grasp the implementation aspects of the Filtered back projection algorithm that you have learnt in class.

Q. Reconstruct the Shepp Logan phantom, given the projection data.

1. Call the "projection.m" function to generate the projection data, $P_\theta(t)$, using the function call
"[proj_data, angles]=projection(No_of_angles, No_of_rays);"
No_of_angles will decide the viewing directions, θ_i , at which the projections are taken. These are equally distributed over 360^o.
No_of_rays, t, specifies the number of rays in each direction i.e. it defines the number of points in the projection data for each angle.
Proj_data stores the projection data for each angle columnwise. [No_of_rays X No_of_angles]
Plot the proj_data using the image function in matlab. The figure you obtain is called a sinogram.
Experiment with different no. of angles and rays.

2. Obtain the 1-D Fourier transform $S_\theta(\omega)$ using the Fourier Slice Theorem.
Note: zero padding may be required if the no_of_rays is not equal to 2^N.

3. Obtain the modified backprojection data $Q_\theta(t)$

   a. Multiply $S_\theta(\omega)$ by a suitable filter function.
   b. Take the Inverse Fourier Transform of the product to obtain $Q_\theta(t)$

4. Backprojection

   a. Note that $t=x\cos\theta + y\sin\theta$. You will need to define a grid with the limits for x and y set to desired image size i.e. say $-1 \le x, y \le 1$
   b. For each pair of coordinates (x,y) sum $Q_\theta(t)$ for all angles θ_i to obtain the filtered backprojection f(x,y)
   c. Plot the phantom values and the reconstructed values along any chosen cross section and compare.
      Note: Load the file "SheppLogan.mat" to obtain the phantom data.