Project 1

Sinogram (SG1) from a known object

Reference Images

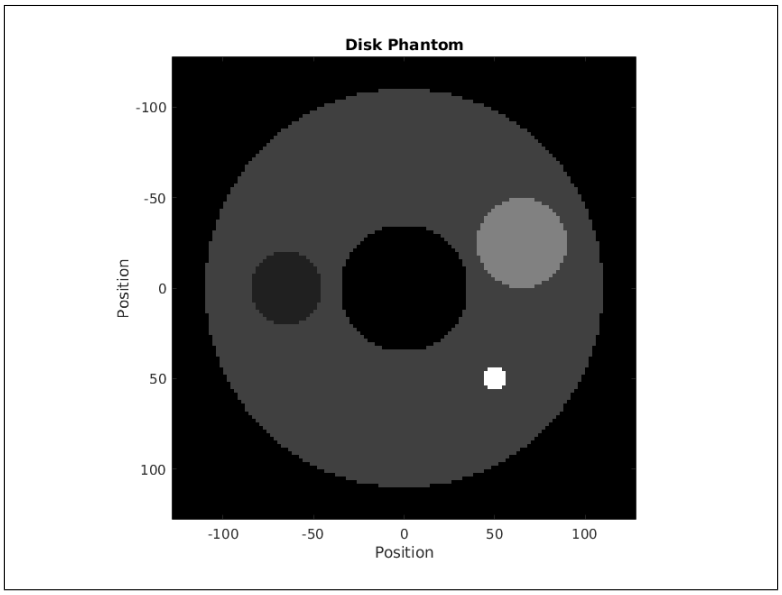

Figure 1: The Disk-Phantom Generated from Sinogram (SG1)

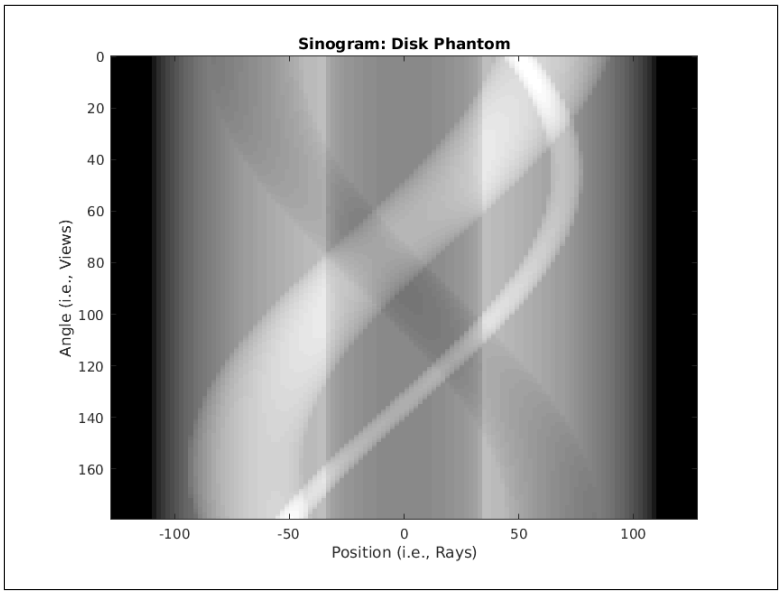

Figure 2: The Sinogram (SG1)

Part (A). 0^{th} movement of each projection as a function of projection angle

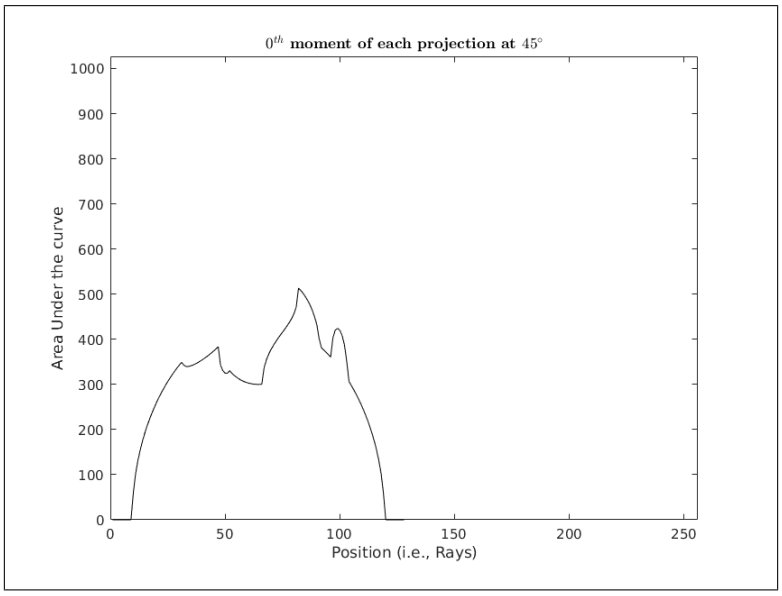

Figure 3: 0th Moment of each projection at a given angle ($\theta = 45°$)

The zeroth moment of a projection as a function of of the projection angle is nothing but the projection of the object on the perpendicular plane (R) at a particular instant. Let us consider an angle θ. Then the projection (g) as a function of θ is the line integral of the object along the rays.

Part (B). Simple Backprojection

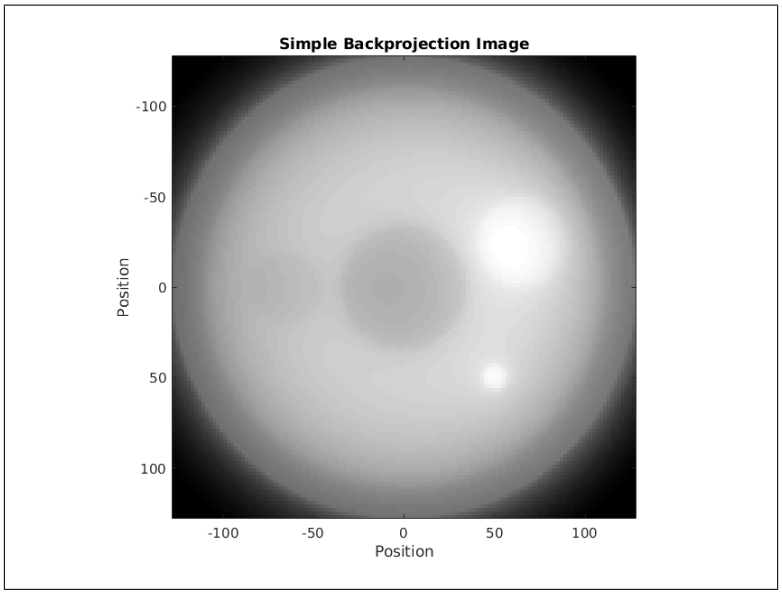

Figure 4: Output of Simple Backprojection

Part (C). Filtered Backprojection

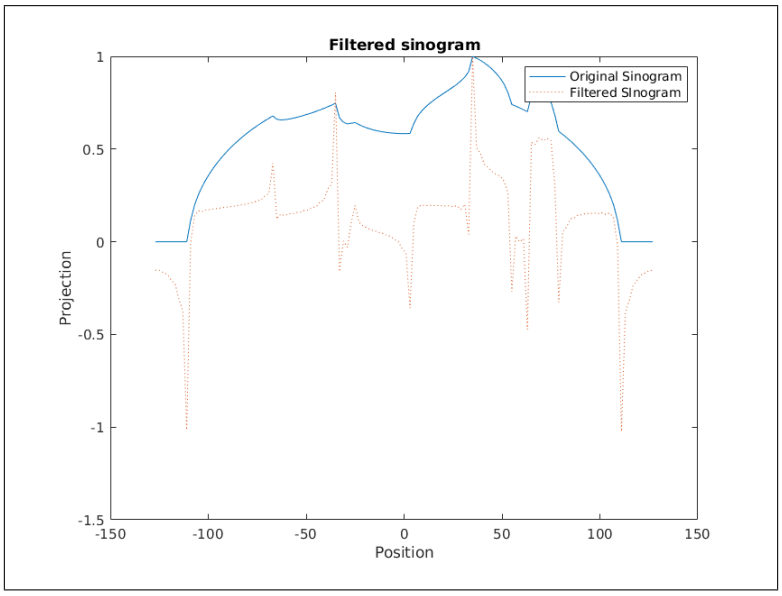

Figure 5: Projection at $\theta = 45°$ for Simple and Filtered Backprojection

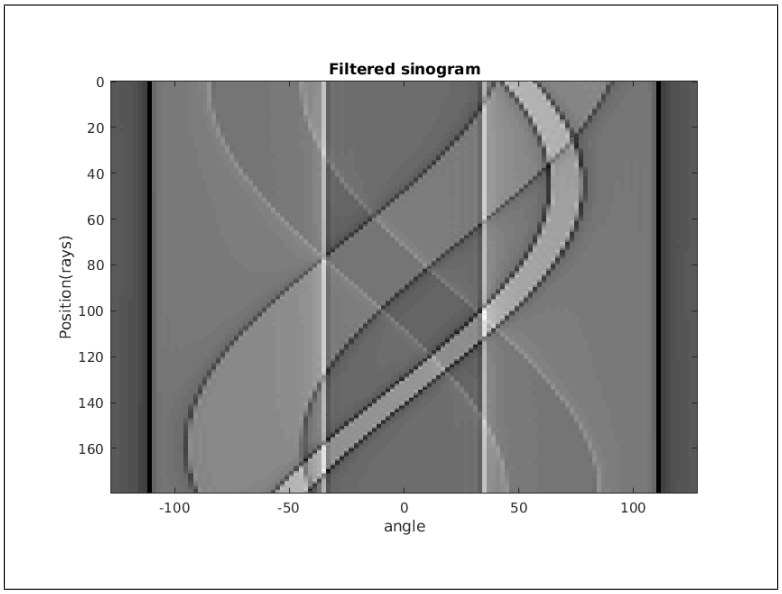

Figure 6: Filtered Sonogram

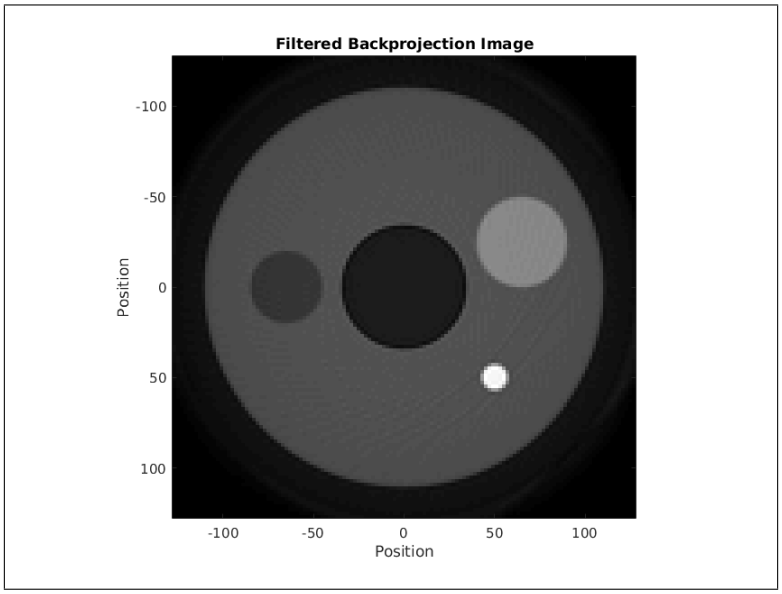

Figure 7: Reconstructed image using Ram-Lak Filtered Backprojection

Artifacts

A common artifact observed in the image is presence of "streaks" across the disks. This is because of the nature of the backprojection algorithm. The iterative rotation and addition creates these streaks as the Ram-Lak filter accentuates the edges in the circle projection.

Part (D). Image Profile through y-axis

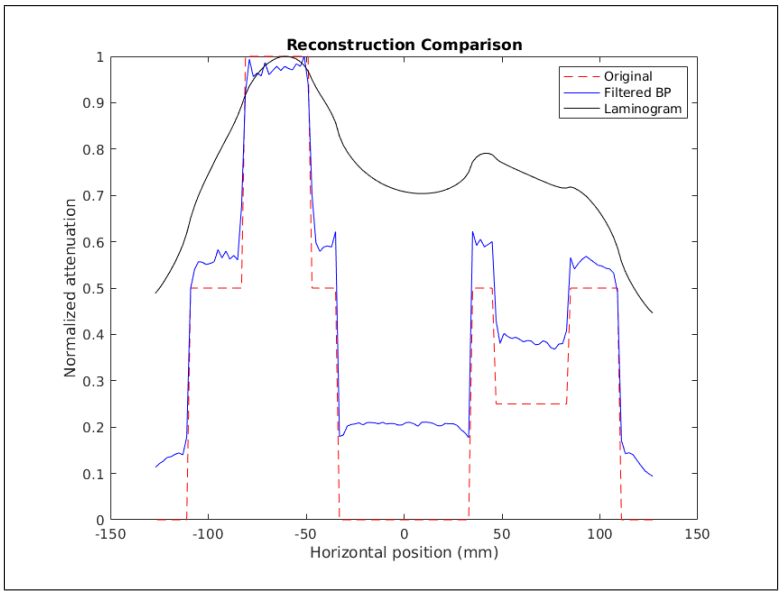

Figure 8: Image profile at $y = -7mm$ for original, simple backprojection reconstructed and filtered backprojection reconstructed image

Artifacts

A common artifact in the filtered backprojection algorithm is the presence of Gibbs Noise along the regions of peaks. This results in the observed "streaks" in the filtered image. The simple backprojection algorithm blurs the attenuation profile resulting in a smoother image with low contrast information as observed in the reconstructed image.

Part (E). Downsampled Reconstruction

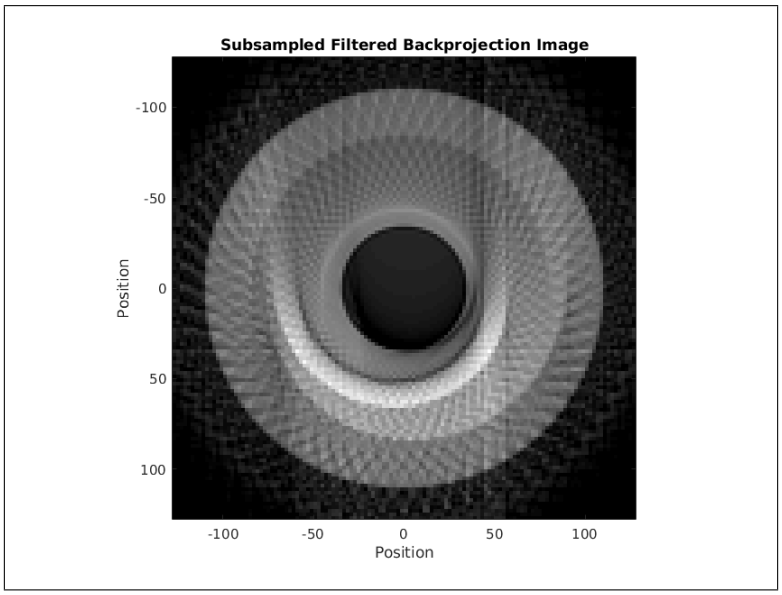

Figure 9: Filtered Image Reconstruction of downsampled sinogram

Artifacts

As a result of downsampling/reduction of angular resolution, the multiple disks appear overlapping through different, coarse angles especially along the centre. This results in an overlapped disk filled with Gibbs noise.

Sinogram (SG2) from an uknown object

Part (F). Sinogram of Unknown Object

Reference Sinogram

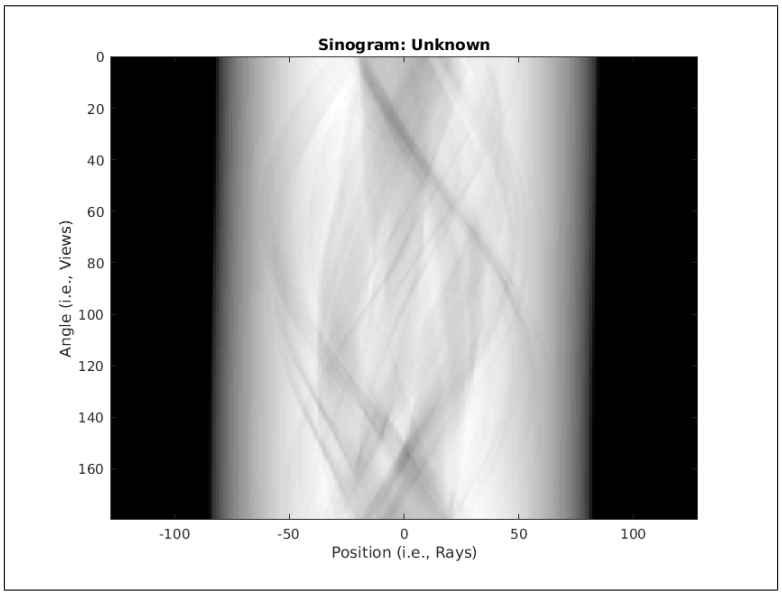

Figure 10: Sinogram (SG2) of unknown object

Discussion

Part (E). Reconstructed Images using simple and filtered backprojection

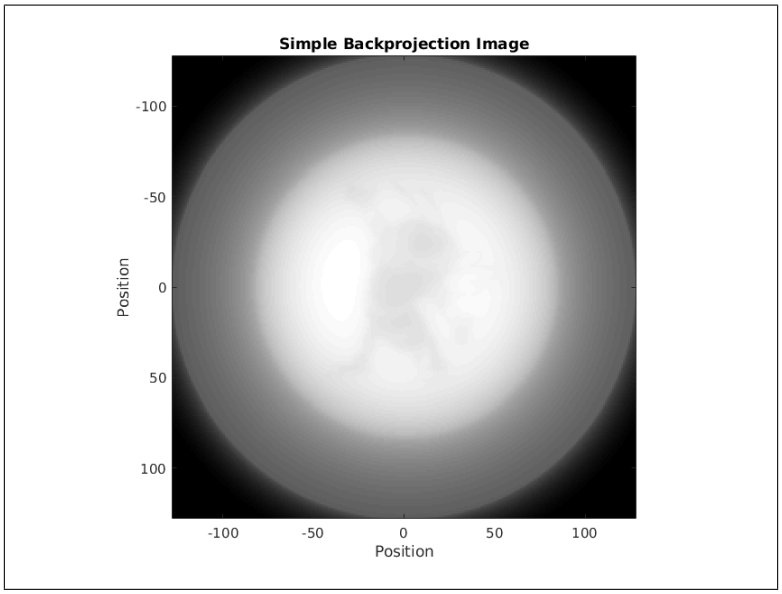

Figure 11: Unknown Object constructed using simple backprojection

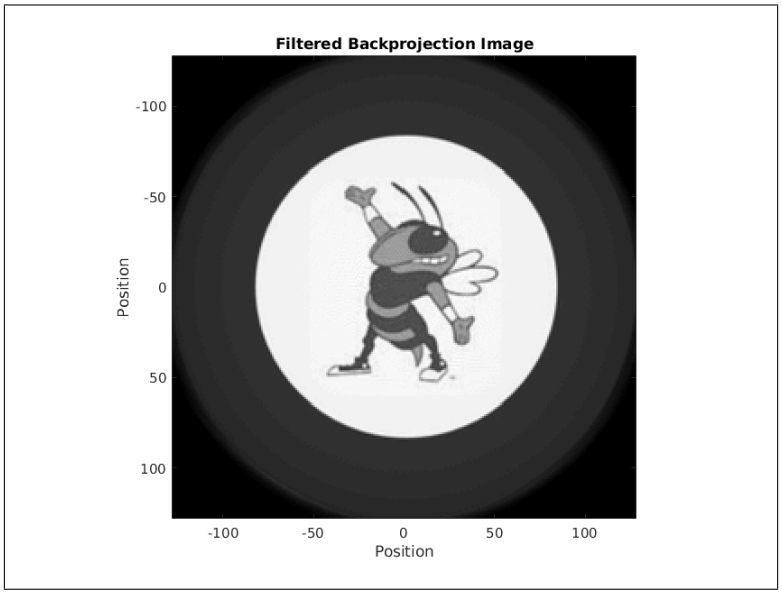

Figure 12: Unknown Object constructed using filtered backprojection