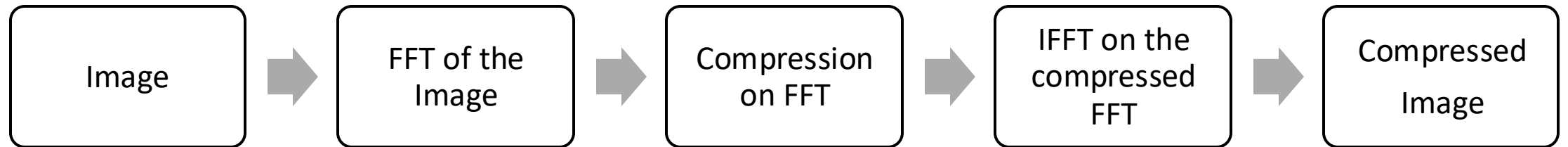


Image Compression Using FFT

Abstract:

- It is the application of data compression on digital images.
- Image compression plays a crucial role in various domains for efficient storage, transmission.
- Image compression can be lossy or lossless. Lossless compression is sometimes preferred for artificial images such as technical drawings, icons, or comics.
- The basic idea is to convert the image from the spatial domain to the frequency domain using the FFT, where the high-frequency components can be reduced or eliminated to achieve compression.

Steps:



Steps:

- Image compression using the Fast Fourier Transform (FFT) is a technique based on the frequency domain representation of images.
1. Convert the image to the frequency domain: The first step is to convert the image from the spatial domain to the frequency domain using the FFT algorithm.
 2. Quantization: To compress the image, we can quantize these magnitudes by reducing the precision or dividing them into smaller ranges. This step helps to reduce the amount of data required to represent the image.

3. Discard high-frequency components: The high-frequency components represent fine details and noise in the image. By discarding these high-frequency components, we can achieve compression. This can be done by in two Methods:
1. Sorting the Fourier Coefficients and Eliminating the higher Values by using command sort in matlab.
 2. Filtering the Fourier Transform using a Low pass filter.
4. Reconstruction: Obtain the Reconstructed by doing IFFT

Code:

1.By using Sorting the Fourier Series Method:

```
A=imread("image.jpg");
B=rgb2gray(A);
Bt=fft2(B);
flow=log(abs(fftshift(Bt))+1);
Btsort = sort(abs(Bt(:)));
keep=0.90;
thresh = Btsort(floor((1-keep)*length(Btsort)));
ind = abs(Bt)>thresh;
Atlow = Bt.*ind;
Alow=uint8(iff2(Atlow));
keep=0.50;
thresh = Btsort(floor((1-keep)*length(Btsort)));
```

```
ind = abs(Bt)>thresh;
Atlow = Bt.*ind;
Alow2=uint8(iff2(Atlow));
keep=0.01;
thresh = Btsort(floor((1-keep)*length(Btsort)));
ind = abs(Bt)>thresh;
Atlow = Bt.*ind;
Alow3=uint8(iff2(Atlow));
keep=0.002;
thresh = Btsort(floor((1-keep)*length(Btsort)));
ind = abs(Bt)>thresh;
Atlow = Bt.*ind;
Alow4=uint8(iff2(Atlow));
```

```
figure(1);imshow(A);title("Original Image");
figure(2);imshow(B);title("Gray Scale Image");
figure(3);imshow(flow,[]);title("FFT of the Image");
figure(4);imshow(Alow) imwrite(Alow,"imc1.jpg");
title("Image Reconstructed with 90% of FFT Values");
figure(5);imshow(Alow2) imwrite(Alow2,"imc2.jpg");
title("Image Reconstructed with 50% of FFT Values");
figure(6);
imshow(Alow3)
imwrite(Alow3,"imc3.jpg");
title("Image Reconstructed with 1% of FFT Values");
figure(7);imshow(Alow4)
imwrite(Alow3,"imc4.jpg");
title("Image Reconstructed with 0.2% of FFT Values");
```

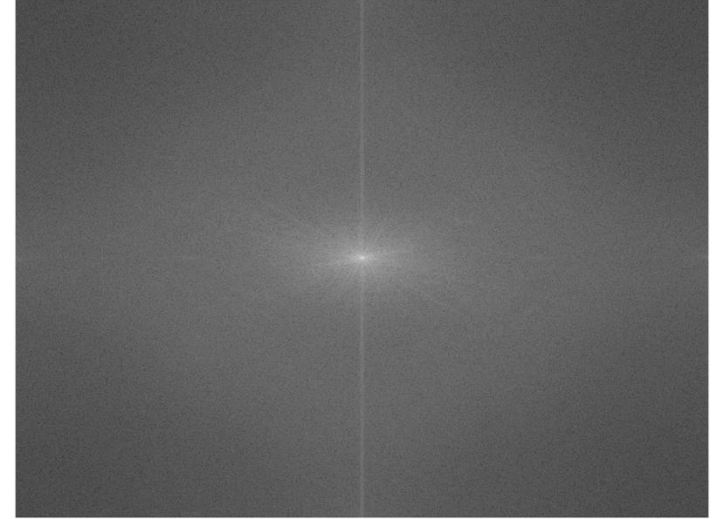
Original Image



Gray Scale Image



FFT of the Image



Output:

Image Reconstructed with 0.2% of FFT Values



Image Reconstructed with 1% of FFT Values



Image Reconstructed with 90% of FFT Values








Image Reconstructed with 50% of FFT Values



Compressed Images:

Sizes of the Images:

 image.jpg	14-05-2023 09:33	JPG File	1,275 KB
 imc1.jpg	02-06-2023 21:45	JPG File	905 KB
 imc2.jpg	02-06-2023 21:45	JPG File	852 KB
 imc3.jpg	02-06-2023 21:45	JPG File	356 KB
 imc4.jpg	02-06-2023 21:45	JPG File	298 KB

Code:

2.By Filtering the FFT using Lowpass Filter:

```
A=imread("image.jpg");  
B=rgb2gray(A);  
Bt=fft2(B);  
flow=log(abs(fftshift(Bt))+1);  
[b1,a1]=butter(5,0.9);  
y=(filter2(b1,a1,flow))+1;  
thresh = y(floor((1-0.90)*length(y)));  
ind = abs(Bt)>thresh;  
Atlow = Bt.*ind;  
Alow=uint8(iff2(Atlow));  
[b2,a2]=butter(15,0.9);  
y1=(filter2(b2,a2,flow))+1;
```

```
thresh = y1(floor((1-0.90)*length(y1)));  
ind = abs(Bt)>thresh; Atlow = Bt.*ind;  
Alow2=uint8(iff2(Atlow));  
[b3,a3]=butter(25,0.9);  
y2=(filter2(b3,a3,flow))+1;  
thresh = y2(floor((1-0.90)*length(y2)));  
ind = abs(Bt)>thresh;  
Atlow = Bt.*ind;  
Alow3=uint8(iff2(Atlow));
```

```
figure(1);imshow(A);title("Original Image");
figure(2);imshow(B);title("Gray Scale Image");
figure(3);imshow(mat2gray(flow),[]);
title("FFT of the Image");
figure(4);freqz(b1,a1);
title("Low Pass Filter with Order 5");
figure(5);
imshow(mat2gray(y),[]);
title("FFT after Filtering with order 5");
figure(6);
imshow(Alow) % Plot Reconstruction
title("Image After Filtering with a Filter of Order 5");
imwrite(Alow,"ic1.jpg");
figure(7);freqz(b2,a2);
title("Low Pass Filter with Order 15");
```

```
figure(8);
imshow(mat2gray(y1),[]);
title("FFT after Filtering with a Filter of Order 15");
figure(9);
imshow(Alow2) % Plot Reconstruction
title("Image After Filtering with Filter of Order 15");
imwrite(Alow2,"ic2.jpg");
figure(10);freqz(b3,a3);
title("Low Pass Filter with Order 25");
figure(11);
imshow(mat2gray(y2),[]);
title("FFT after Filtering with a filter of Order 25");
figure(12);imshow(Alow3) % Plot Reconstruction
title("Image After Filtering with Filter of Order 25");
imwrite(Alow3,"ic3.jpg");
```

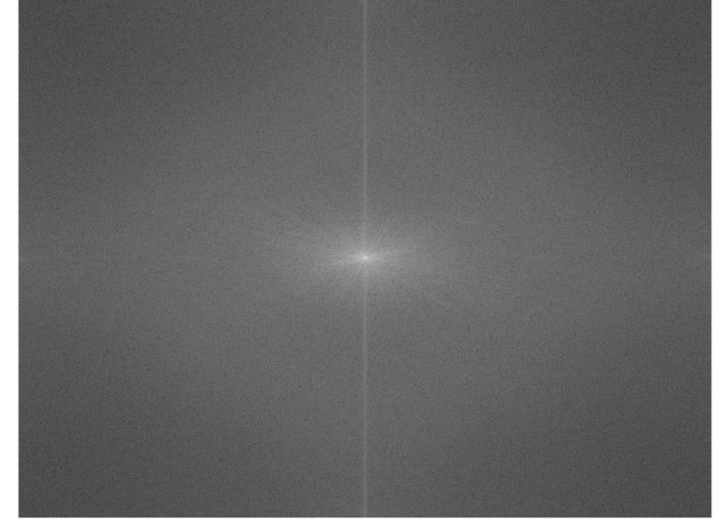
Original Image



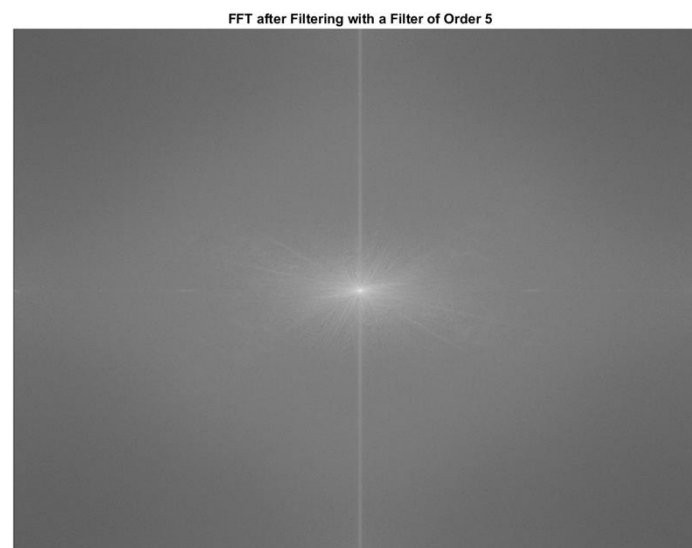
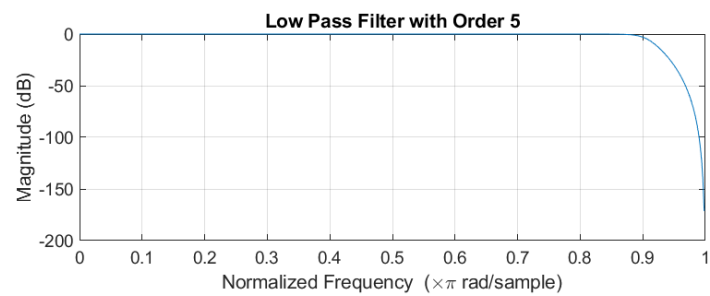
Gray Scale Image

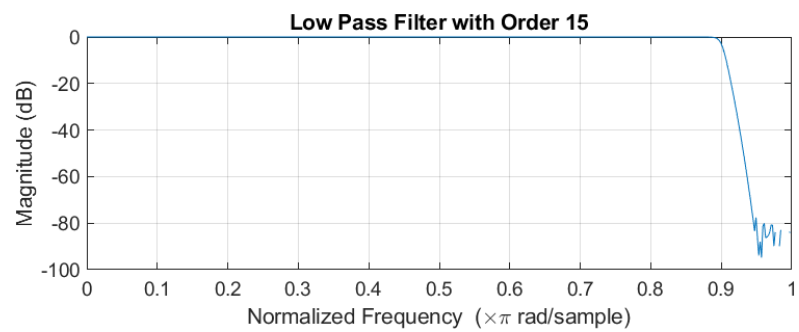


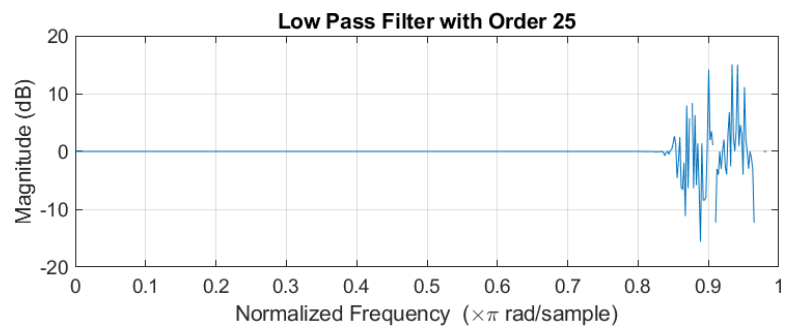
FFT of the Image







Output:







Sizes of the Images:

 ic1.jpg	02-06-2023 21:17	JPG File	905 KB
 ic2.jpg	02-06-2023 21:49	JPG File	635 KB
 ic3.jpg	02-06-2023 21:17	JPG File	253 KB
 image.jpg	14-05-2023 09:33	JPG File	1,275 KB

Thank You