Convolution in Frequency domain

The convolution theorem is a fundamental property of the Fourier transform. It is often stated like:

"Convolution in time domain (spatial domain) equals multiplication in frequency domain"

or vice versa

$$f(x,y) * h(x,y) \quad \Leftrightarrow \quad F(u,v)H(u,v)$$

Space convolution = frequency multiplication

In words: the Fourier transform of the convolution of two functions is the product of their individual Fourier transforms

Example:

If we have two images **f** and **h**, how can we apply the convolution between these images in frequency domain by using matlab?

1- Apply fft2 to each image

F= fft2(f)

H= fft2(h)

2- Multiply F and H

Fconv= F .× H

That means Fconv= fft2(f) .× fft2(h)

3- Return to spatial domain by using inverse Fourier transform to Fconv

Y= ifft2(Fconv)

Y= ifft2(fft2(f) .× fft2(h))

Y= fftshift (ifft2 (fft2(f) .× fft2(h)))

Frequency Convolution in MATLAB

```
clc
clear all
close all
A= imread('cameraman.tif');
[r c]=size(A);  %% size of the image

%%% construct gaussian function with-
%%% standared deviation = s and size (m x m)

m=input('size of filter');
s=input('standared deviation')
G = fspecial('gaussian', [m  m], s);

%%% Frequency Convolution %%%

T=ifft2(fft2(A).*fft2(G,r,c));  %% frequency Convolution


figure,subplot(1,2,1), imshow(A), title('the original image')
subplot(1,2,2),imshow(T,[]), title('convolved image')
```