Assignment 2.2

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A Inverse Radon

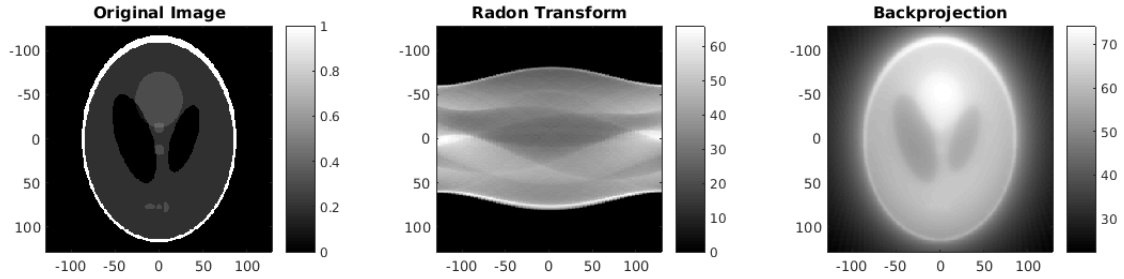

Figure 1: Shepp Logan Phantom Image, its Radon transform and back-projection of this Radon transform

Figure 2 shows the results of applying back projection on filtered radon transforms. The Images reconstructed by filtered backprojections has artifacts because of discretization. As the filter changes from Ram-Lak to Shepp-Logan to Cosine the resultant resconstruction become more and more smooth. As CutOff frequency decreases, more and more high freqency signal removed as a result of artifacts are getting reduced from reconstructed image.

B Effect of Blurring

RRMSE	Value
S_0	0.815184
S_1	0.526613
S_5	0.066342

Table 1: RRMSE values for the reconstructed image at various level of blurring

Higher the smoothing lower is the reconstruction error as shown in Table 1. Blurring the image smoothes out the discretization noise, as a result of which the reconstruction of more smoothed out image matches more and more with actual image.

Figure 3 and 4 show the blurred images and their respective recontructions from Radon transform

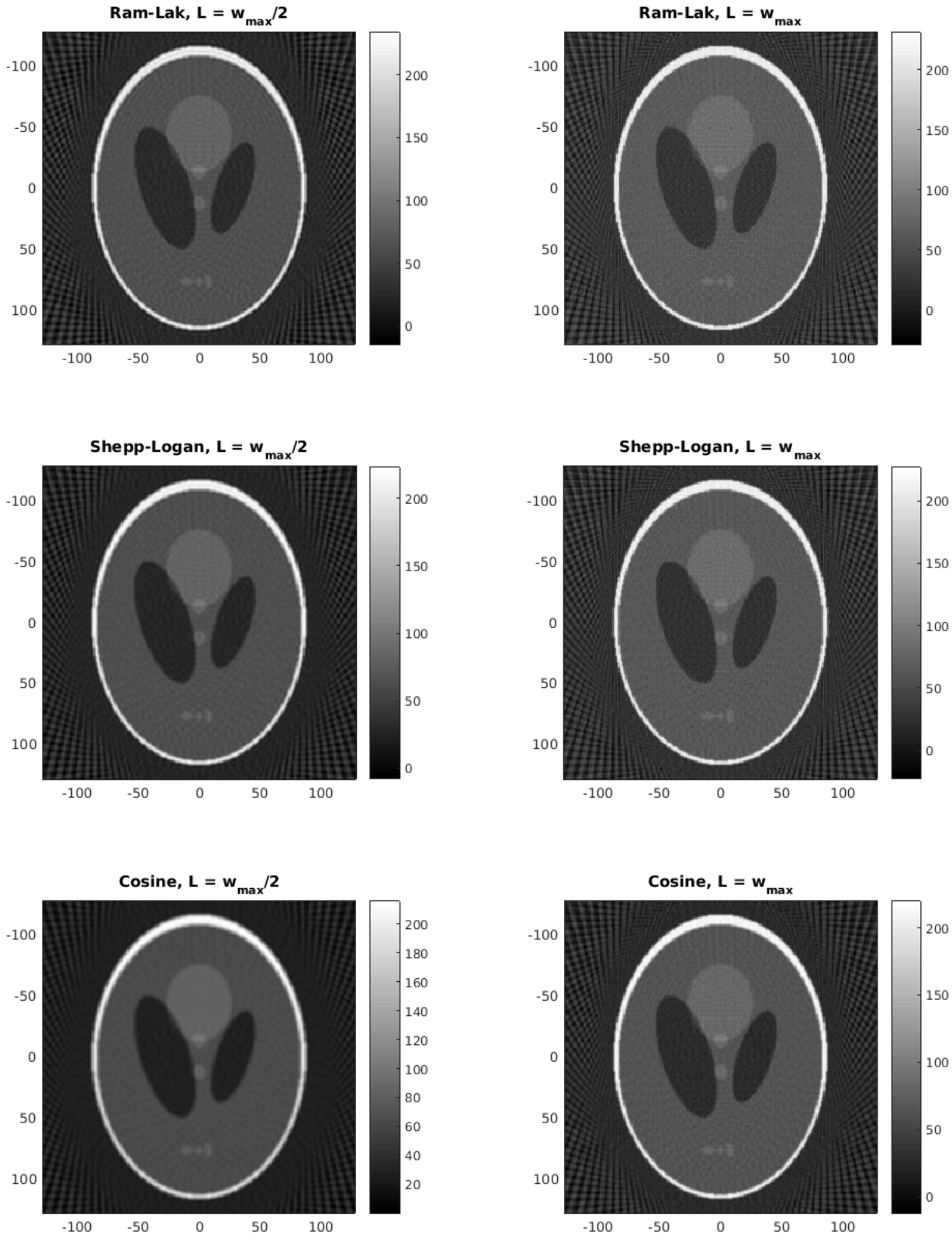

Figure 2: Filtered Back-projection with different filters

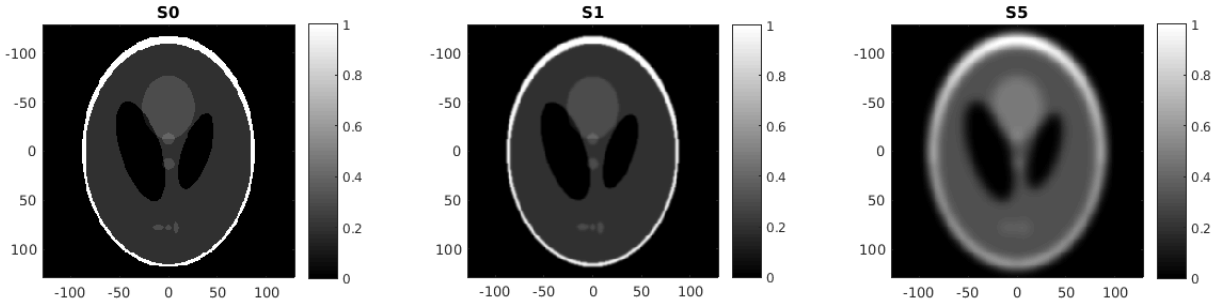

Figure 3: Shepp Logan Phantom Image, and its blurred version with standard deviation 1 and 5 pixel width respectively

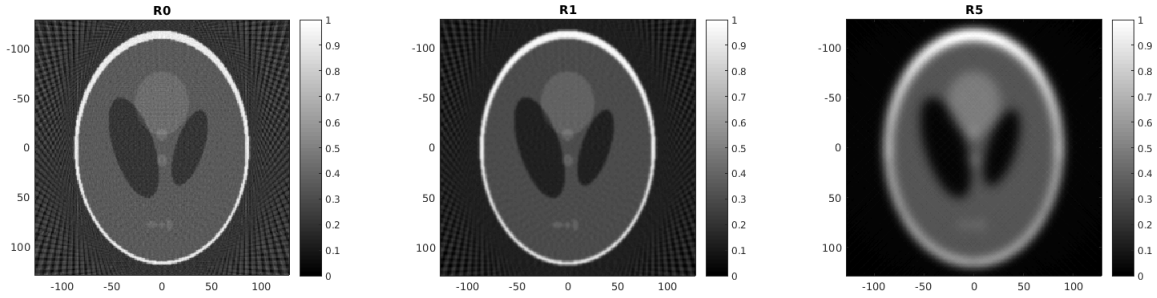

Figure 4: Image reconstructed from radon transform of above images

C RRMSE vs L

When L(Cutoff frequency) is small and close to zero the filter attenuates very low frequencies along with high frequencies as a results of which frequencies consising if useful information goes to zero, hence the error rates are very high.

On the other end when L is large the high frequencies contributing as noise do not get attenuated and increases the reconstruction error.

The RRMSE is minimum somewhere in between 0 and w_{max}. In highly blurred images because the high frequency signals are already attenuated the RRMSE does not increase by large amount after reaching minima as shown in Figure 7.

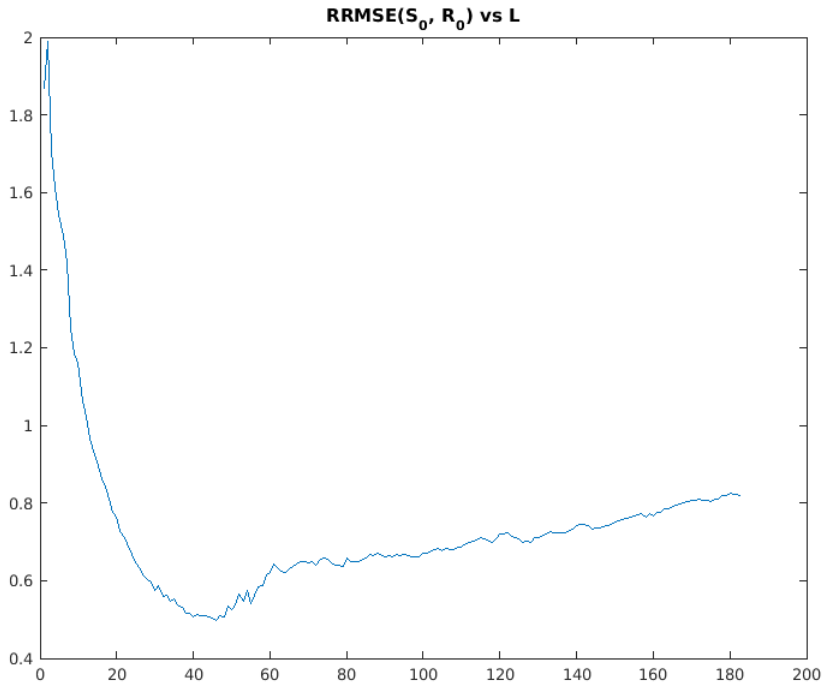

Figure 5: Shepp-Logan Phantom Image's Radon transform with $\Delta s = 0.5, 1, 3$ respectively

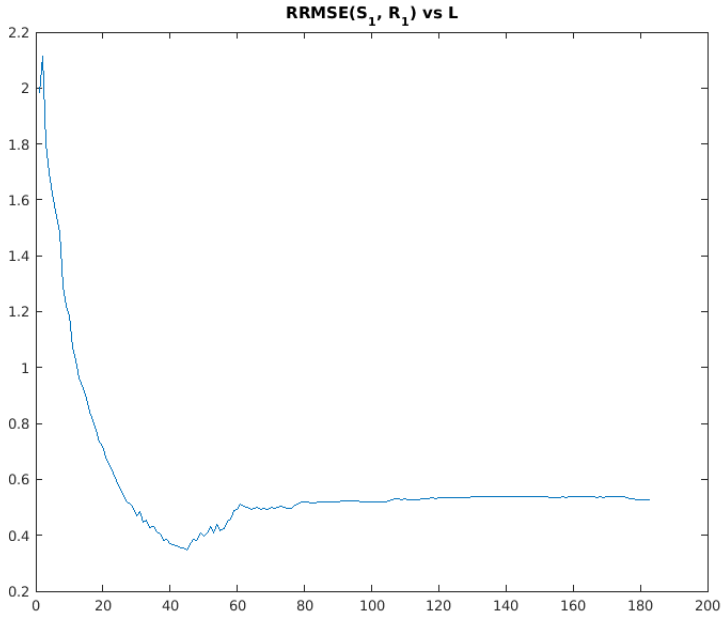

Figure 6: Shepp-Logan Phantom Image's Radon transform Intesity along $\theta = 0^0$ and $\theta = 90^0$ with $\Delta s = 0.5, 1, 3$ respectively

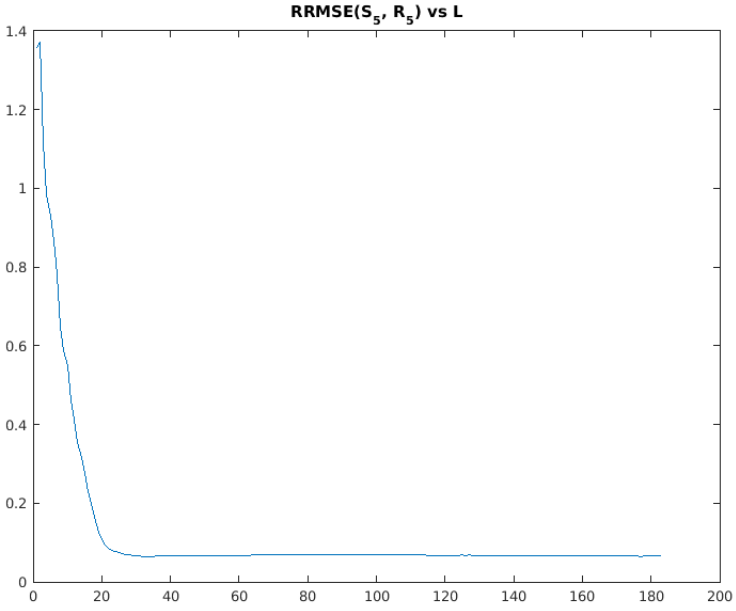

Figure 7: Shepp-Logan Phantom Image's Radon transform Intesity along $\theta = 0^0$ and $\theta = 90^0$ with $\Delta s = 0.5, 1, 3$ respectively