CS663 - Assignment 3 - Question 1

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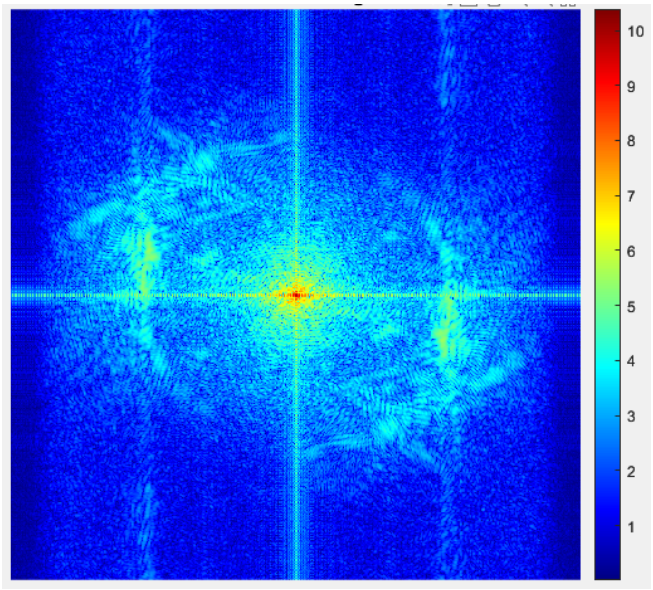
- Fourier transforms of the images are in the log absolute format.

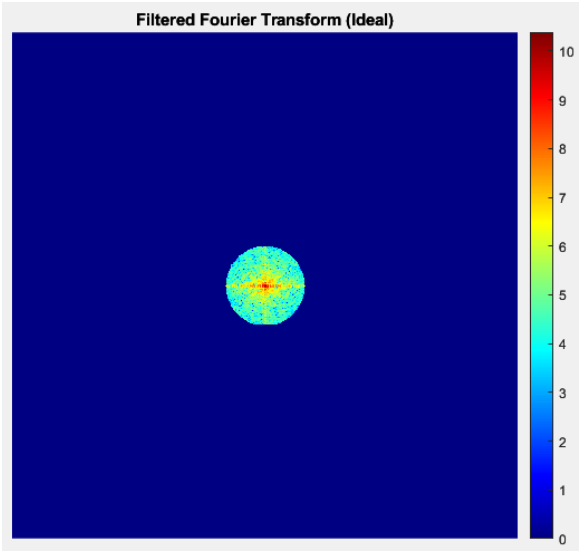
Barbara256 original image



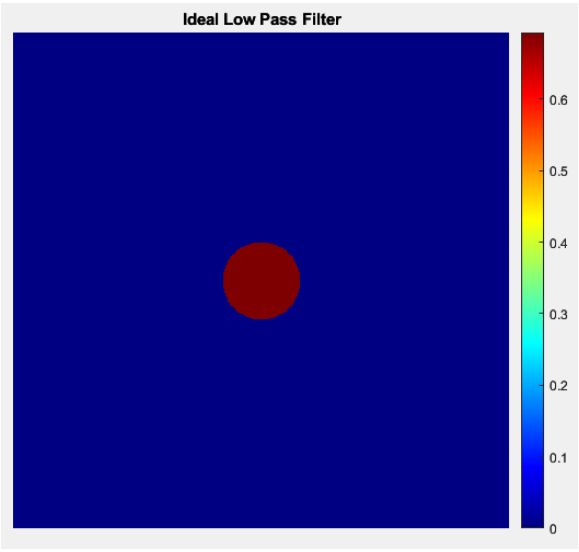
Barbara256 Fourier transform

- (A) an ideal low pass filter with cutoff frequency $D \in \{40, 60\}$
  Now we are taking for cutoff frequency 40,60,80 for ideal low pass filter
- **For cutoff frequency = 40**

Filtered ideal low pass image



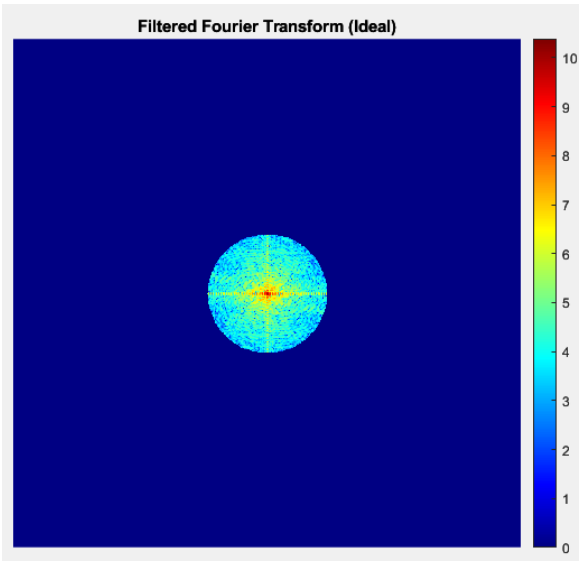
Fourier transformed of filtered image



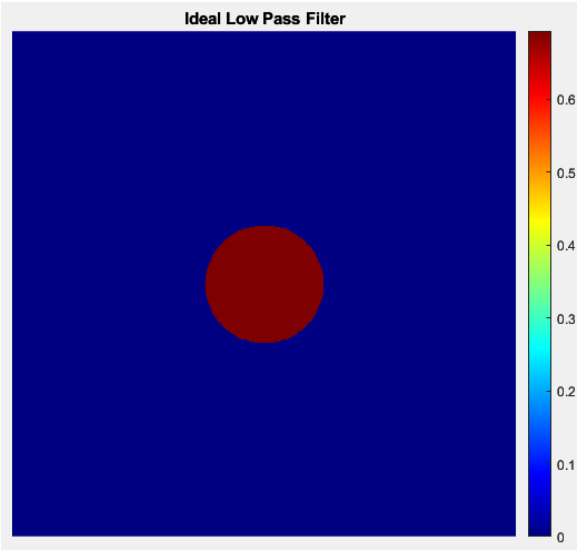
Ideal low pass filter frequency response

- **For cutoff frequency = 60**

Filtered ideal low pass image



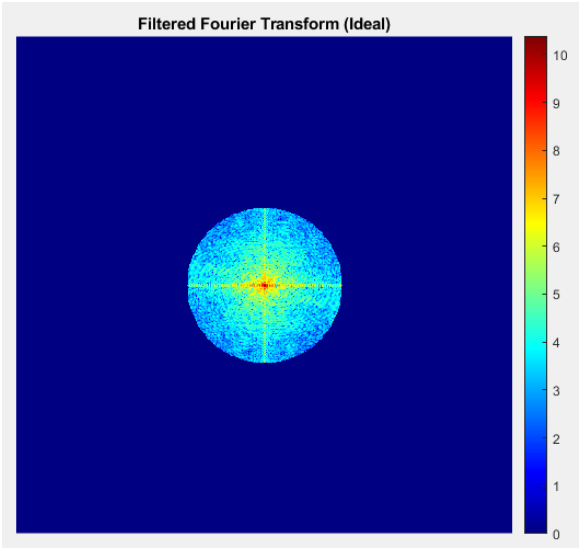
Fourier transformed of filtered image



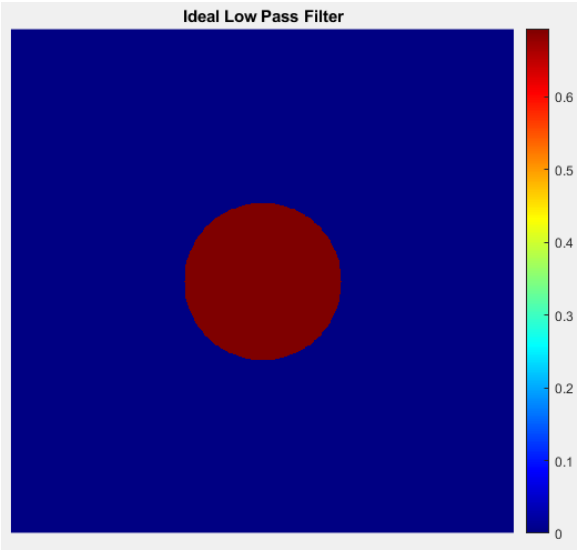
Ideal low pass filter frequency response

- **For cutoff frequency = 80**

Filtered ideal low pass image



Fourier transformed of filtered image

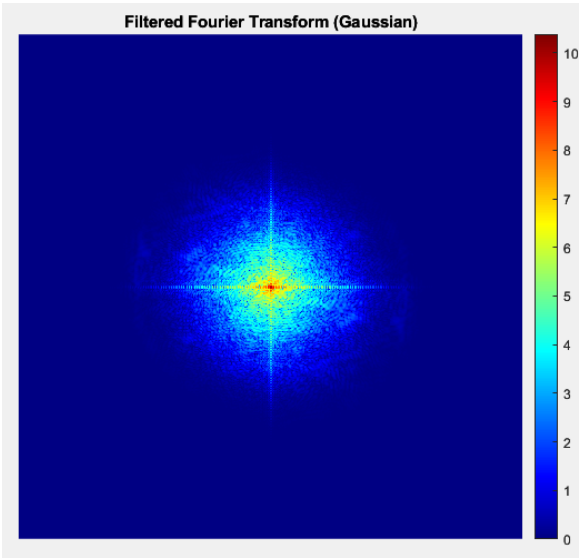


Ideal low pass filter frequency response

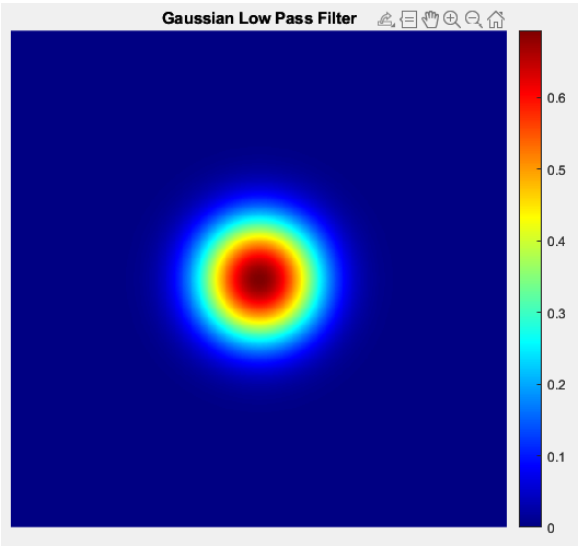
- (B) an Gaussian low pass filter with $\sigma \in \{40, 60\}$
  Now we are taking for σ 40,60,80 for ideal low pass filter

- **For cutoff frequency = 40**

Filtered Gaussian low pass image



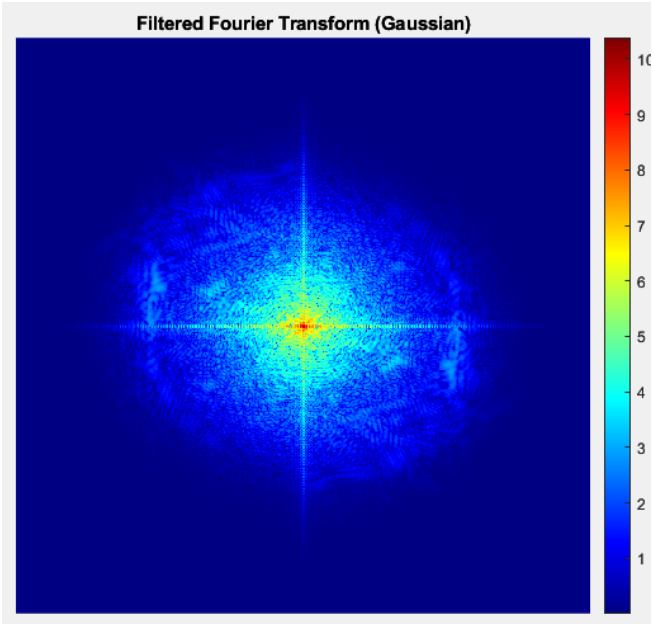
Fourier transformed of filtered image



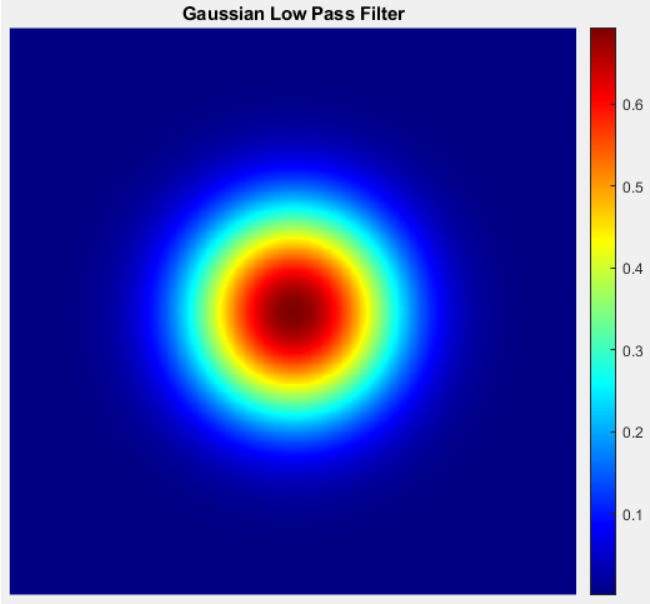
Gaussian low pass filter frequency response

- **For cutoff frequency = 60**

Filtered Gaussian low pass image



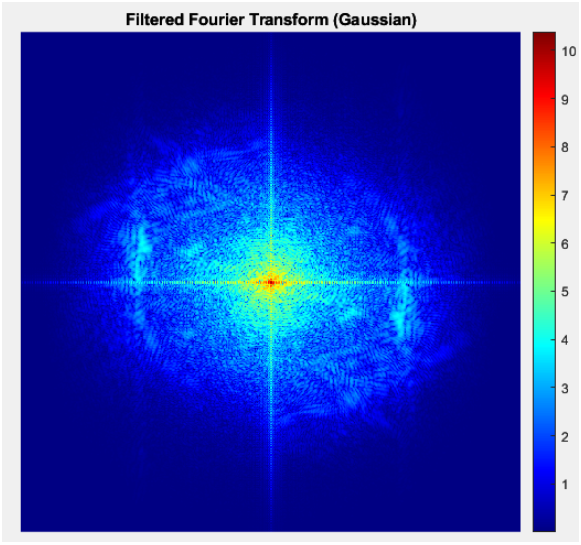
Fourier transformed of filtered image



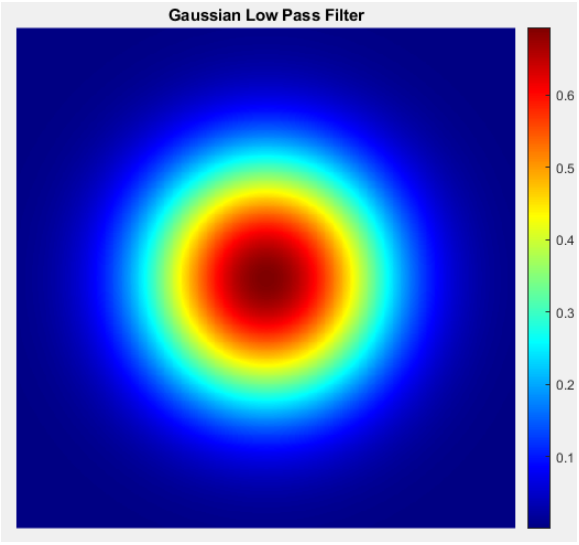
Gaussian low pass filter frequency response

- **For cutoff frequency = 80**

Filtered Gaussian low pass image



Fourier transformed of filtered image



Gaussian low pass filter frequency response

Conclusions

From the results, it's evident that as the cutoff frequency (for the ideal low-pass filter) or sigma (for the Gaussian low-pass filter) increases, higher-frequency components, which correspond to finer details in the image, become more visible.

Additionally, we observe that the ideal low-pass filter introduces ringing artifacts, which manifest as spurious signals near sharp transitions in the image. These artifacts are undesirable and result from the abrupt removal of frequencies higher than the cutoff point in the ideal low-pass filter.

In contrast, when a Gaussian low-pass filter is applied, these ringing artifacts are absent. This is due to the smoother attenuation of high frequencies by the Gaussian filter.