```matlab
clc;
clear;

% Loading and Reading an Image
img = imread('new_york.jpeg');
my_img = rgb2gray(img);  % Convert to grayscale
imshow(my_img);
title('My Original Image');

% Fourier Transform of the image
FT_shifted = fftshift(fft2(my_img));  % Shift zero frequency components to
the center
magnitude_spectrum = log(1 + abs(FT_shifted));  % Magnitude spectrum

% Display the original and its magnitude spectrum
figure;
subplot(1,2,1), imshow(my_img);
title('My Original Image');
subplot(1,2,2), imshow(magnitude_spectrum, []);
title('Magnitude Spectrum');
```
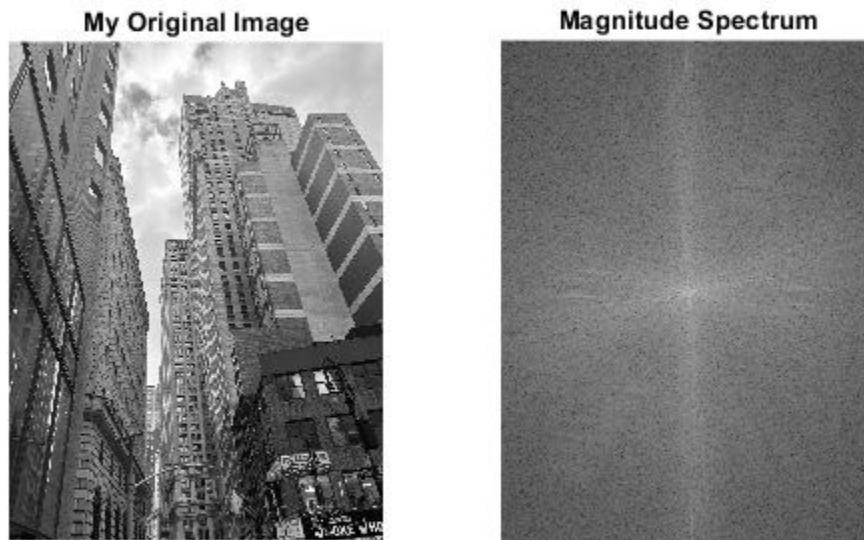
My Original Image

My Original Image   Magnitude Spectrum

Butterworth Low-Pass Filter

```matlab
D = 15;  % Cutoff frequency
[rows, cols] = size(my_img);
[x, y] = meshgrid(1:cols, 1:rows);
x = x - (cols / 2);
y = y - (rows / 2);

% Butterworth Low-Pass Filter
bl = 1 ./ (1 + ((x.^2 + y.^2) / D^2).^2);  % Low-pass filter
cf = fftshift(fft2(my_img));  % Fourier Transform
cfbl = cf .* bl;  % Apply low-pass filter

% Display Low Pass Filtered Image
figure;
subplot(1, 2, 1);
imshow(mat2gray(log(1 + abs(cfbl))));  % Magnitude Spectrum
title('Magnitude Spectrum of Butterworth Low-Pass Filter');
subplot(1, 2, 2);
imshow(uint8(abs(ifft2(ifftshift(cfbl)))));  % Inverse Fourier Transform
title('Image After Applying Butterworth Low-Pass Filter');
```
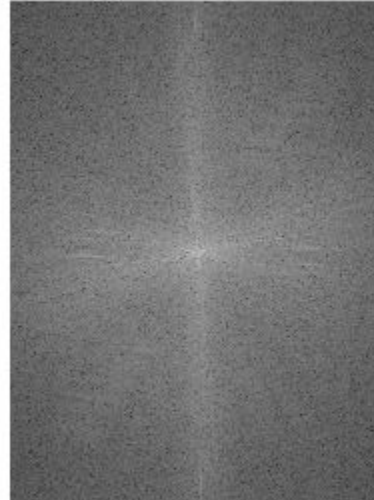
My Original Image

Magnitude Spectrum

Magnitude Spectrum of Butterworth Low-Pass Filter

Image After Applying Butterworth Low-Pass Filter
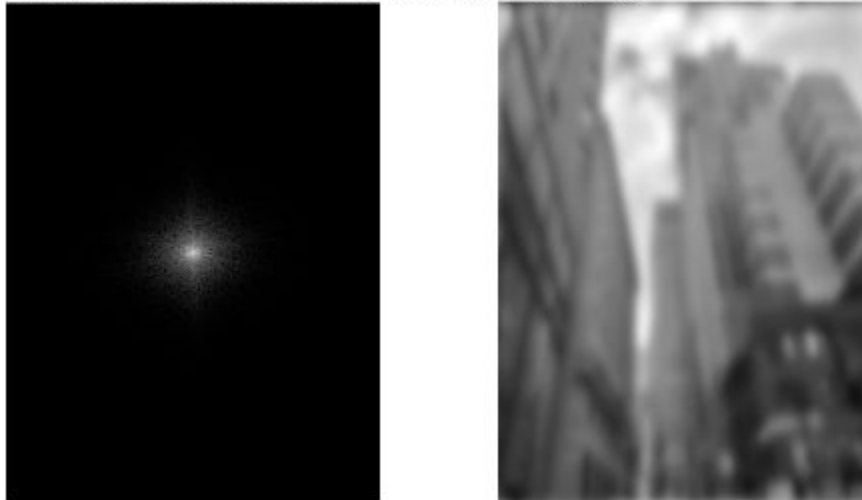
Butterworth High-Pass Filter

```
bh = 1 - bl;  % High-pass filter from low-pass
cfbh = cf .* bh;

% Display High Pass Filtered Image
figure;
subplot(1, 2, 1);
imshow(mat2gray(log(1 + abs(cfbh))));  % Magnitude Spectrum
title('Magnitude Spectrum of Butterworth High-Pass Filter');
subplot(1, 2, 2);
imshow(uint8(abs(ifft2(ifftshift(cfbh)))));  % Inverse Fourier Transform
title('Image After Applying Butterworth High-Pass Filter');
```
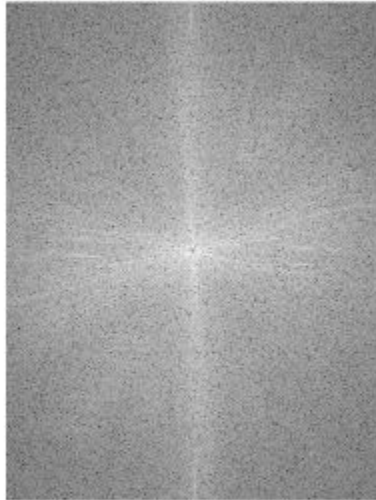

Magnitude Spectrum of Butterworth Low-Pass Filter   Image After Applying Butterworth Low-Pass Filter

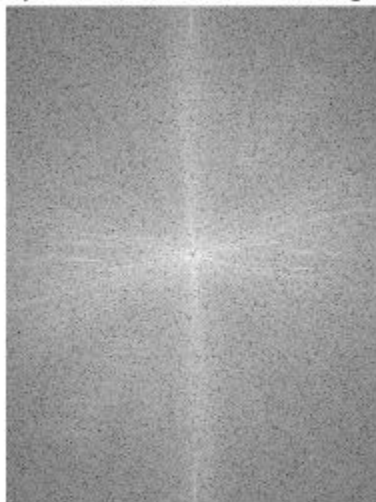Magnitude Spectrum of Butterworth High-Pass Filter   Image After Applying Butterworth High-Pass Filter
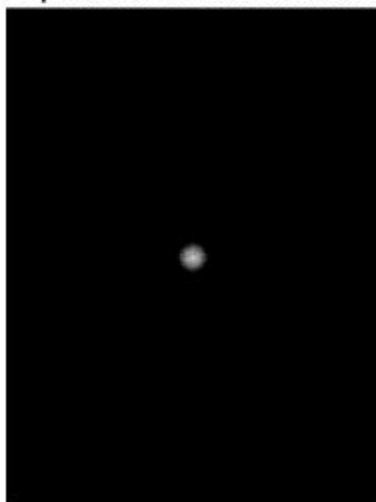
Gaussian Low-Pass Filter

```
sigma = 12;  % Standard deviation
g_lp = exp(-(x.^2 + y.^2) / (2 * sigma^2));  % Gaussian Low-pass filter
cfglp = cf .* g_lp;  % Apply Gaussian Low-pass filter

% Display Gaussian Low Pass Filtered Image
figure;
subplot(1, 2, 1);
imshow(mat2gray(log(1 + abs(cfglp))));  % Magnitude Spectrum
title('Magnitude Spectrum of Gaussian Low-Pass Filter');
subplot(1, 2, 2);
imshow(uint8(abs(ifft2(ifftshift(cfglp)))));  % Inverse Fourier Transform
title('Image After Applying Gaussian Low-Pass Filter');
```

Magnitude Spectrum of Butterworth High-Pass Filter

Image After Applying Butterworth High-Pass Filter

Magnitude Spectrum of Gaussian Low-Pass Filter

Image After Applying Gaussian Low-Pass Filter

Gaussian High-Pass Filter

```
g_hp = 1 - g_lp;  % Gaussian high-pass filter from low-pass
cfghp = cf .* g_hp;  % Apply Gaussian High-pass filter

% Display Gaussian High Pass Filtered Image
figure;
subplot(1, 2, 1);
imshow(mat2gray(log(1 + abs(cfghp))));  % Magnitude Spectrum
title('Magnitude Spectrum of Gaussian High-Pass Filter');
subplot(1, 2, 2);
imshow(uint8(abs(ifft2(ifftshift(cfghp)))));  % Inverse Fourier Transform
title('Image After Applying Gaussian High-Pass Filter');
```
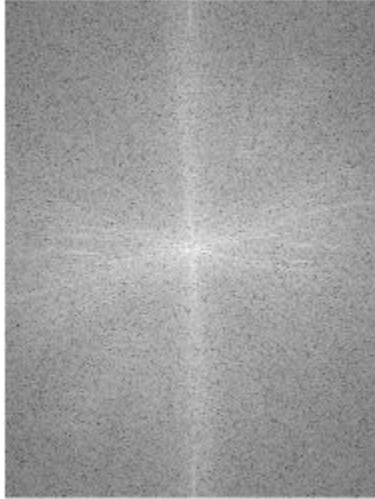

Magnitude Spectrum of Gaussian Low-Pass Filter   Image After Applying Gaussian Low-Pass Filter
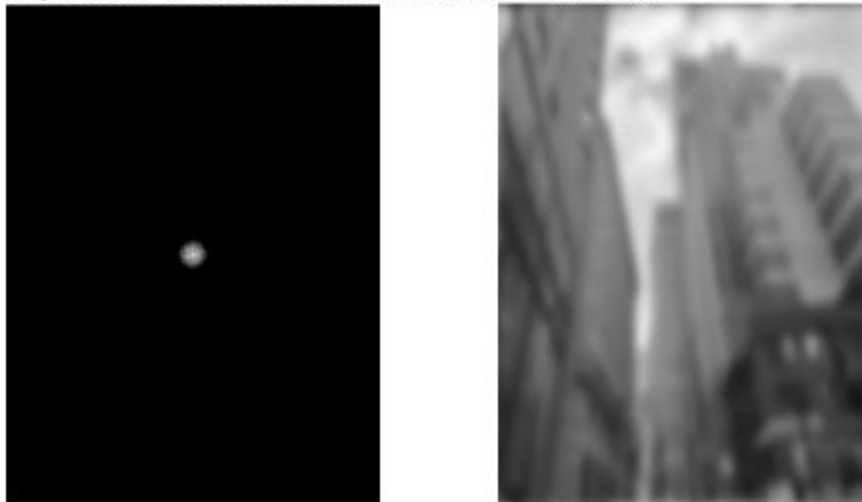
Magnitude Spectrum of Gaussian High-Pass Filter   Image After Applying Gaussian High-Pass Filter

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