q1

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1 Implement 2D Fast Fourier Transform

- Implemented using FFT in 1D
- Using the implemented 1D fft appy it on all rows
- Implement FFT on the output from all the rows for the desired output

1.0.1 FFT in one 1D

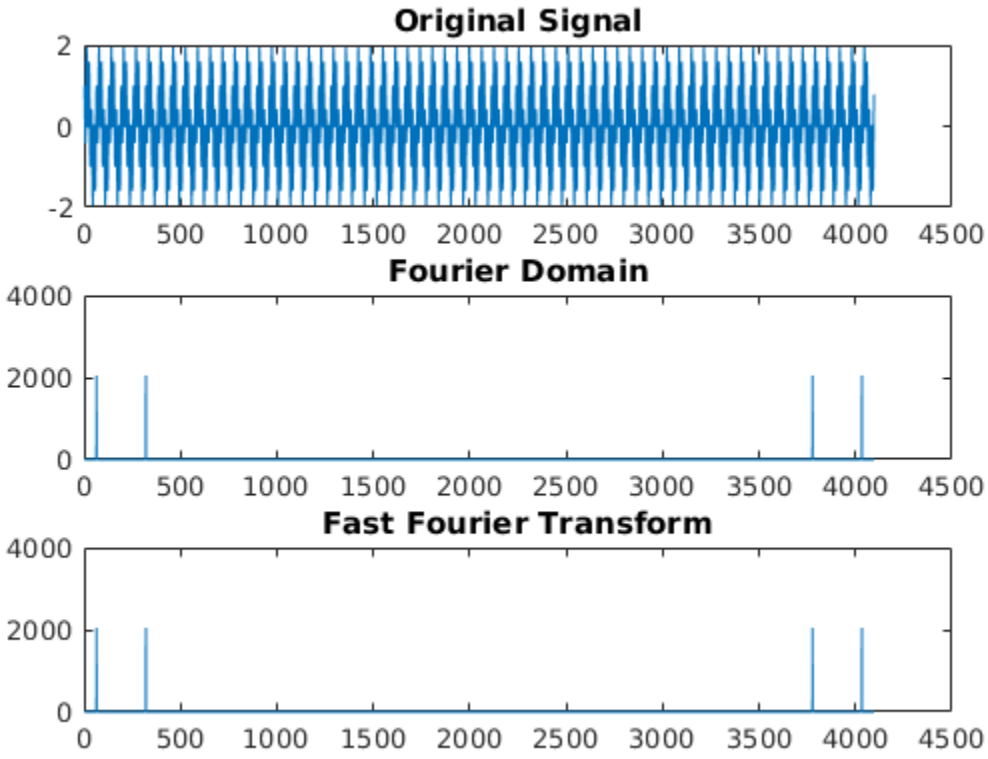
```
function [out_sig] = NEWFFT(in_sig,k,N)
    len = size(in_sig,2)
    out_sig = zeros(1,len);
    if len == 1
        out_sig = in_sig;

    else
        Ok = in_sig(1:2:len);
        Ek = in_sig(2:2:len);

        FOk = NEWFFT(Ok,k,N/2);
        FEk = NEWFFT(Ek,k,N/2);
        size(FOk)
        size(FEk)
        f1 = FEk + exp(-1i*2*pi*k/N).*FOk;
        f2 = FEk - exp(-1i*2*pi*k/N).*FOk;

        out_sig = cat(2,f1,f2);
    end
end
```

1.0.2 Using FFT in 1D example

```
In [7]: % Sampling Frequency
        fs = 64;
        % Frequency
        N = 64;
        n = 0:N*fs -1/fs;
```

```
t = 2*pi*[0:1/fs:N-1/fs];
y = sin(t) + cos(5*t);

% Hence the formula of Fourier transform is
ft_mat = exp(-1i*2*pi*n'*n/(N*fs));
y_ft = y*ft_mat;
```

In [11]:
```
figure;
subplot(3,1,1);
plot(y);
title('Original Signal');

subplot(3,1,2);
plot(abs(y_ft));
title('Fourier Domain');

% Using FFT
y_fft = NEWFFT(y,n,N*fs);
subplot(3,1,3);
plot(abs(y_fft));
title('Fast Fourier Transform');
```



2 Implementing FFT for 2D

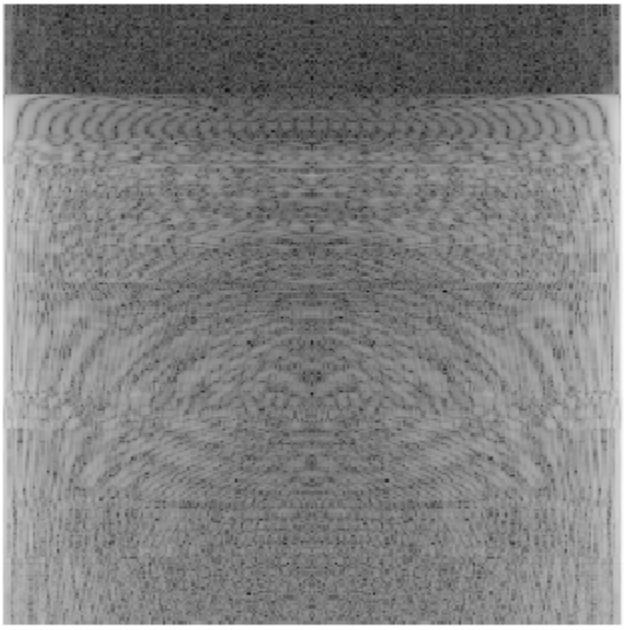
2.0.1 Function

```
function [out_image] = NEW_FFT2(in_image)
    N = size(in_image,1);
    M = size(in_image,2);
    out_image = zeros(N,M);
    for n=N
        size(out_image(n,:))
        out_image(n,:) = NEWFFT(in_image(n,:),[1:M],N);
    end

    out_image = abs(out_image);
    out_image = log(out_image + 1);
    out_image = mat2gray(out_image);
    imshow(out_image)



end
```

2.0.2 Test our function on multiple images

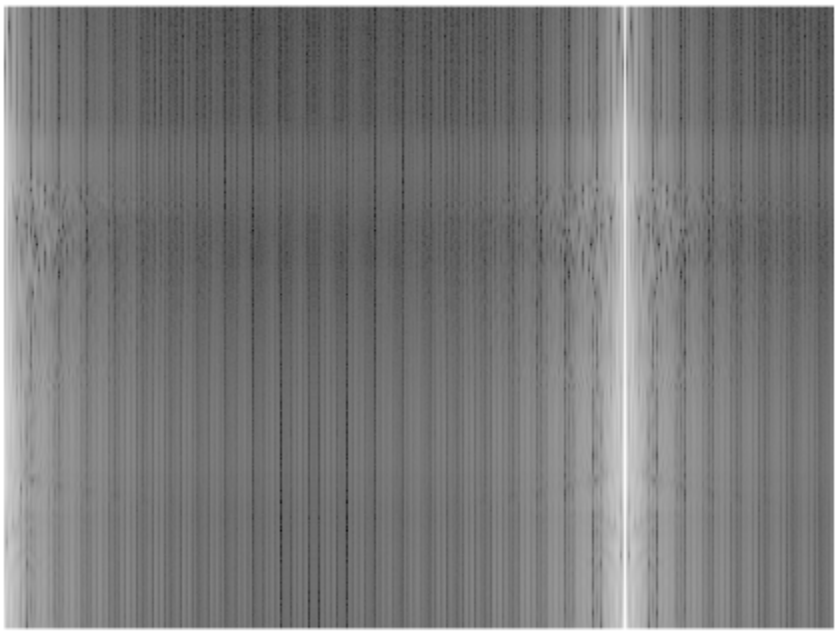
```
In [1]: img = imread('./cameraman.png');
        imshow(img);
        img = double(img);
```

In [2]:
```
% Transform the image
new_img = NEW_FFT2(img);
```

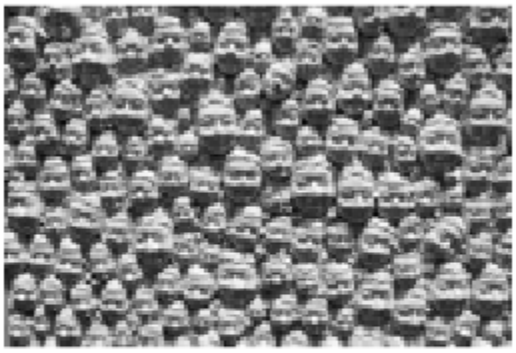
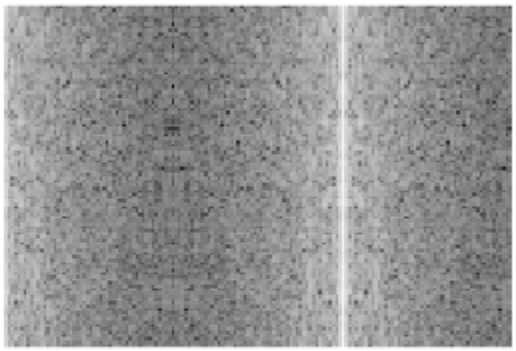


```
In [2]: img = imread('./blur.jpg');
        img = rgb2gray(img);
        img = imresize(img,1/3);
        imshow(img);
        img = double(img);
```

```
In [3]: new_img = NEW_FFT2(img);
```



```
In [3]: img = imread('./Faces.jpg');
        img = rgb2gray(img);
        img = imresize(img,1/4);
        imshow(img);
        img = double(img);
```



```
In [5]: new_img = NEW_FFT2(img);
```