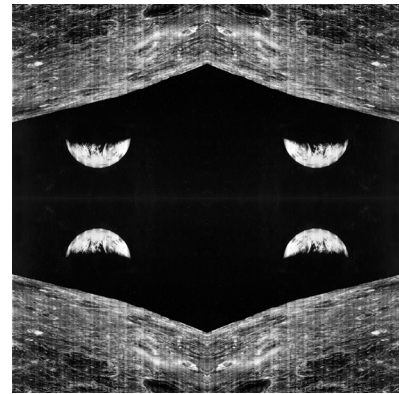


- Suppose we have the function  $f(x, y) = \text{rect}(x)\text{rect}(y)$  and we want to figure out the projection of this function onto a line at  $45^\circ$  to the x-axis. We can use the Radon transform results in reverse to make this calculation.

- First, calculate  $F(\xi, \eta)$
- Next, calculate  $G_{45}(\xi_o)$ .
- Finally, calculate  $g_{45}(x_o)$

- The projection of a rotationally symmetric object  $f(r)$  onto a line at angle  $\theta$  is given by  $g_\theta(x_o) = 2\text{sinc}(2x_o)$ . Find the unknown object  $f(r)$ .

- Download the image *LunarOrbiterAug23\_1966.jpg* from the class website. You will need Matlab or something similar to do this problem. The base image is a composite of a series of vertical strips captured on repeated orbits around the moon. The downloaded image is a bit weird in that it reflects the original image in both



the horizontal and vertical directions. The reason for this will become clear when we discuss the limitation of the Fast Fourier Transform (FFT) algorithm and methods to mitigate them.

- Use the FFT routines in Matlab to calculate the 2D Fourier transform  $F(\xi, \eta)$  of the image. Plot the magnitude of the Fourier transform  $|F(\xi, \eta)|$  on a log scale.

- b) Create a binary filter  $H(\xi, \eta)$  that will remove the artifacts associated with the vertical strips. Plot  $H(\xi, \eta)$ . Note, the filter should leave the peak at  $F(0,0)$ . Why?
- c) Use the FFT routines in Matlab to calculate the inverse Fourier transform of  $F(\xi, \eta)H(\xi, \eta)$ . Plot your filtered image.
- d) **Bonus:** There are specks in the background of this image. Do you think they are stars or noise? Justify your answer.