1.a) Following are the RRMSE Values for various filters and corresponding parameters:

1) Ram-Lak Filter
   RRMSE(Original Image,Matlab reconstructed) = 0.2902
   RRMSE(Original Image,Manual Ram-Lak with L=wmax) = 0.3270
   RRMSE(Original Image,Manual Ram-Lak with L=wmax/2) = 0.3328

2) SheppLogan Filter
   RRMSE(Original Image,Matlab Reconstructed) = 0.2811
   RRMSE(Original Image,Manual SheppLogan with L=wmax) = 0.3187
   RRMSE(Original Image,Manual SheppLogan with L=wmax/2) = 0.3239

3) Cosine Filter
   RRMSE(Original Image,Matlab Reconstructed) = 0.2762
   RRMSE(Original Image,Manual Cosine with L=wmax) = 0.3144
   RRMSE(Original Image,Manual Cosine with L=wmax/2) = 0.3375

It can be clearly seen that Cosine filter performs better than both Ram-Lak Filter and SheppLogan filter for L = wmax but SheppLogan filter performs the best for L = wmax/2. That shows that SheppLogan Filter produces the least smoothening and high resolution effect.

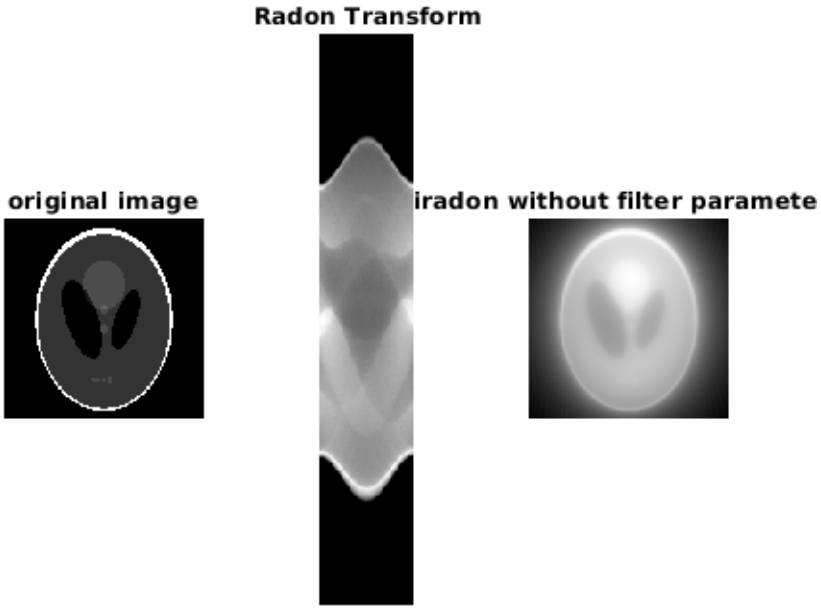
It can be observed that for all three filters implemented, rrmse in case of L=wmax is less than rrmse when L=wmax/2. This is because L basically is a measure of compromise between the reduction of noise and the detail or contrast of the reproduced image. L being wmax lets a bit of high frequencies and sharpen the edges leading to high constrast while also not allowing much high frequencies (noise) to pass. L = wmax/2 seems to be an overkill since it does not lead to a good contrast in the image.

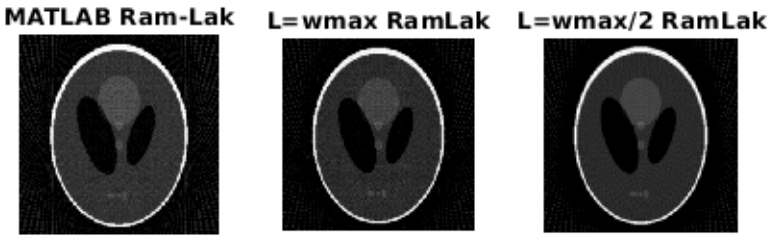
Because the Ram-Lak Filter is sensitive to noise , SheppLogan and Cosine filters perform better as they are formed by multiplying Ram-Lak filter by sine and cosine functions respectively, thus de-emphasizing higher frequencies.

1.b) In case of Original image S0 : Rrmse(highest) = 0.3270
In case of S5 (sigma = 5) : Rrmse(Lowest) = 0.2013

Gaussian filtering of image reduces background noise and improves Signal to noise ratio of the image , thus improving contrast. Because of this , a gaussian filtered image with high standard deviation(S5) has much less noise than the original image(S0). So it is better reconstructed on filtered back projection through a filter like Ram-Lak which is sensitive to noise(as pointed out in part a) than a noisy image. This is why its rrmse is much less.

1.c) For each of the 3 examples, it was observed that the RRMSE values decrease as L approaches wmax. This is because noise has already been filtered by the gaussian filtering done to images S1 and S5. Therefore allowing higher frequencies to pass will only sharpen the edges and good contrast,thus better reconstruction and less RRMSE.


Radon Transform
original image
iradon without filter paramete


MATLAB Ram-Lak
L=wmax RamLak
L=wmax/2 RamLak

MATLAB SheppLogan

L=wmax Shepp

L=wmax/2 Shepp

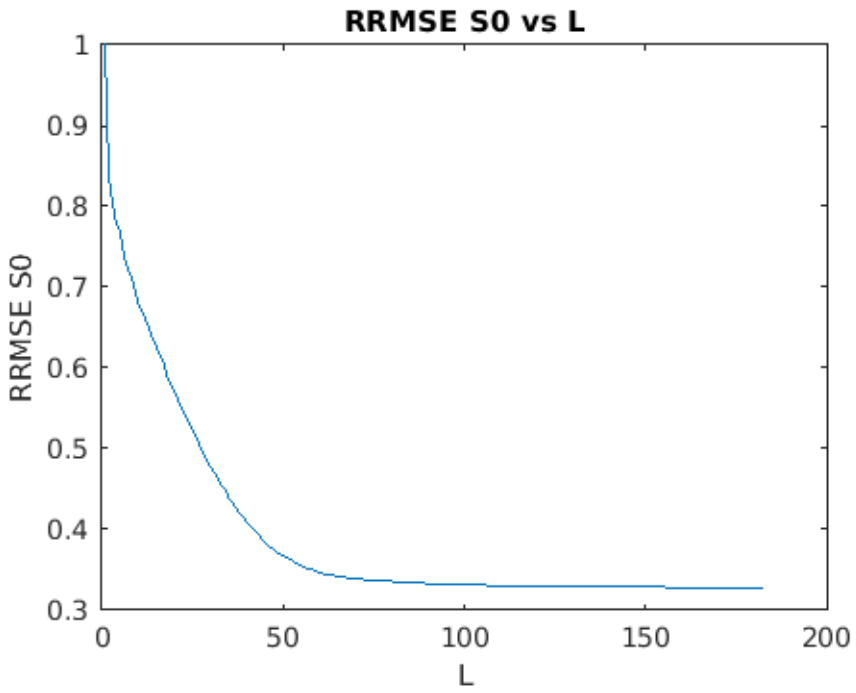
MATLAB Cosine

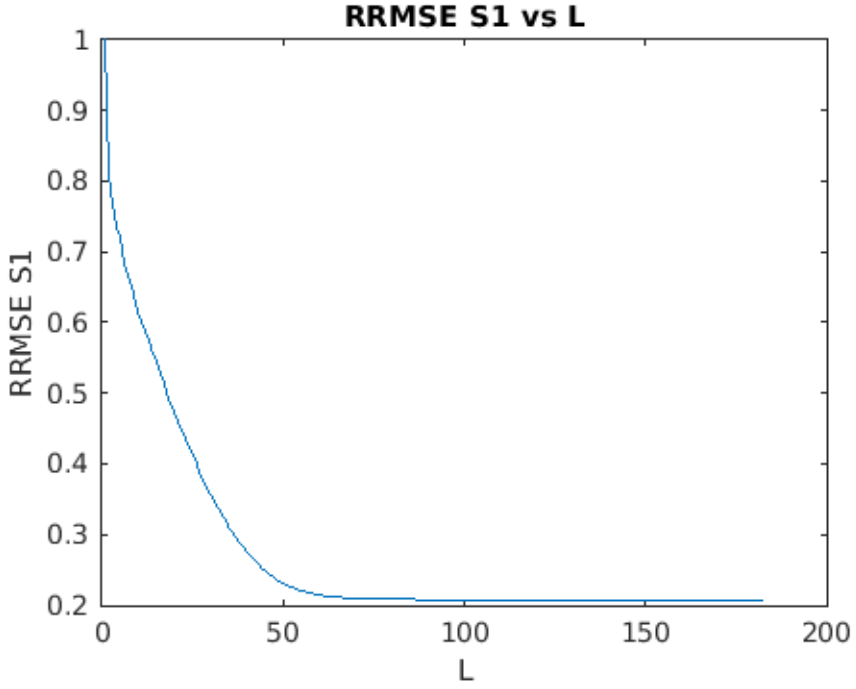
L=wmax Cosine

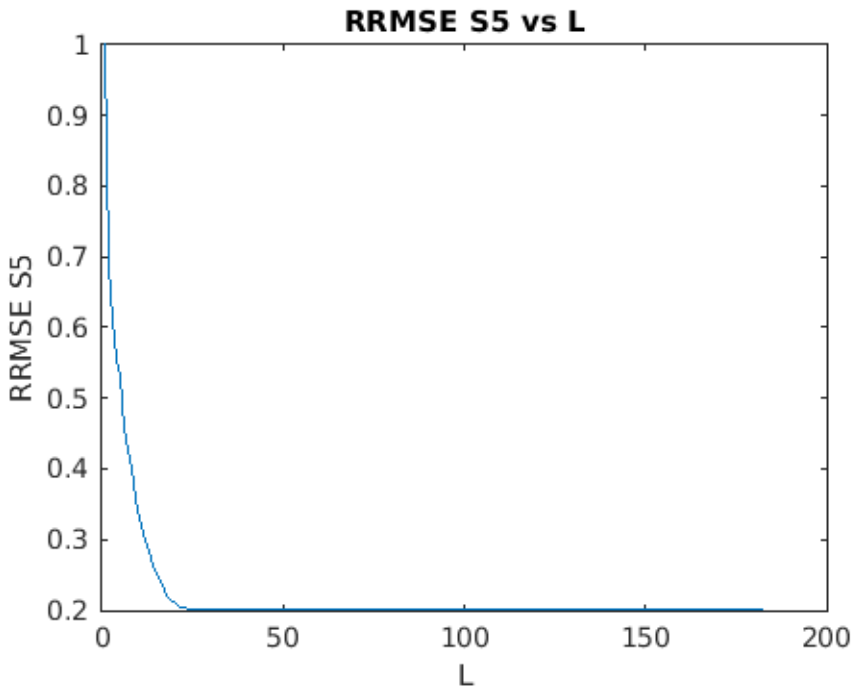
L=wmax/2 Cosine


No Noise
Gaussian sigma=1
FIlter sigma=5


Reconstructed S0
Reconstructed S1
Reconstructed S5


RRMSE S0 vs L
RRMSE S0
L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0
50
100
150
200


RRMSE S1 vs L
RRMSE S1
L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
50
100
150
200



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