# CS663 Assignment-3

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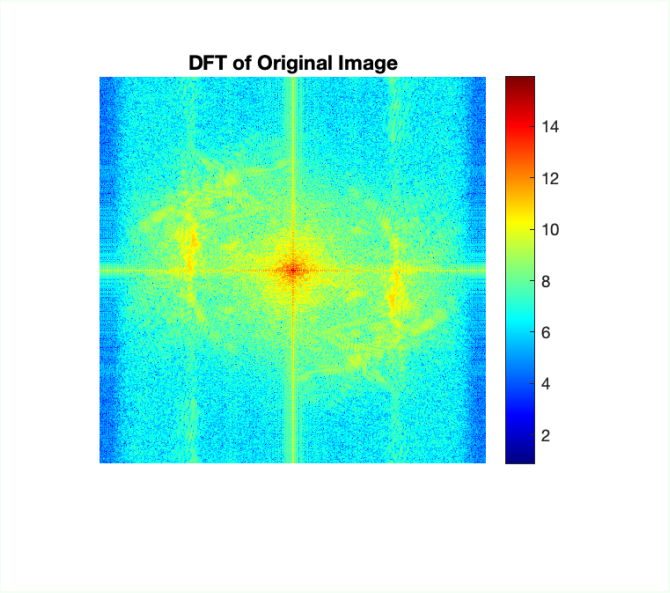
## Question 1

### Solution

**Note:** All the Fourier Transform and Frequency Response figures are shown in logarithm absolute format.

### Original Image

(a) Original Image

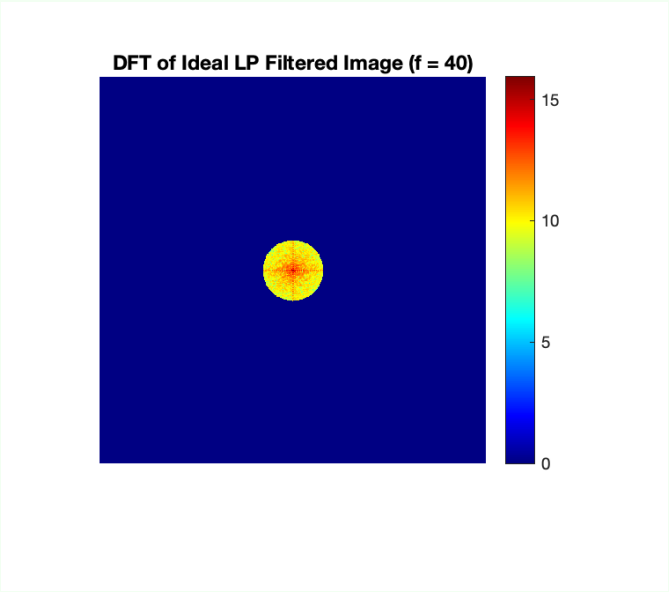



(b) Fourier Transform of Original Image

## Ideal Low Pass Filter

**Cutoff Frequency = 40**


(a) Filtered Image




(b) Fourier Transform of Filtered Image

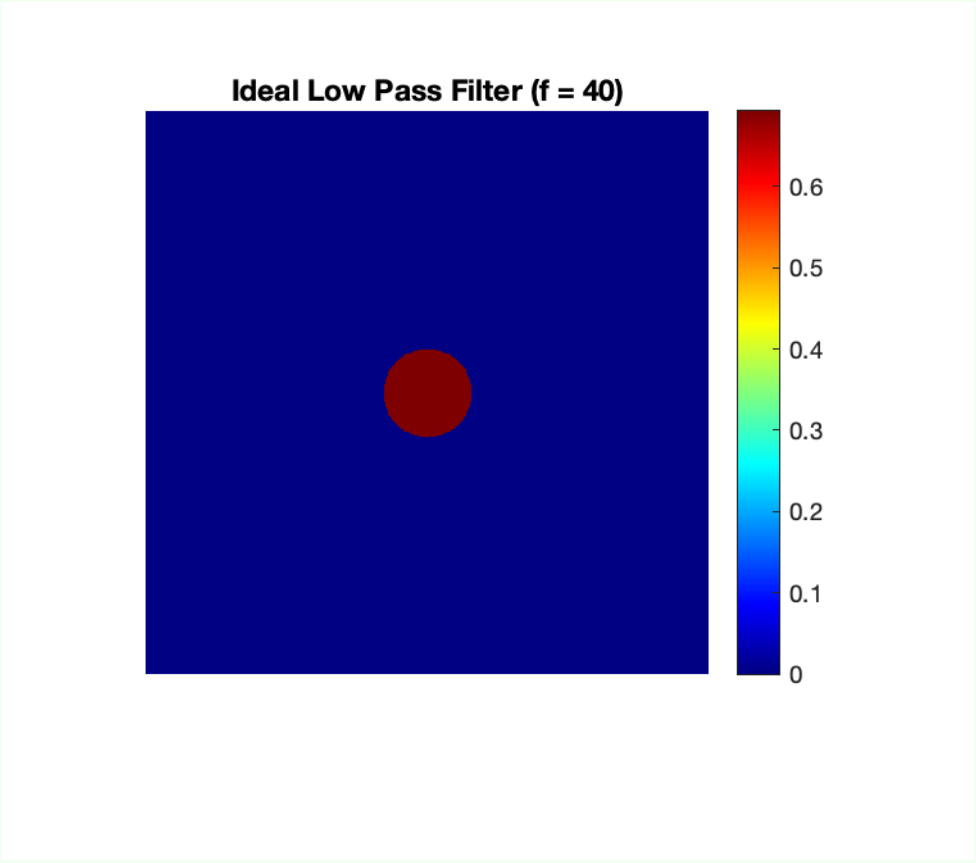
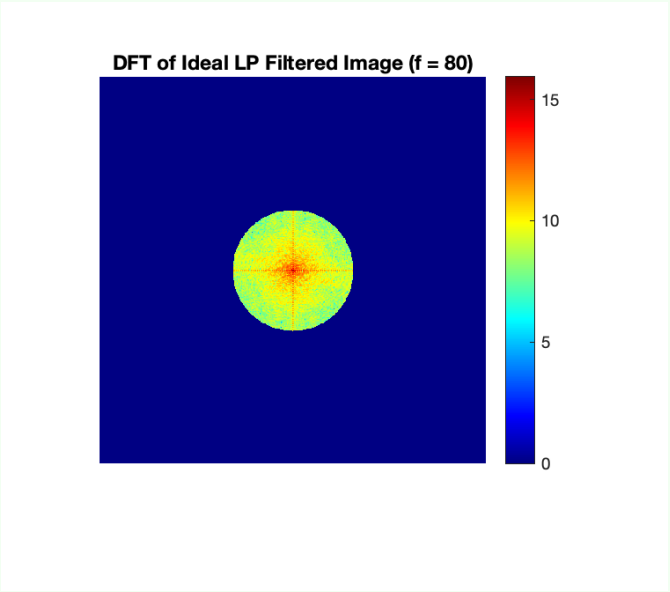



Figure 3: Frequency Response of Filter

**Cutoff Frequency = 80**


(a) Filtered Image




(b) Fourier Transform of Filtered Image

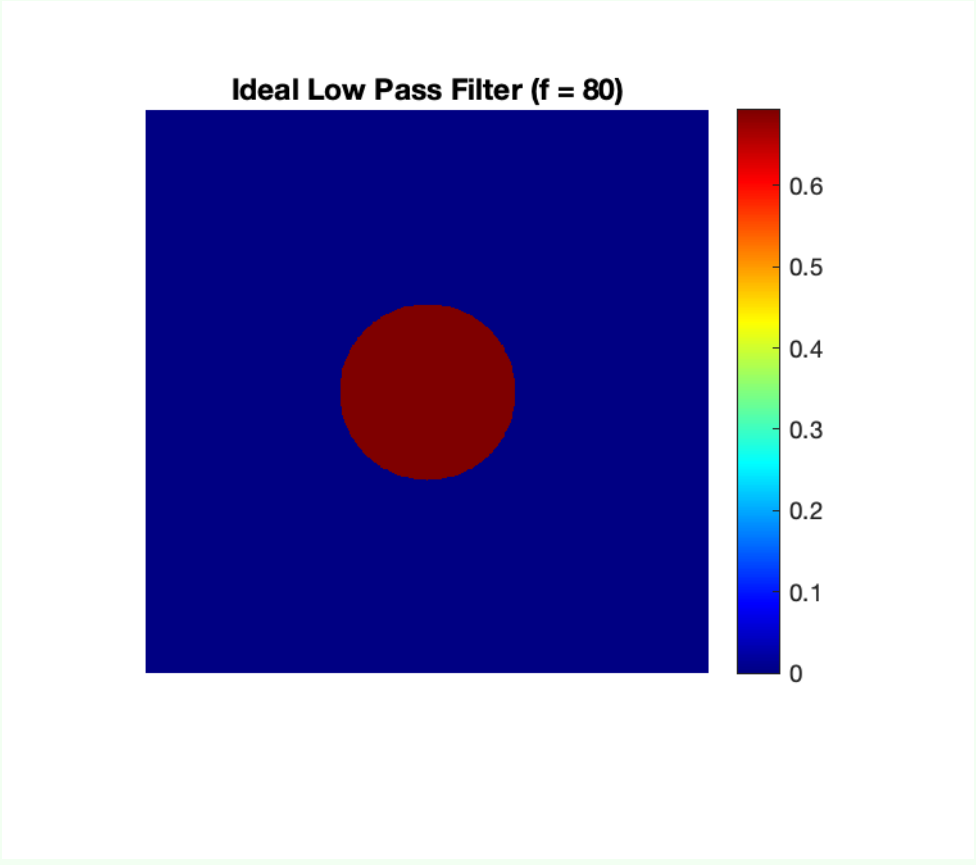
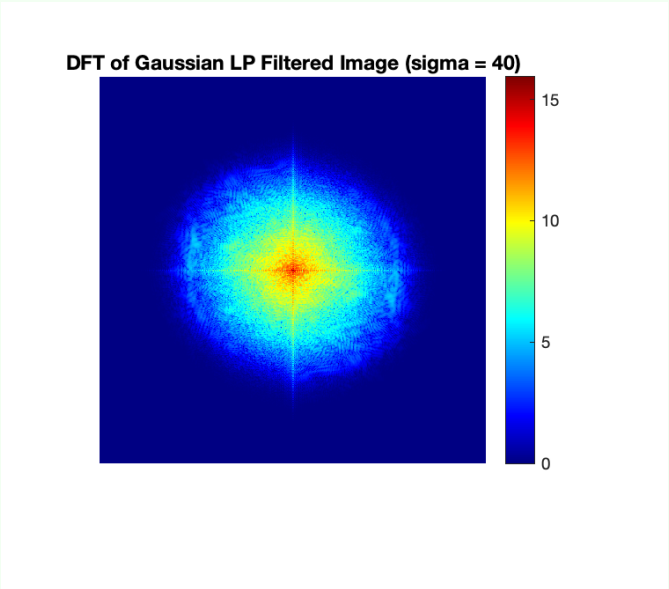



Figure 5: Frequency Response of Filter

## Gaussian Low Pass Filter

**Sigma = 40**


(a) Filtered Image




(b) Fourier Transform of Filtered Image

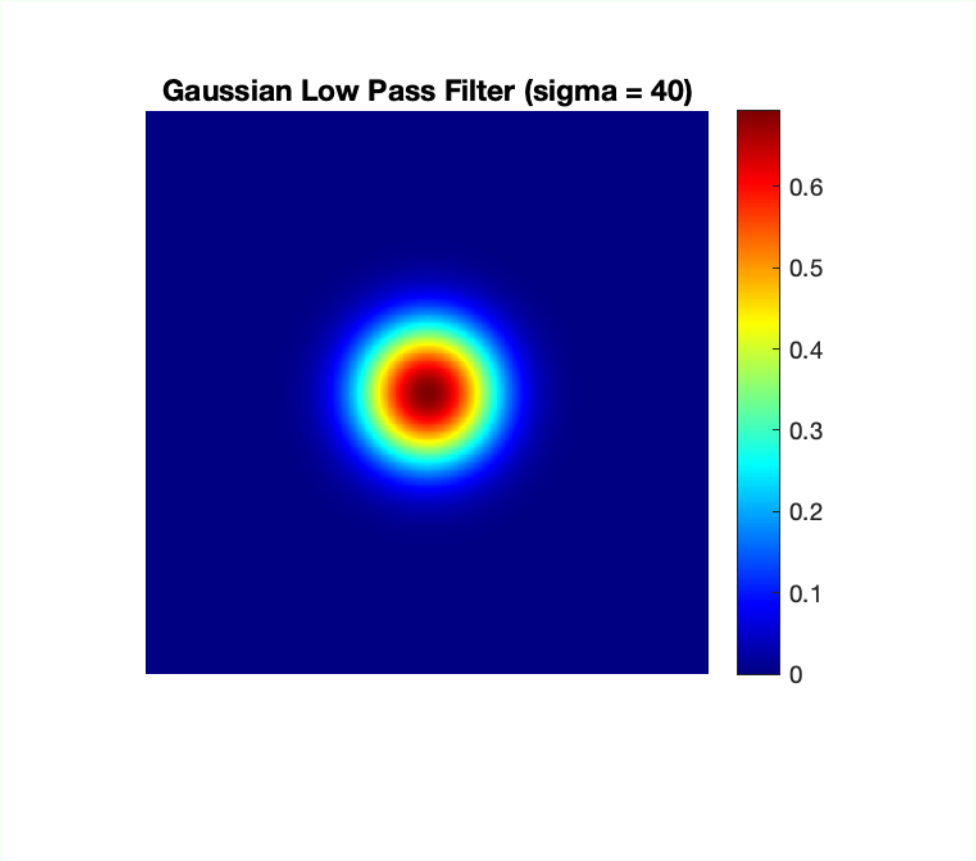
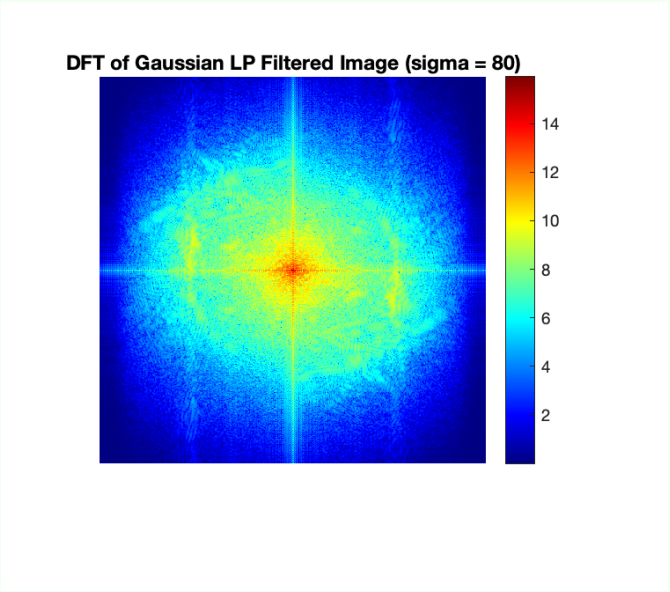



Figure 7: Frequency Response of Filter

**Sigma = 80**


(a) Filtered Image




(b) Fourier Transform of Filtered Image

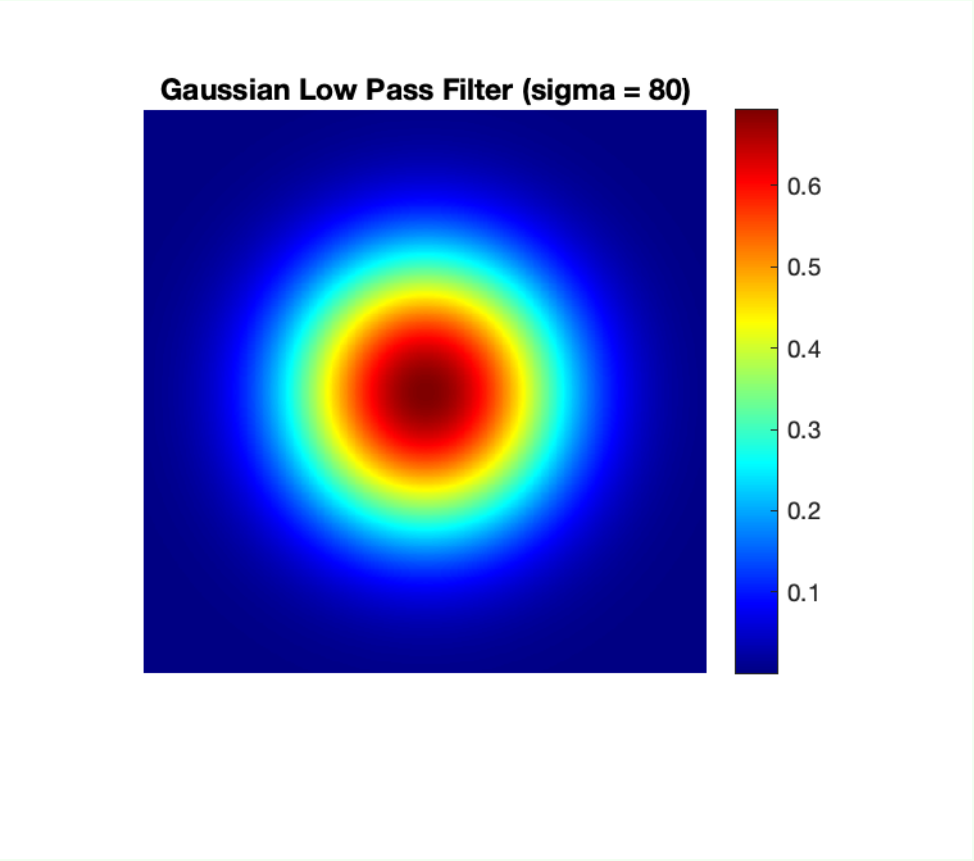



Figure 9: Frequency Response of Filter

## Observations

- From the obtained results we can easily see that as the cut-off frequency (for ideal low pass filter) / sigma (for Gaussian low pass filter) is increased, the higher frequency components which correspond to finer details in the image start becoming clearly visible.
- Also we can see that for ideal low pass filter there is a presence of **ringing artifacts** that appear as spurious signals near sharp transitions in the images. These ringing artifacts are quite undesirable and are a result of the complete elimination of high frequencies higher than the cut-off frequency by the ideal low pass filter.

- When a Gaussian low pass filter is used these ringing artifacts are absent. This is because the Gaussian low pass filter does not completely eliminate the higher frequencies and rather weakens them.
- In the Filtered Fourier Transform, we can see that Ideal Low Pass Filter creates sharp boundaries (beyond some distance from the centre), whereas the Gaussian doesn't have one, as we move away from the centre, the Fourier gradually fades away.