Question 2

CS663 (Digital Image Processing) Assignment 3

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Question 2

PART

I

Problem 1
Consider the barbara256.png image from the homework folder. Implement the following in MATLAB: (a) an ideal low pass filter with cutoff frequency $D \in \{40, 80\}$, (b) a Gaussian low pass filter with $\sigma \in \{40, 80\}$. Show the effect of these on the image, and display all filtered images in your report. Display the frequency response (in log absolute Fourier format) of all filters in your report as well. Comment on the differences in the outputs. Also display the log absolute Fourier transform of the original and filtered images. Comment on the differences in the outputs. Make sure you perform appropriate zero-padding while doing the filtering! [20 points]

Wherever it concerns, **LAF** is short for Log Absolute Fourier

Section 1

Original Image and its Log Absolute Fourier

Given below are the original images and the Log Absolute Fourier Magnitude of this image

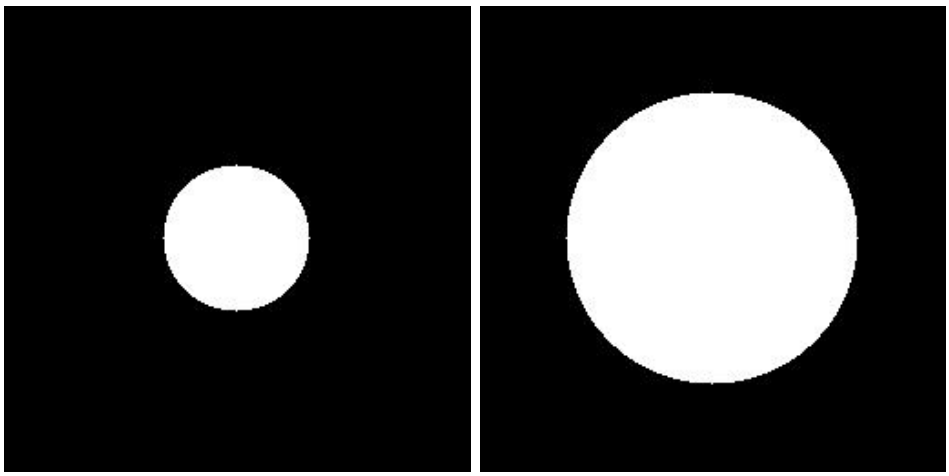
(a) Original Barbara Image (b) LAF of Original Image

Section 2

Log Absolute Fourier of Various Filters

Subsection 2.1

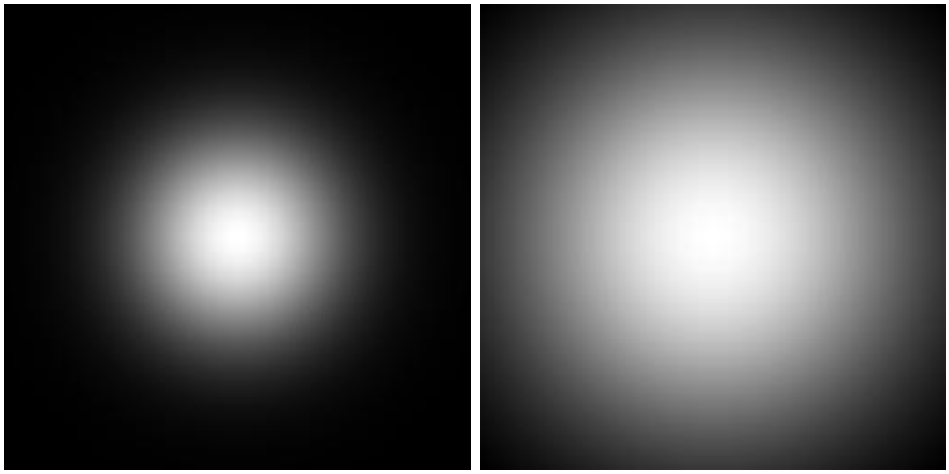
Ideal Filter



(a) Ideal Cut-off frequency D = 40 (b) Ideal Cut-off frequency D = 80

Subsection 2.2

Gaussian Filter



(a) Gaussian $\sigma = 40$ (b) Gaussian $\sigma = 80$

A higher value of D or a higher value of σ brings in higher frequencies into the filters to be considered. Also for Gaussian filters, the LAF is more smooth because of the continuous nature of the Gaussian function.

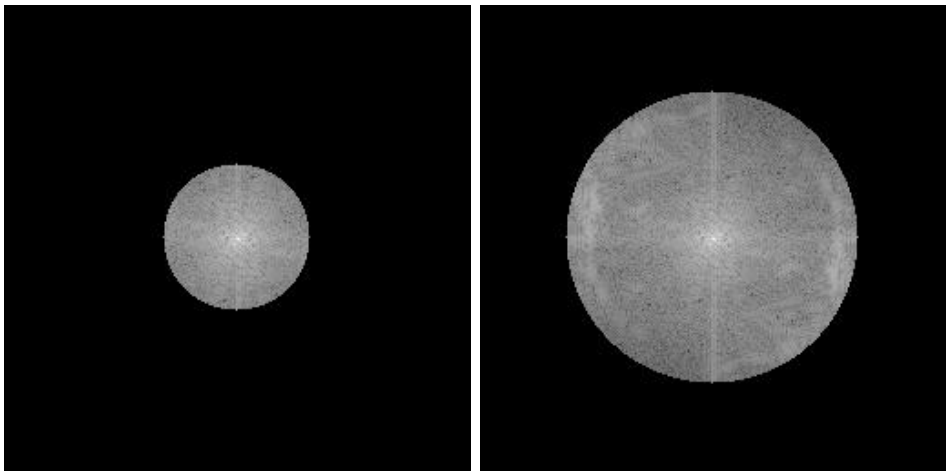
Section 3

Log Absolute Fourier of Filtered Images

Subsection 3.1

Ideal Filter

Following are the LAF of Ideal low-pass filtered images for various values of cutoff-frequency D

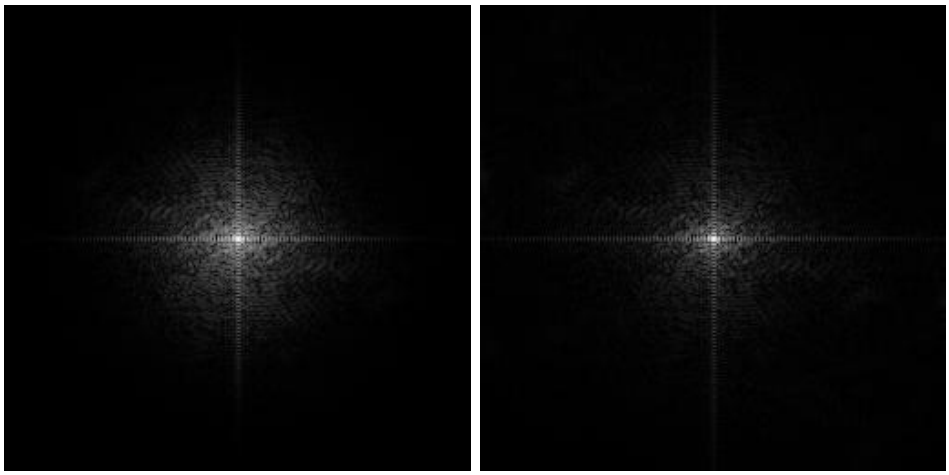


(a) Ideal Cut-off frequency D = 40 (b) Ideal Cut-off frequency D = 80

Subsection 3.2

Gaussian Filter

Following are the LAF of Gaussian low-pass filtered images for various values of σ



(a) Gaussian $\sigma = 40$ (b) Gaussian $\sigma = 80$

Larger the value of D or σ, more high spatial frequency information is incorporated into the filtered image.

Section 4

Final Filtered Image

Subsection 4.1

Ideal Filter

(a) Ideal Cut-off frequency D = 40 (b) Ideal Cut-off frequency D = 80

Subsection 4.2

Gaussian Filter

(a) Gaussian $\sigma = 40$ (b) Gaussian $\sigma = 80$

Ideal Low-Pass Filter has a sudden transition from pass to stop band, which leads to ringing effects in the spatial domain throughout the image, because of the sinc function ($\frac{sin(x)}{x}$) from the inverse fourier transform. But Gaussian low-pass filter reduces ringing artifacts and does not provide as sharp an attenuation of high frequencies.