Lab 4: Multiscale representation and image enhancements
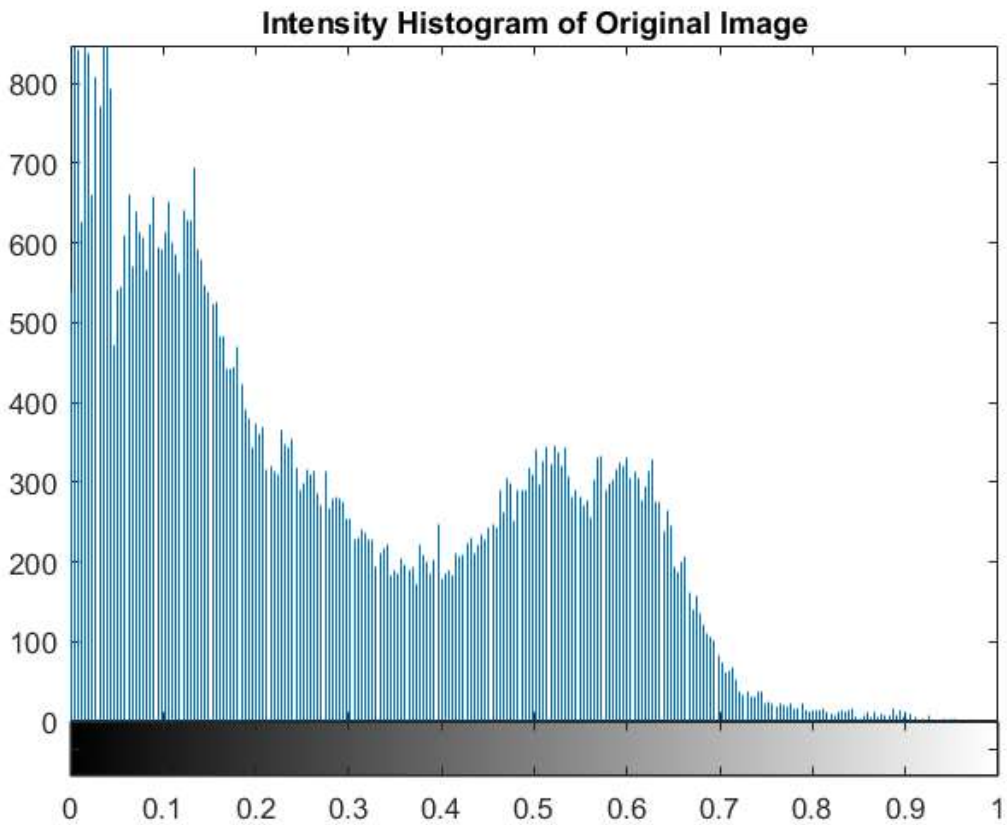
Contents

```
clc;
clear all;
close all;
```

Part A

```
G0 = imread('me.jpg');
G0 = im2double(rgb2gray(G0));
G0 = imresize(G0,[256 256]);
figure;
imshow(G0);
title('Original Image');
figure;
imhist(G0);
title('Intensity Histogram of Original Image')
```
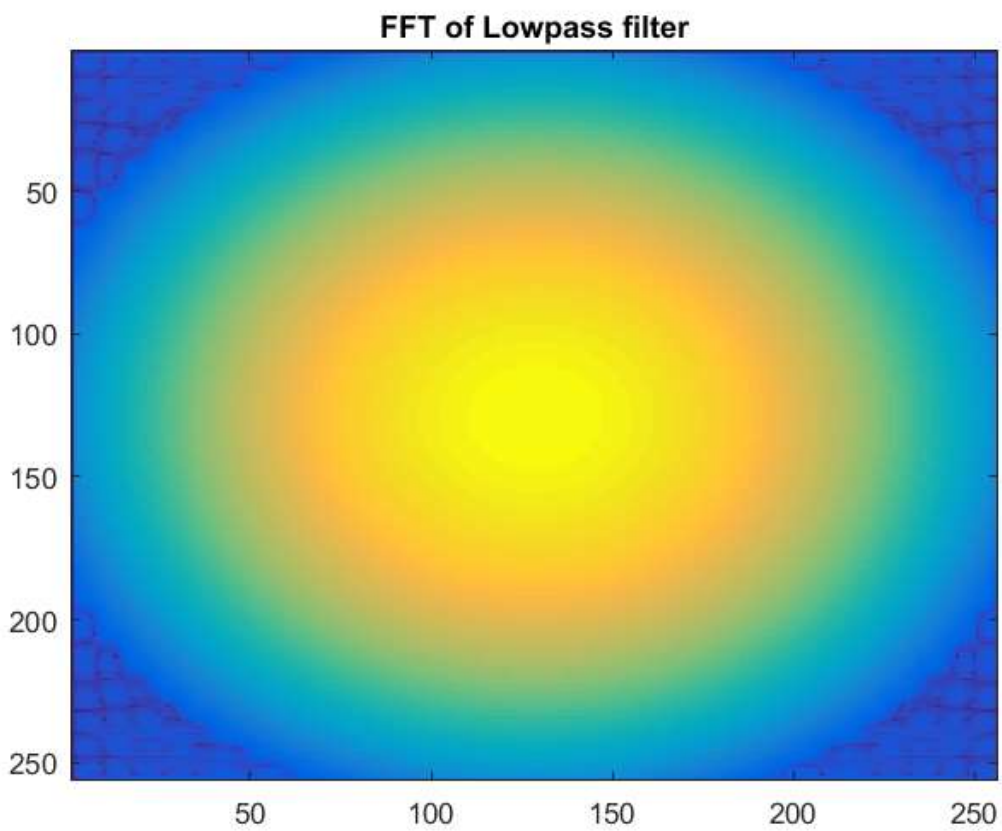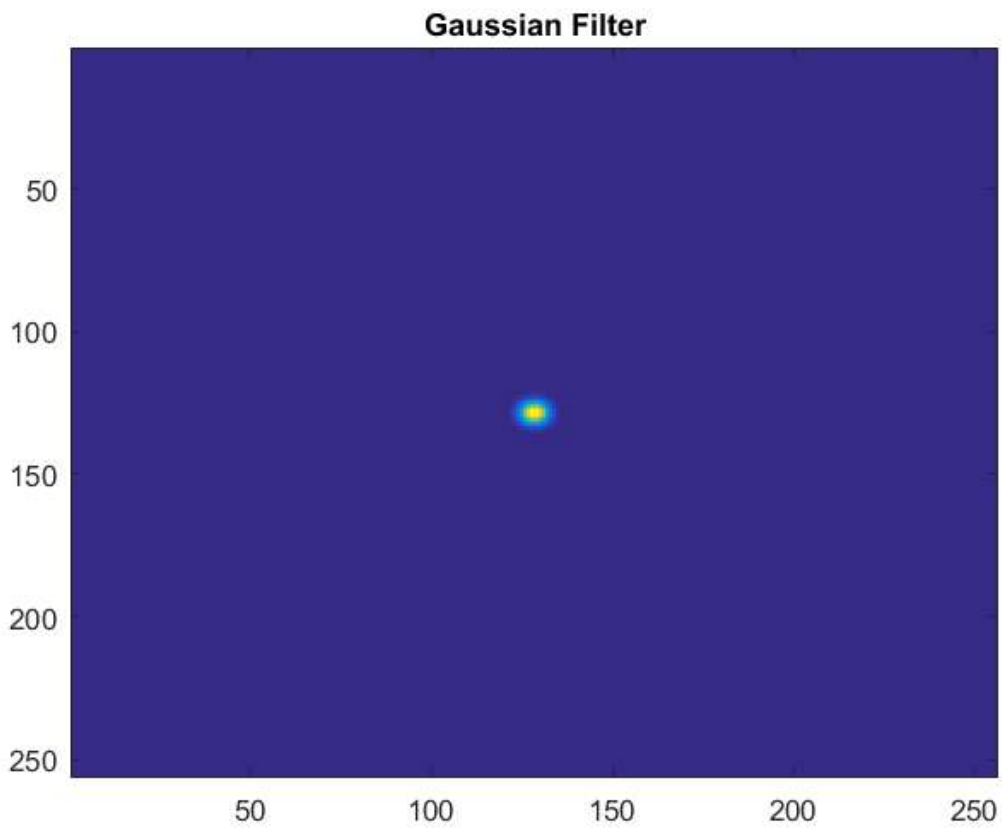

Original Image

Intensity Histogram of Original Image

Part B

```
g = fspecial('gaussian',100,2.5);
s = size(g);
g = padarray(g,[(256-s(1))/2 (256-s(1))/2],0,'both');
figure
imagesc(g);
title('Gaussian Filter')
figure;
imagesc(log(abs(fftshift(fft2(g)))))
title('FFT of Lowpass filter')
```

Gaussian Filter

FFT of Lowpass filter

Part C

```matlab
G1 = imfilter(G0,g);
k = 1;
figure;
imshow(G1)
title(strcat('Low passed image with k=',num2str(k)));
figure;
imagesc(log(abs(fftshift(fft2(G1)))))
title(strcat('FFT of Lowpassed Image with k=',num2str(k)));
figure;
imshow(imresize(G1, [256/(2^k) 256/(2^k)]));
title(strcat('Filtered Image Resized to ',num2str(256/(2^k))))
figure;
imagesc(log(abs(fftshift(fft2(imresize(G1, [256/(2^k) 256/(2^k)]))))))
title(strcat('FFT of Lowpassed Resized Image with k=',num2str(k)));


G2 = imfilter(G1,g);
k = 2;
figure;
imshow(G2)
title(strcat('Low passed image with k=',num2str(k)));
figure;
imagesc(log(abs(fftshift(fft2(G2)))))
title(strcat('FFT of Lowpassed Image with k=',num2str(k)));
figure;
imshow(imresize(G2, [256/(2^k) 256/(2^k)]));
title(strcat('Filtered Image Resized to ',num2str(256/(2^k))))
figure;
imagesc(log(abs(fftshift(fft2(imresize(G2, [256/(2^k) 256/(2^k)]))))))
title(strcat('FFT of Lowpassed Resized Image with k=',num2str(k)));


G3 = imfilter(G2,g);
k = 2;
figure;
imshow(G3)
title(strcat('Low passed image with k=',num2str(k)));
figure;
imagesc(log(abs(fftshift(fft2(G3)))))
title(strcat('FFT of Lowpassed Image with k=',num2str(k)));
figure;
imshow(imresize(G3, [256/(2^k) 256/(2^k)]));
title(strcat('Filtered Image Resized to ',num2str(256/(2^k))))
figure;
imagesc(log(abs(fftshift(fft2(imresize(G3, [256/(2^k) 256/(2^k)]))))))
title(strcat('FFT of Lowpassed Resized Image with k=',num2str(k)));
```
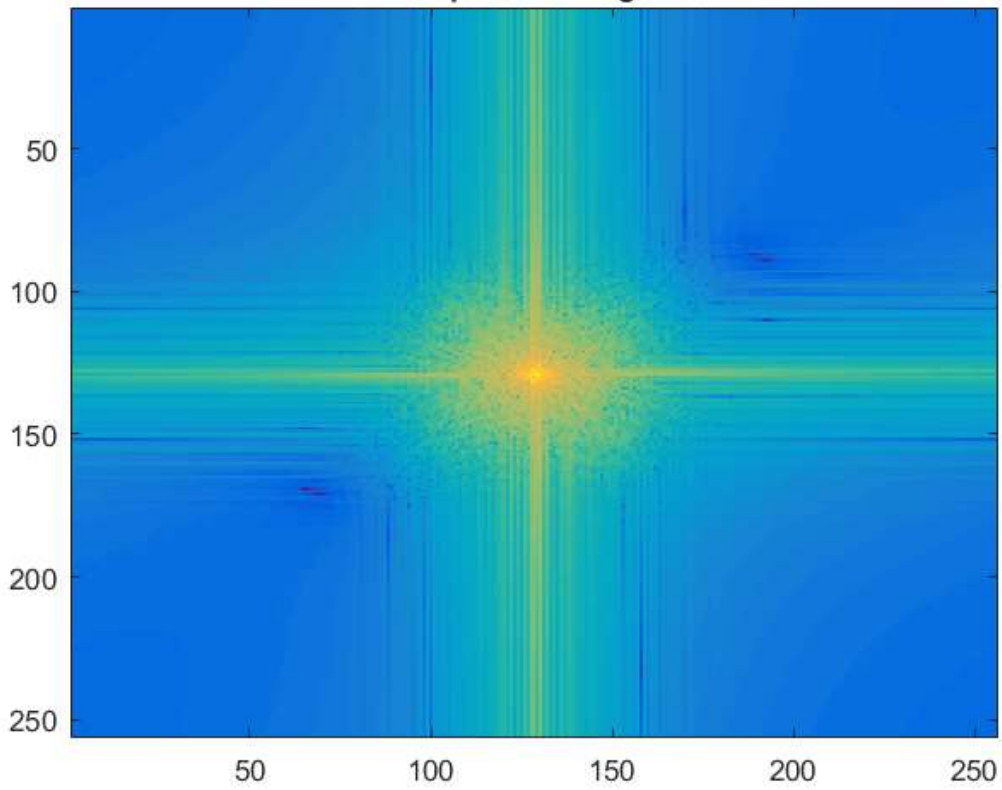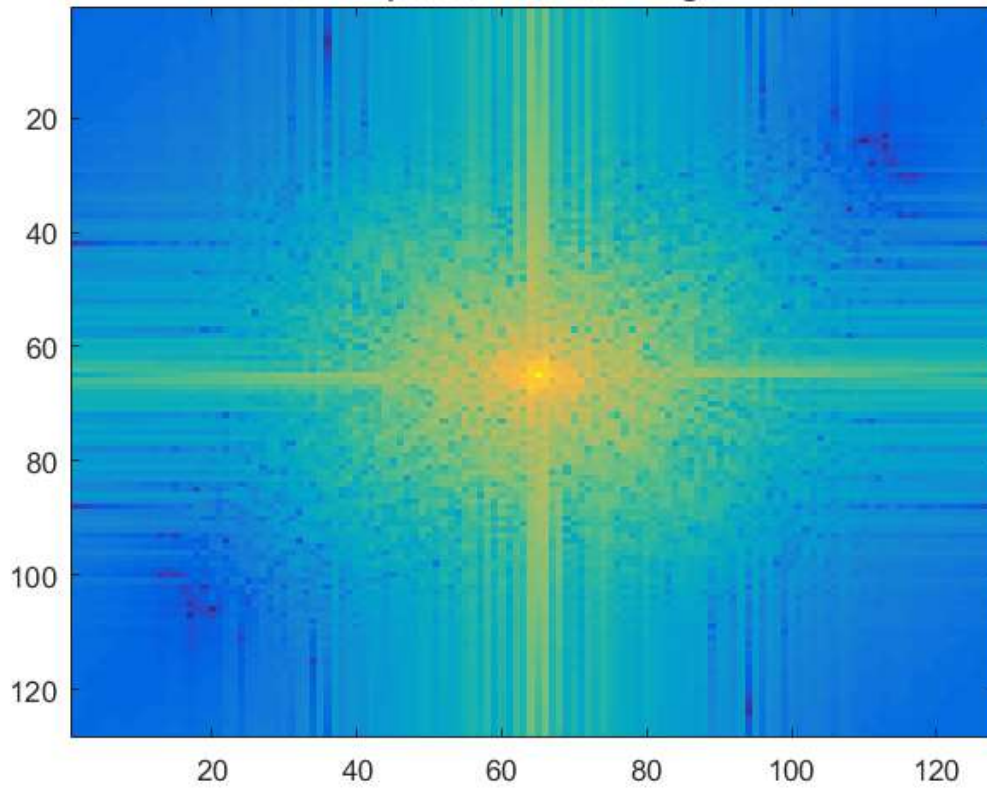
Low passed image with k=1

FFT of Lowpassed Image with k=1
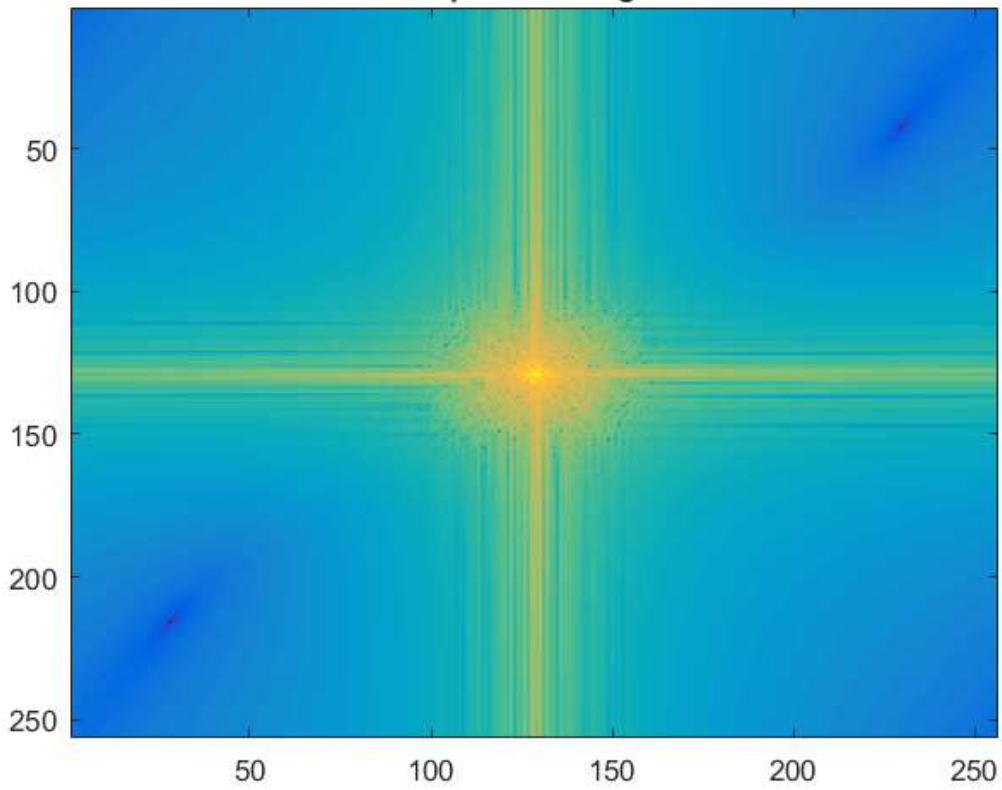
Filtered Image Resized to128

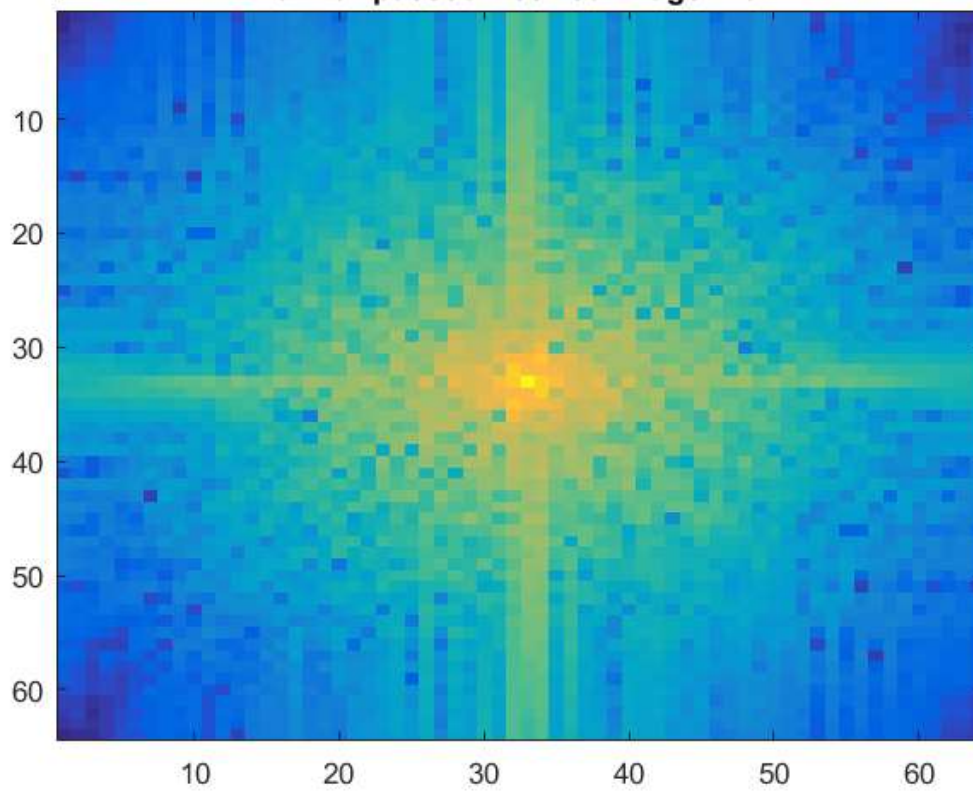**FFT of Lowpassed Resized Image with k=1**

Low passed image with k=2

FFT of Lowpassed Image with k=2
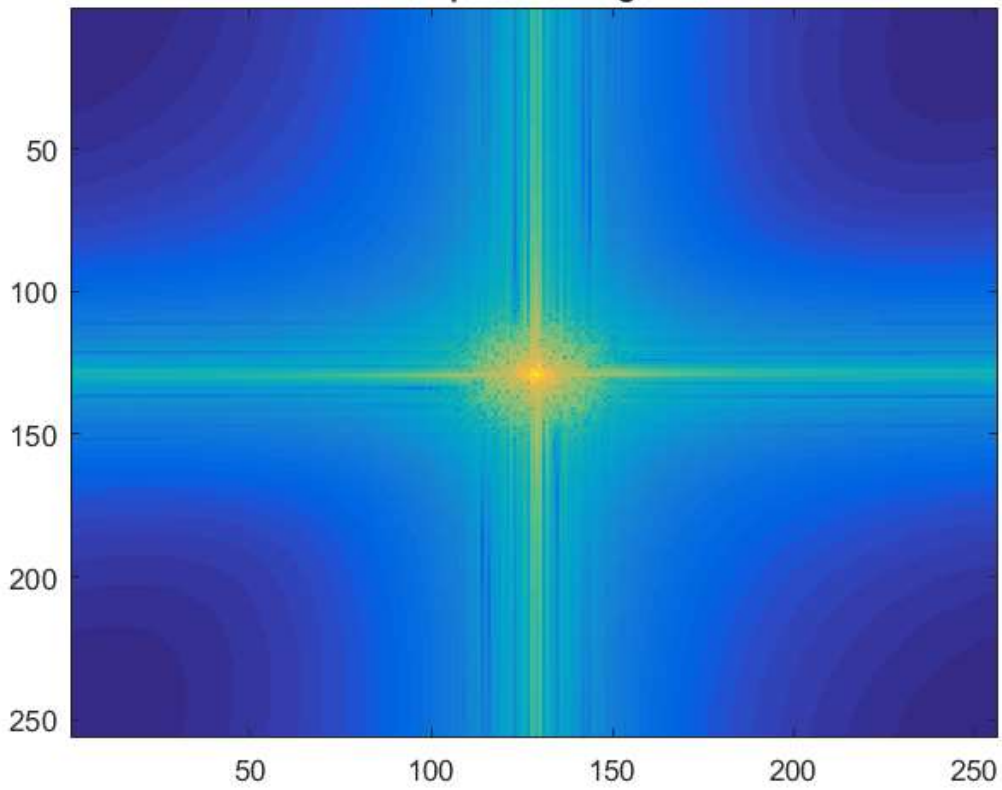
Filtered Image Resized to64

FFT of Lowpassed Resized Image with k=2

Low passed image with k=2

FFT of Lowpassed Image with k=2

Filtered Image Resized to64
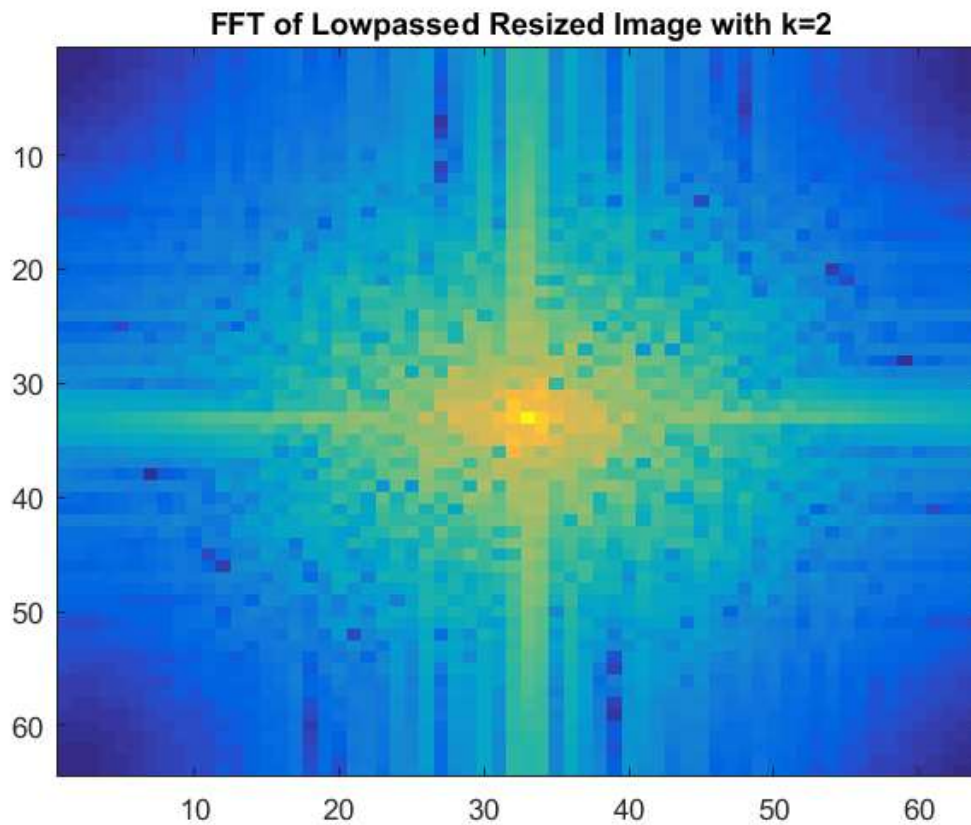

FFT of Lowpassed Resized Image with k=2

Part D

```
L1 = imsubtract(G1,G0);
figure;
imshow(L1);
title('Laplace 1');
figure;
imagesc(log(abs(fftshift(fft2(L1)))))
title('FFT of Laplac Image 1');
figure;
imshow(imresize(L1, [128 128]));
title('Laplac Image Resized to 128')
figure;
imagesc(log(abs(fftshift(fft2(imresize(L1, [128 128]))))))
title('FFT of Laplac Resized Image 1');

L2 = imsubtract(G2,G1);
figure;
imshow(L2);
```

```matlab
title('Laplace 2');
figure;
imagesc(log(abs(fftshift(fft2(L2)))))
title('FFT of Laplac Image 2');
figure;
imshow(imresize(L2, [64 64]));
title('Laplac Image Resized to 64')
figure;
imagesc(log(abs(fftshift(fft2(imresize(L2, [64 64]))))))
title('FFT of Laplac Resized Image 2');

L3 = imsubtract(G3,G2);
figure;
imshow(L3);
title('Laplace 3');
figure;
imagesc(log(abs(fftshift(fft2(L3)))))
title('FFT of Laplac Image 3');
figure;
imshow(imresize(L3, [32 32]));
title('Laplac Image Resized to 32')
figure;
imagesc(log(abs(fftshift(fft2(imresize(L3, [32 32]))))))
title('FFT of Laplac Resized Image 1');
```
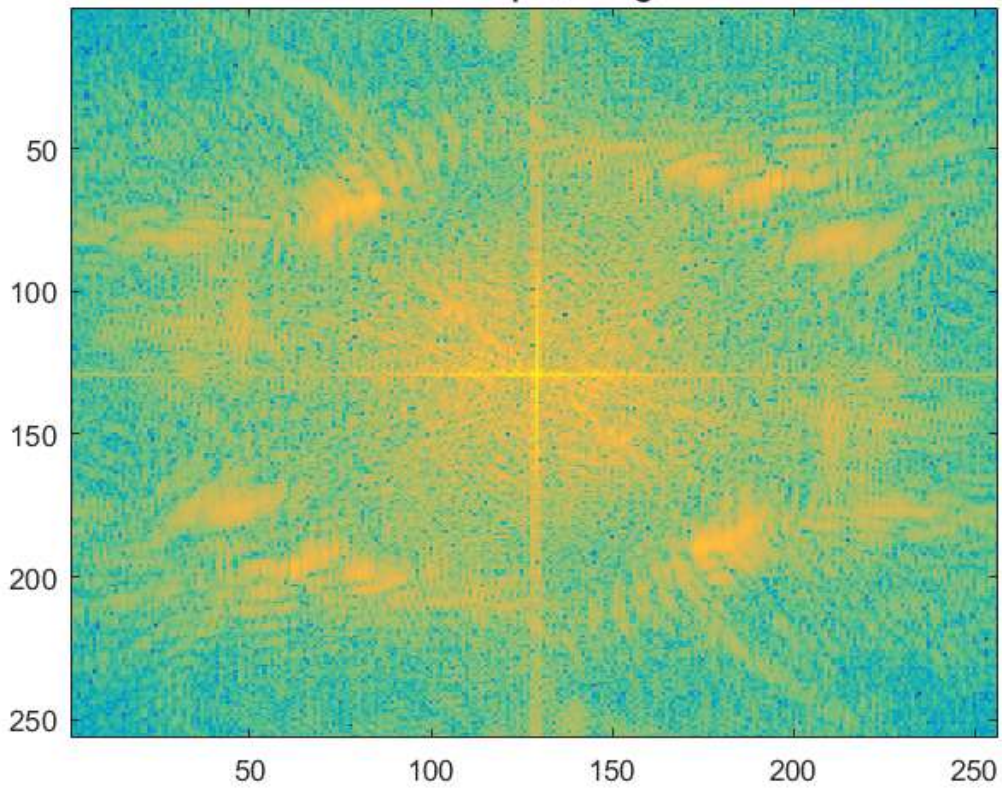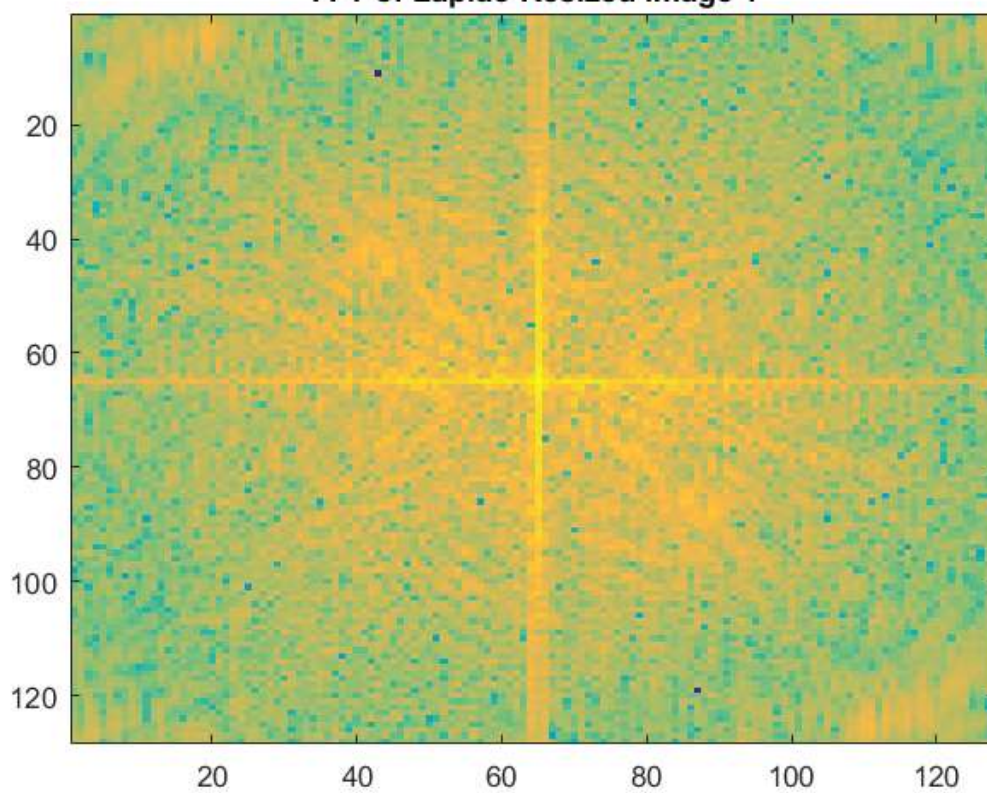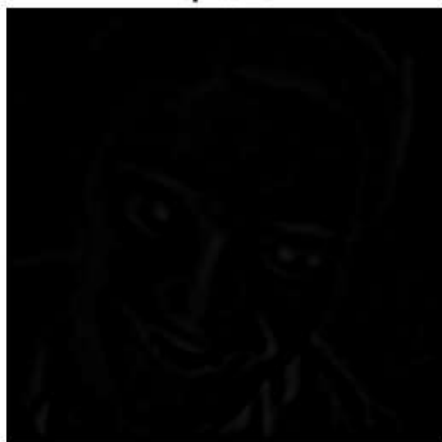

Laplace 1

FFT of Laplac Image 1
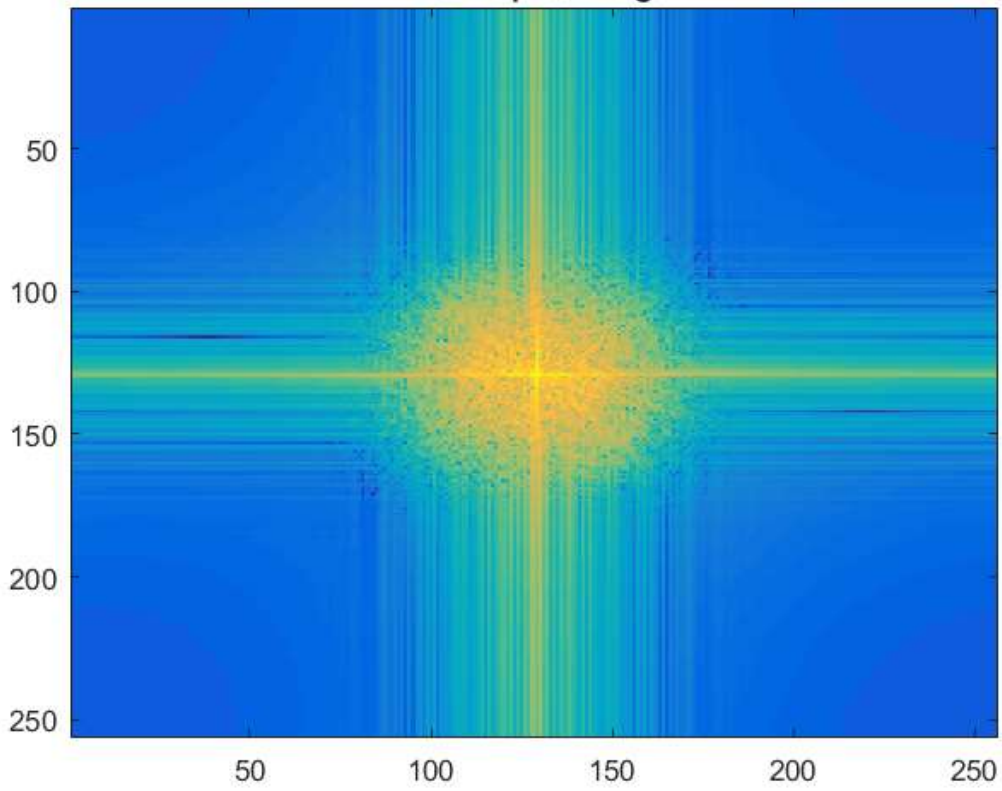

Laplac Image Resized to 128

FFT of Laplac Resized Image 1
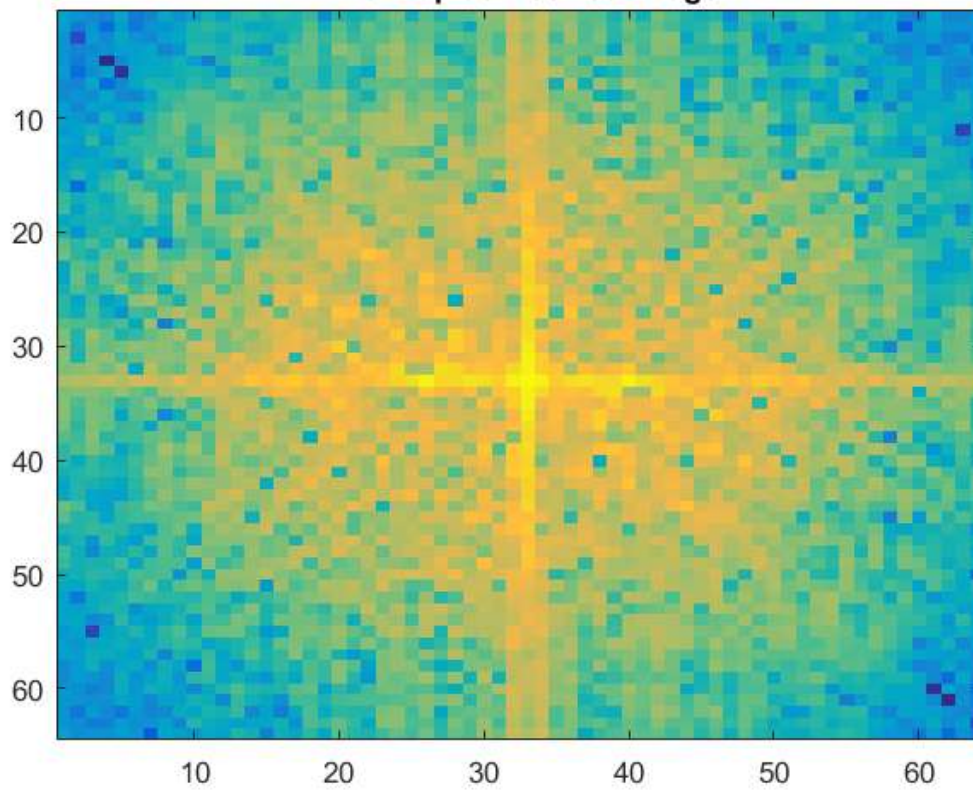

Laplace 2

FFT of Laplac Image 2

Laplac Image Resized to 64

FFT of Laplac Resized Image 2

Laplace 3

FFT of Laplac Image 3

Laplac Image Resized to 3:

FFT of Laplac Resized Image 1
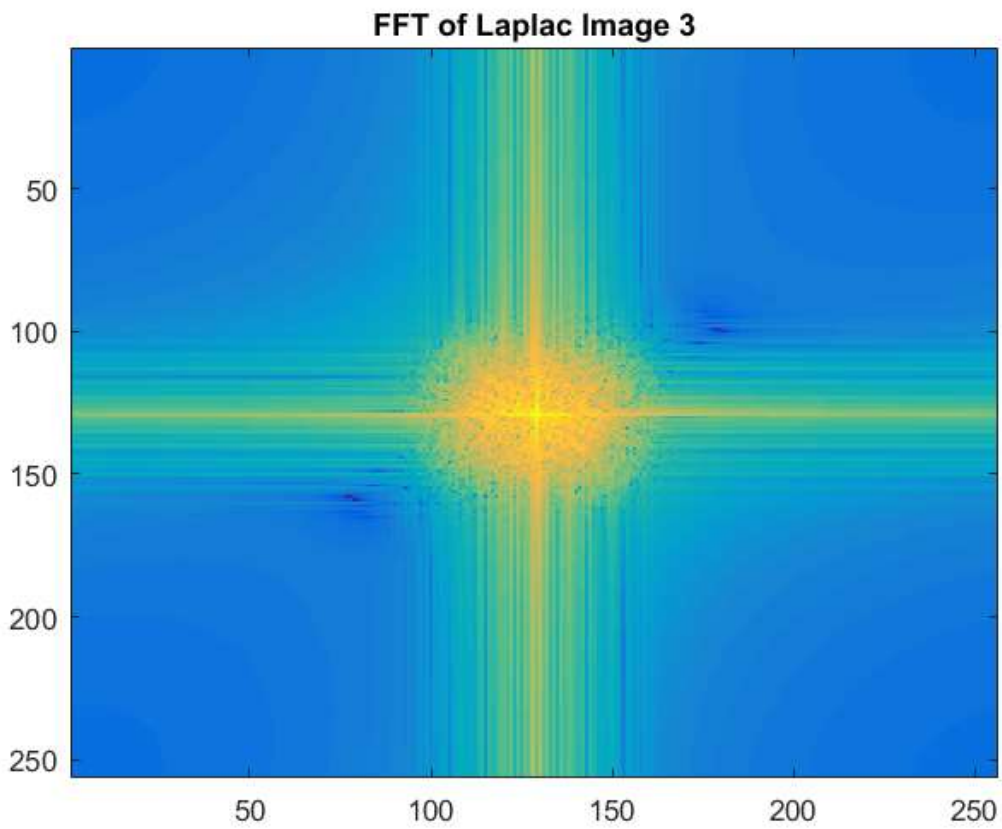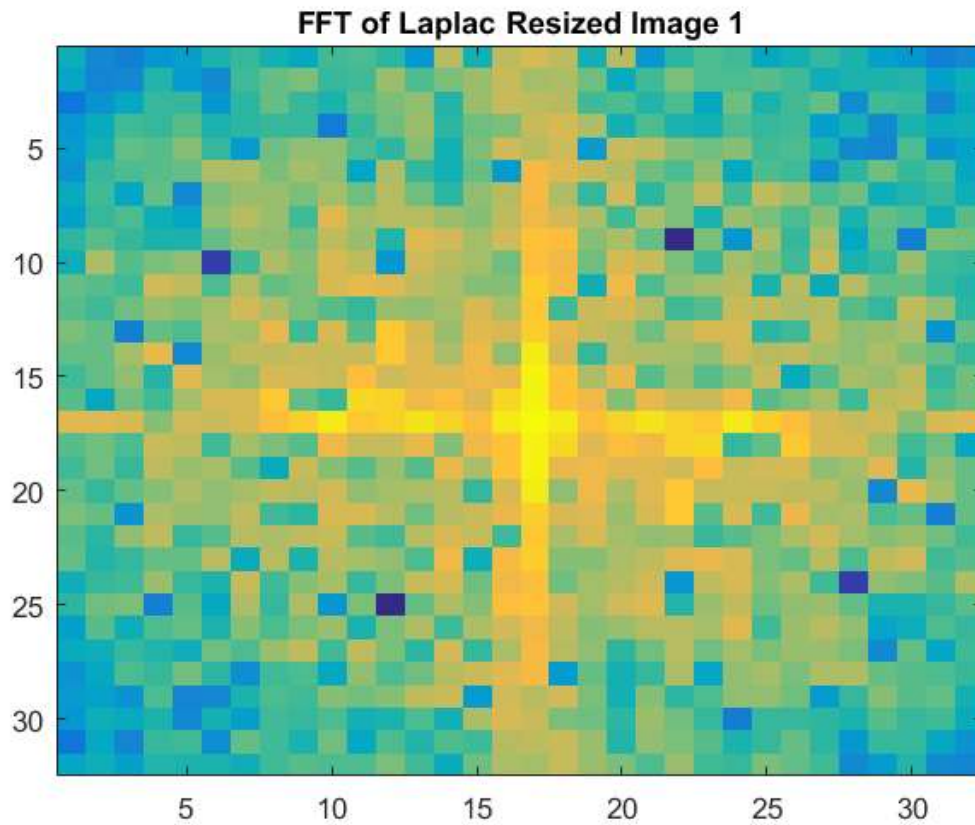
Part E

```matlab
C = zeros(256,256,3);
for i = 1:3
    if i == 1
        [CA1, CH1, CV1, CD1] = dwt2(G0, 'haar', 'mode', 'per');
        C_1 = [CA1 CV1; CH1 CD1];
    elseif i == 2
        [CA2, CH2, CV2, CD2] = dwt2(CA1, 'haar', 'mode', 'per');
        C_2 = [CA2 CV2; CH2 CD2];
        C_1 = [C_2 CV1; CH1 CD1];
    elseif i ==3
        [CA3, CH3, CV3, CD3] = dwt2(CA2, 'haar', 'mode', 'per');
        C_3 = [CA3 CV3; CH3 CD3];
        C_2 = [C_3 CV2; CH2 CD2];
        C_1 = [C_2 CV1; CH1 CD1];
    end
    C(:,:,i) = C_1;
    figure;
    imagesc(C(:,:,i));
    title(strcat('Wavelet ',num2str(i)));
end
```
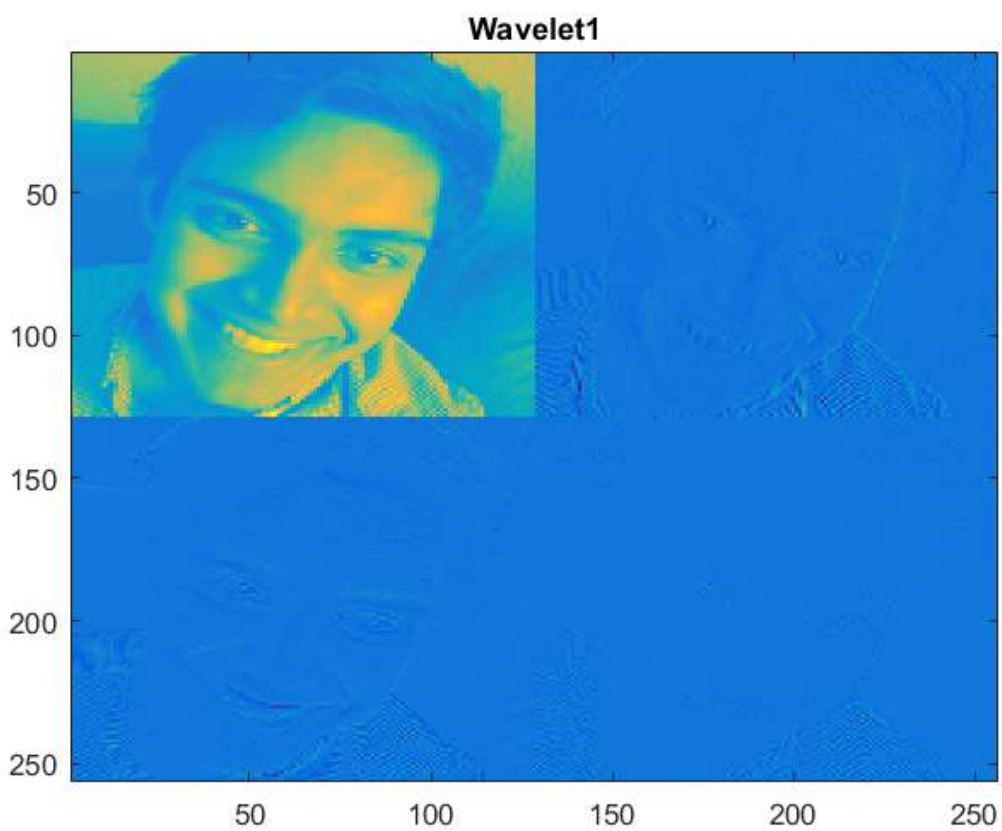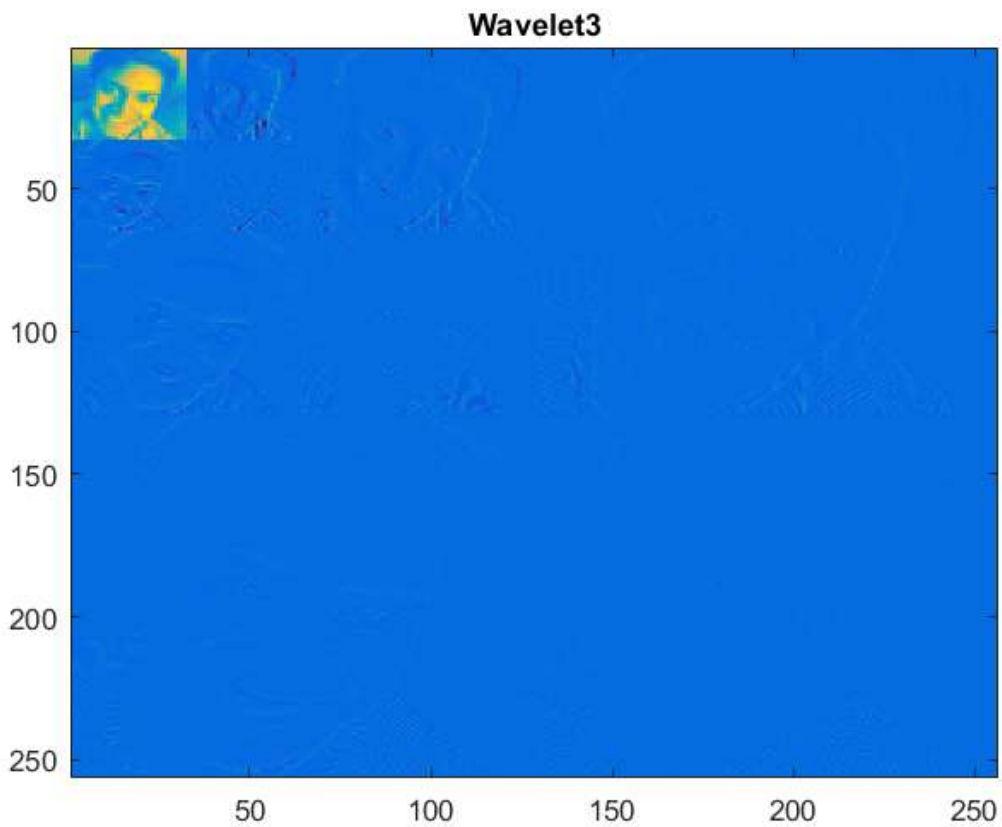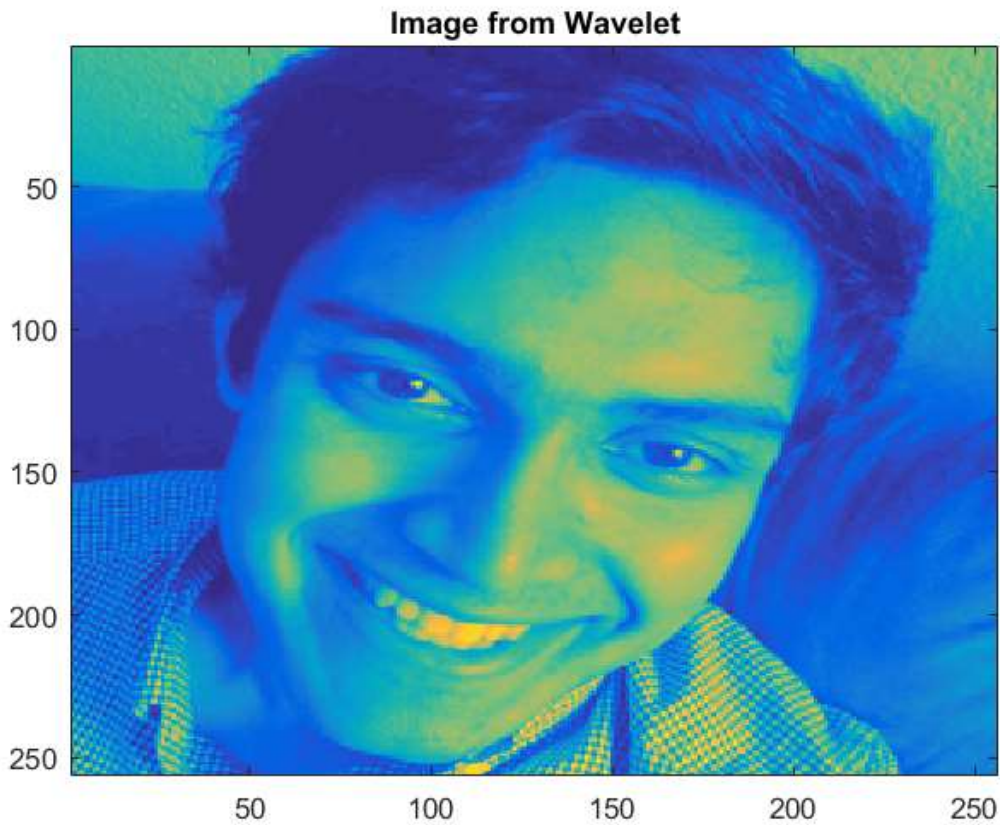
Wavelet1
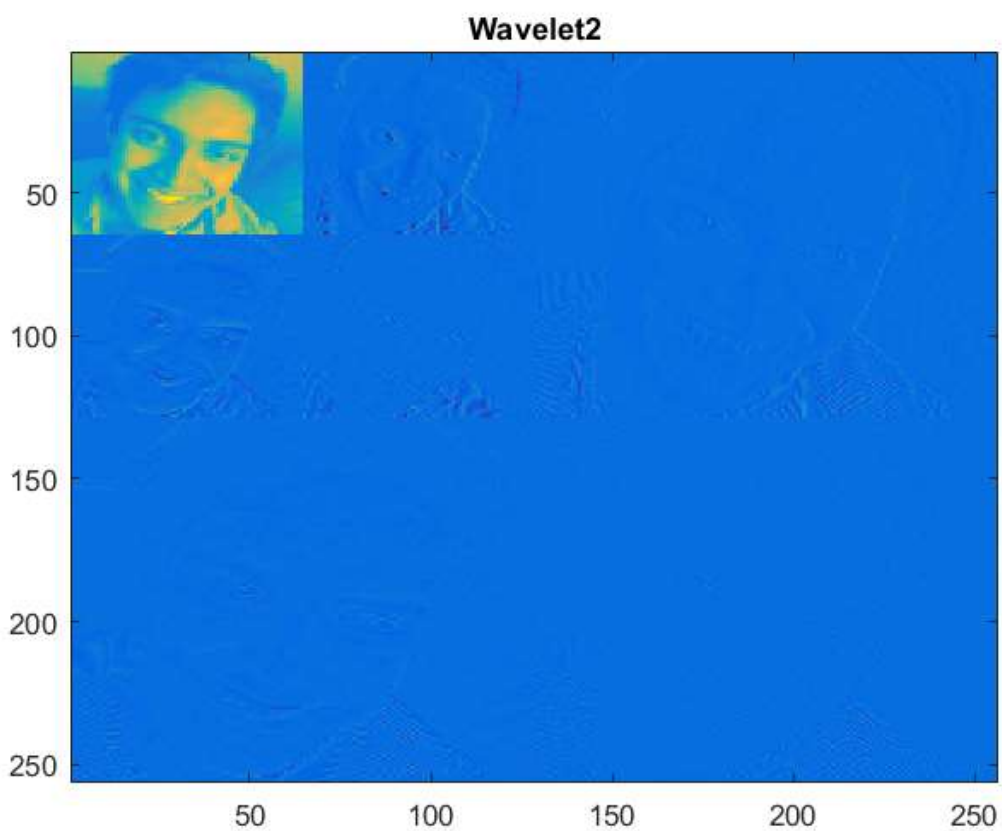
Wavelet2

Wavelet3

Part F

```
CA_2 = idwt2(CA3, CH3, CV3, CD3, 'haar', 'mode', 'per');
CA_1 = idwt2(CA_2, CH2, CV2, CD2, 'haar', 'mode', 'per');
CA_0 = idwt2(CA_1, CH1, CV1, CD1, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('Image from Wavelet');
```
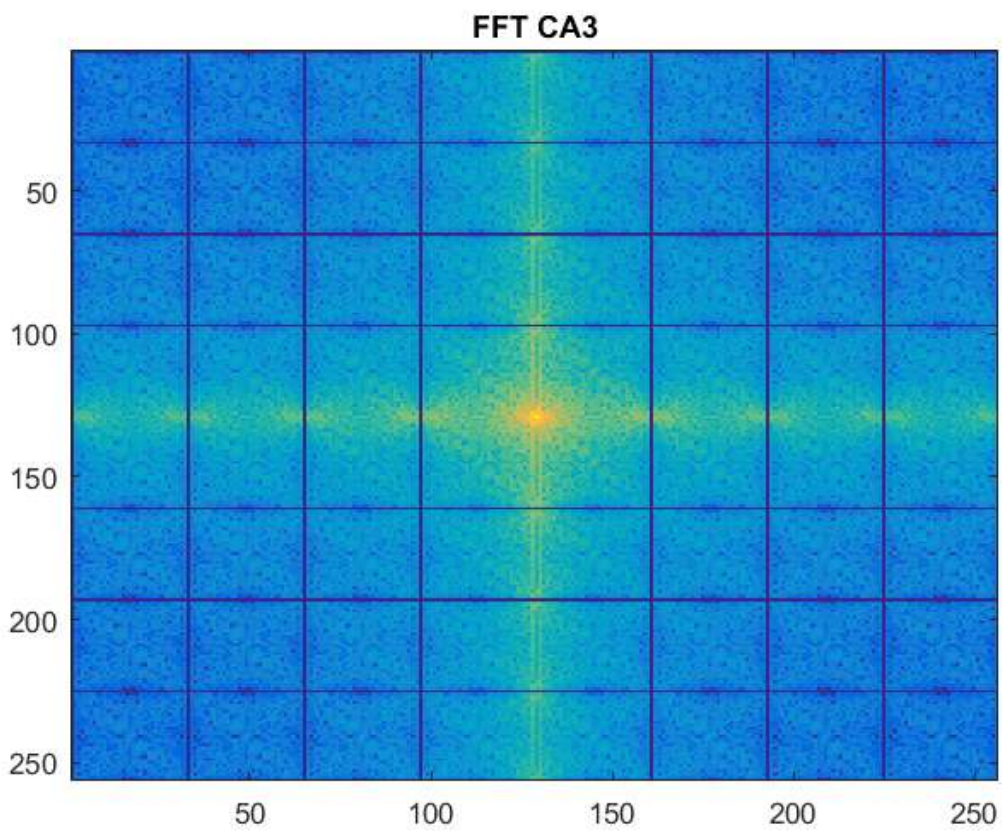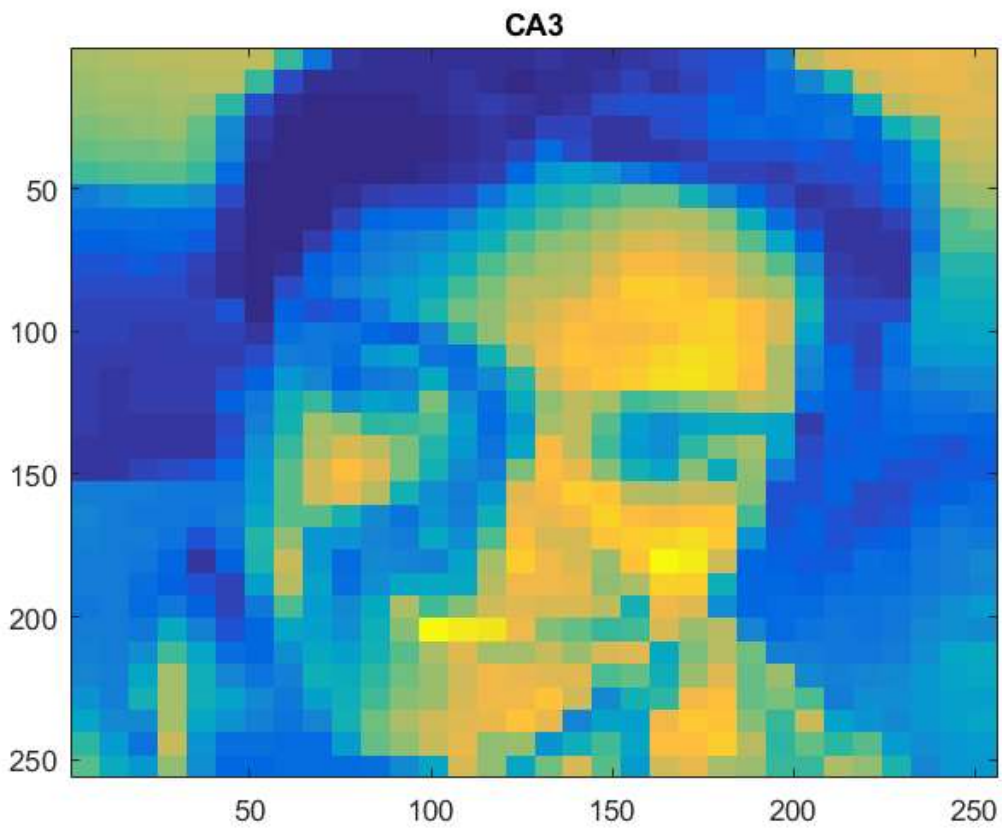
Image from Wavelet

Part G

```
z = zeros(32,32);
z2 = zeros(64,64);
z3 = zeros(128,128);
```

CA3

```
CA_2 = idwt2(CA3, z, z, z, 'haar', 'mode', 'per');
CA_1 = idwt2(CA_2, z2, z2, z2, 'haar', 'mode', 'per');
CA_0 = idwt2(CA_1, z3, z3, z3, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('CA3');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CA3');
```
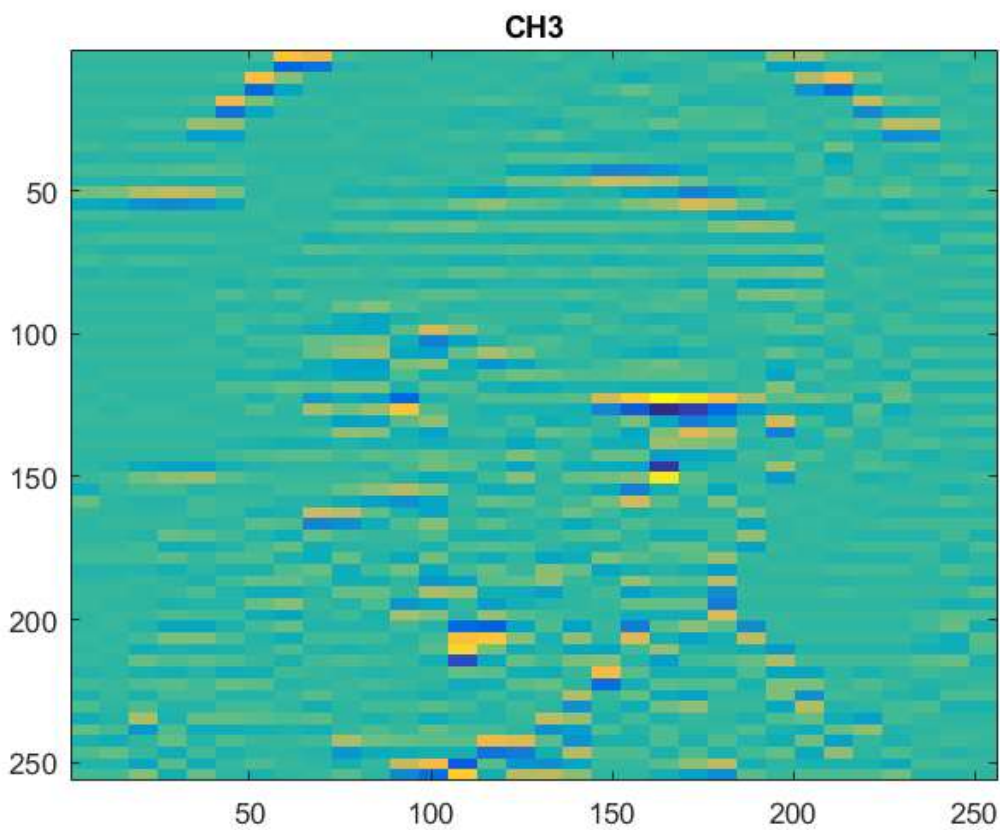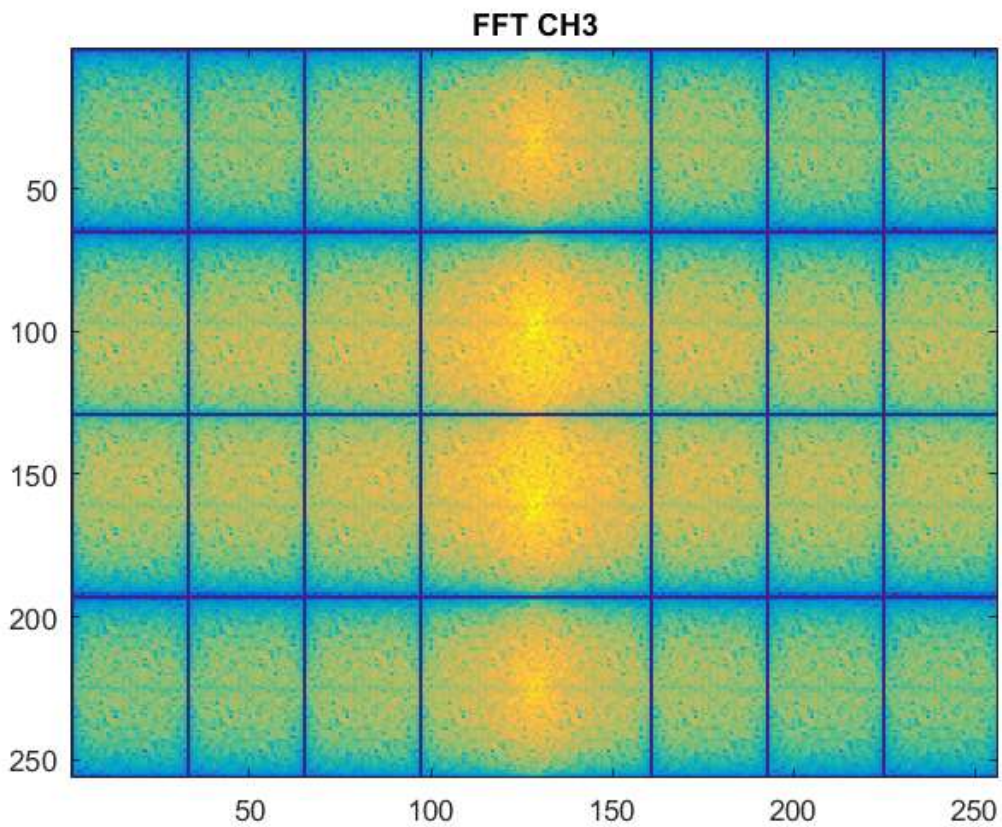
CA3

FFT CA3

CH3

```
CA_2 = idwt2(z, CH3, z, z, 'haar', 'mode', 'per');
CA_1 = idwt2(CA_2, z2, z2, z2, 'haar', 'mode', 'per');
CA_0 = idwt2(CA_1, z3, z3, z3, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('CH3');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CH3');
```
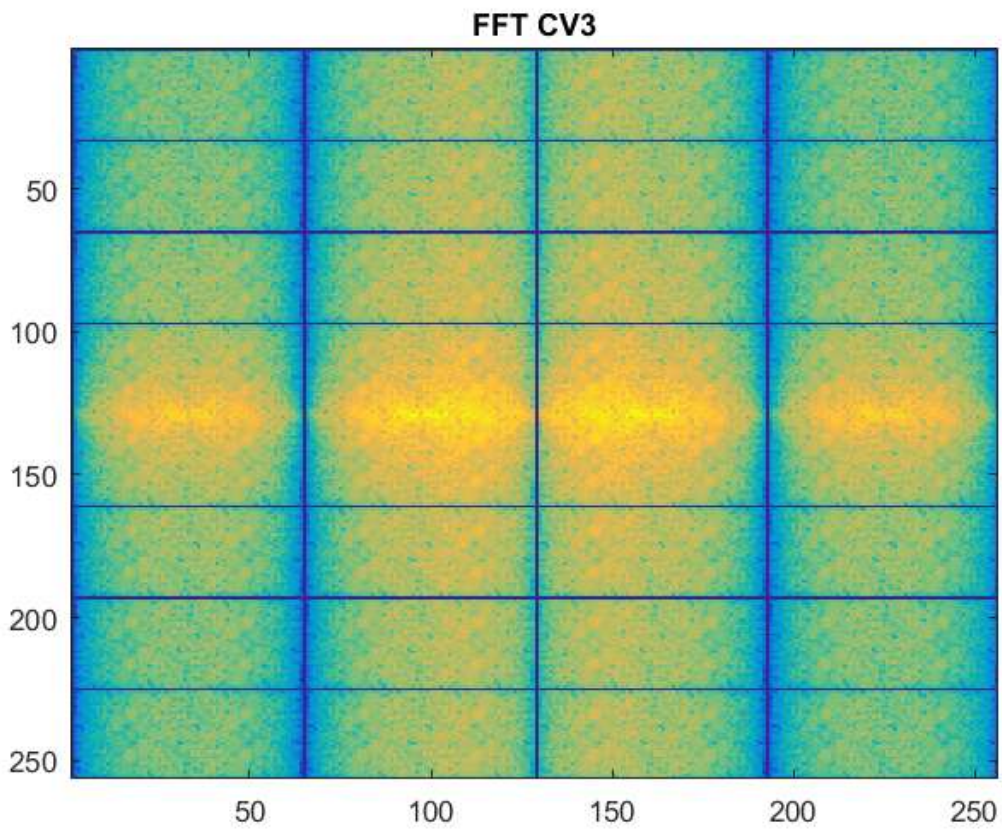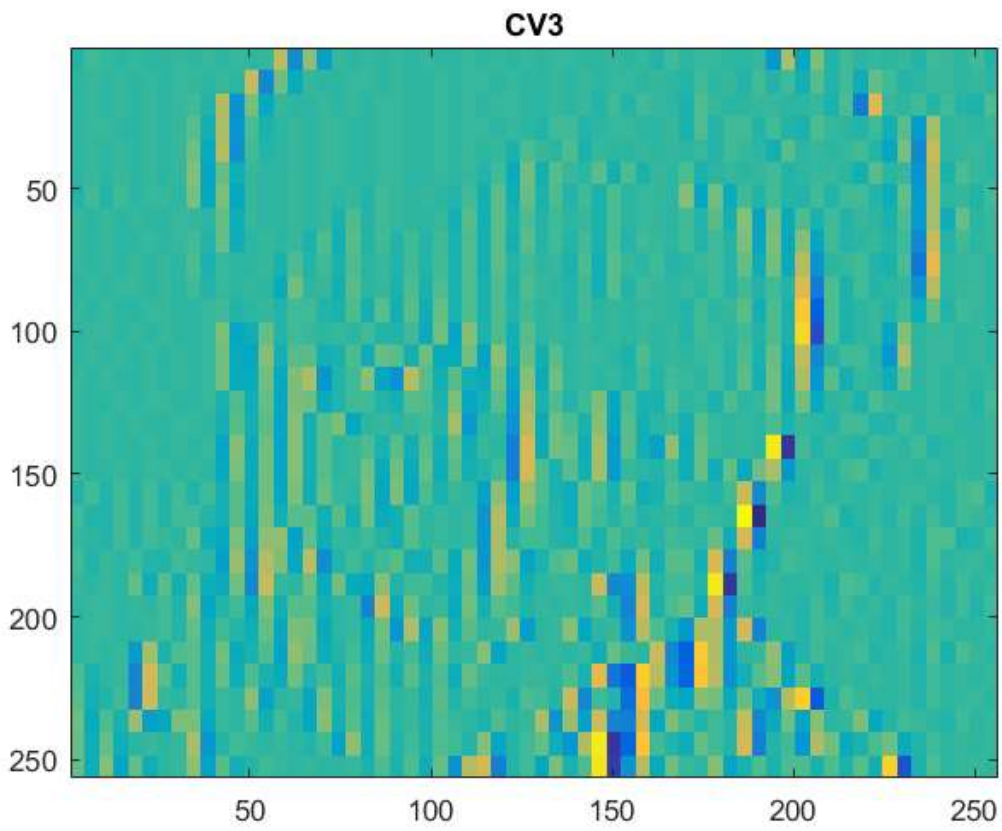

CH3

FFT CH3

CV3

```matlab
CA_2 = idwt2(z, z, CV3, z, 'haar', 'mode', 'per');
CA_1 = idwt2(CA_2, z2, z2, z2, 'haar', 'mode', 'per');
CA_0 = idwt2(CA_1, z3, z3, z3, 'haar', 'mode', 'per');


figure;
imagesc(CA_0);
title('CV3');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CV3');
```
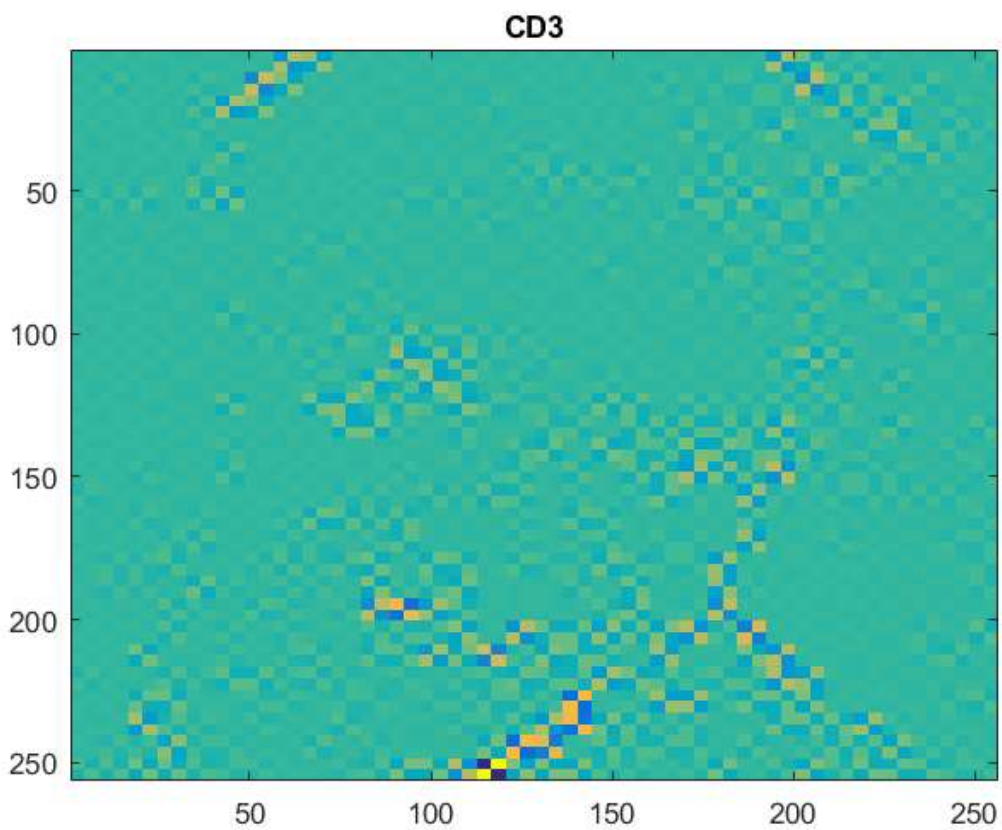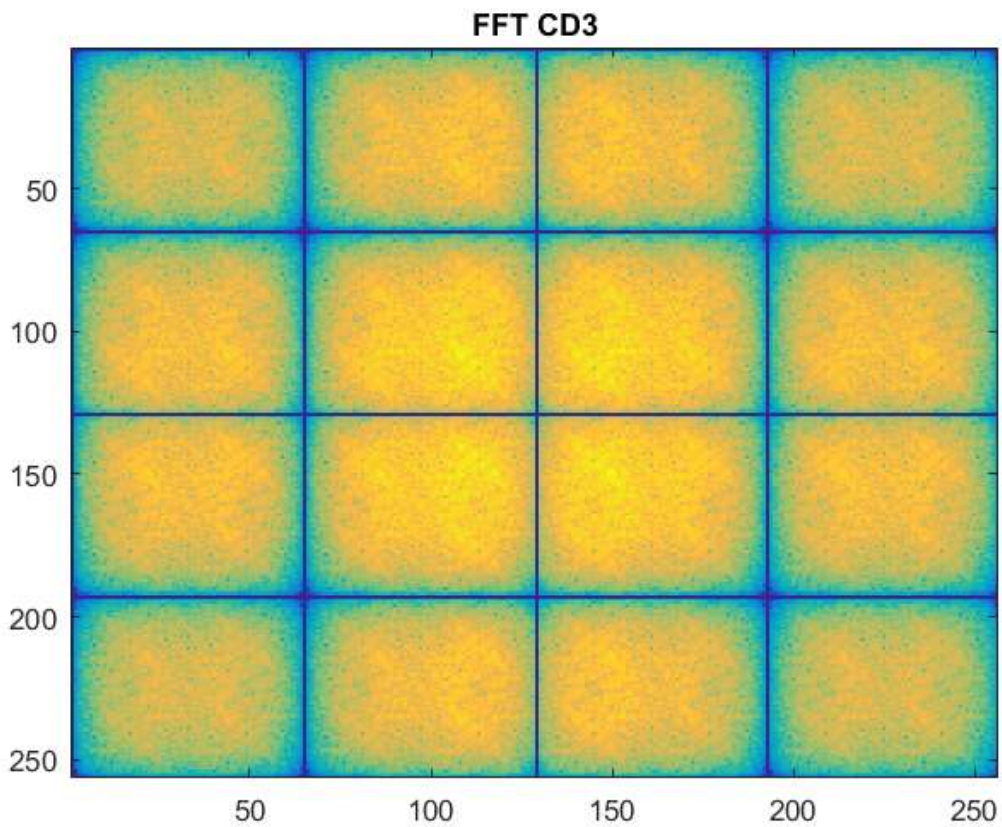
CV3

FFT CV3

CD3

```
CA_2 = idwt2(z, z, z, CD3, 'haar', 'mode', 'per');
CA_1 = idwt2(CA_2, z2, z2, z2, 'haar', 'mode', 'per');
CA_0 = idwt2(CA_1, z3, z3, z3, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('CD3');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CD3');
```
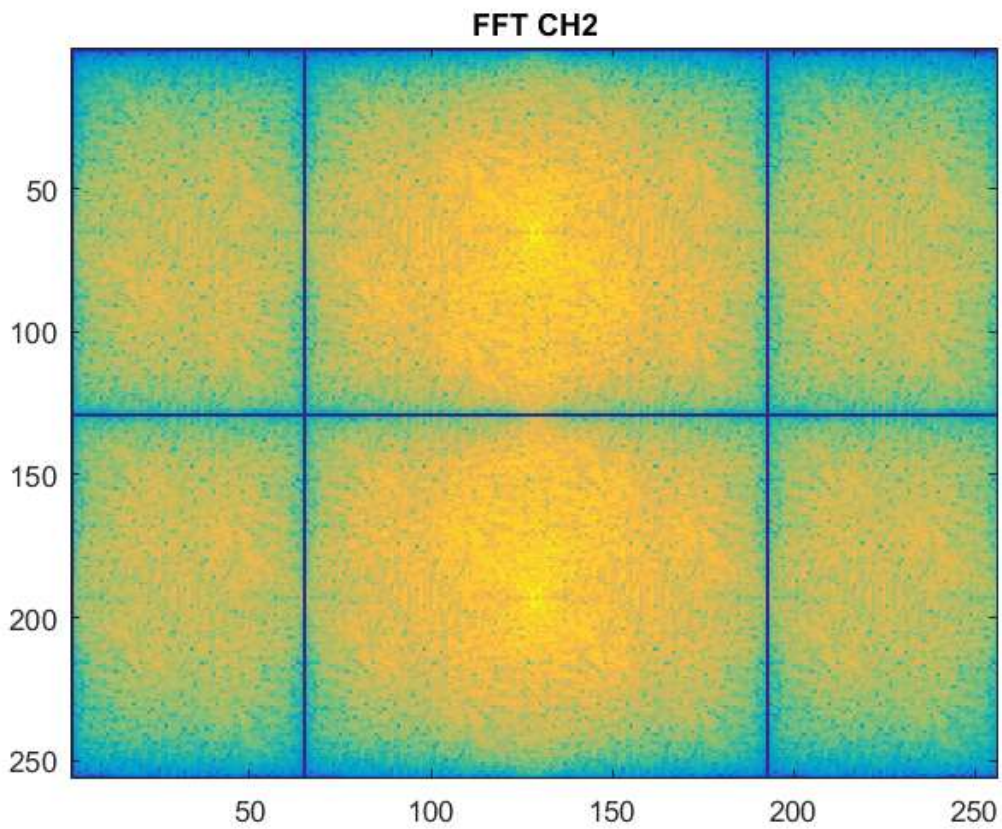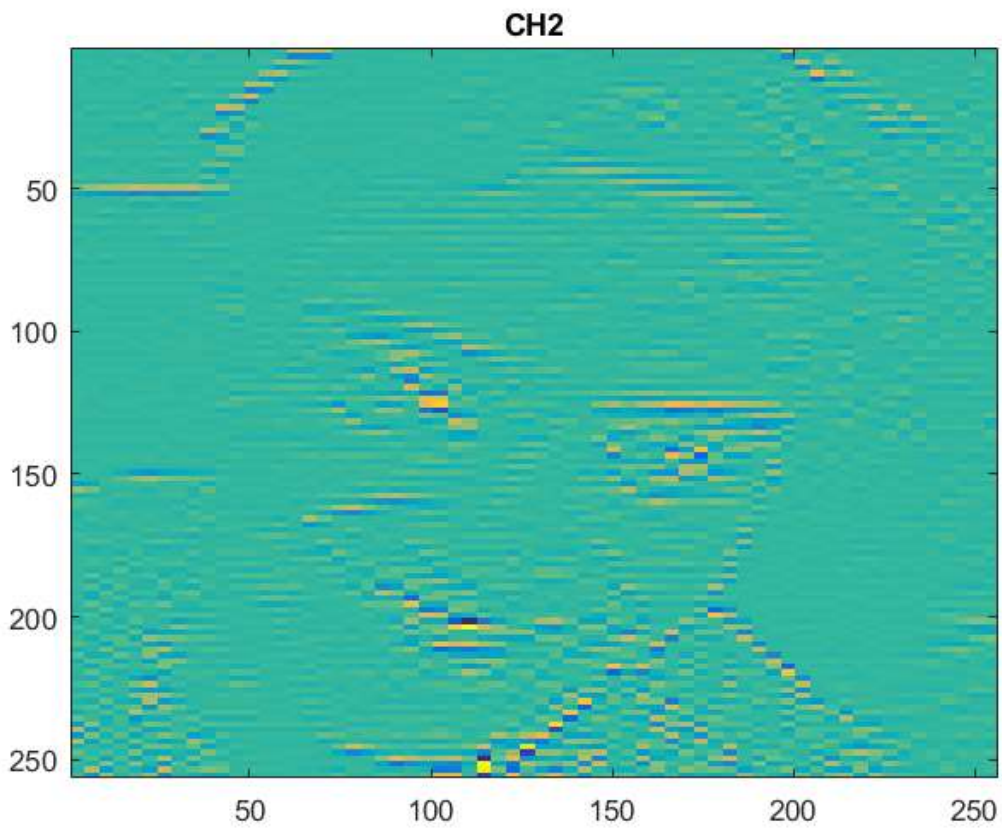

CD3

FFT CD3

CH2

```
CA_1 = idwt2(z2, CH2, z2, z2, 'haar', 'mode', 'per');
CA_0 = idwt2(CA_1, z3, z3, z3, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('CH2');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CH2');
```
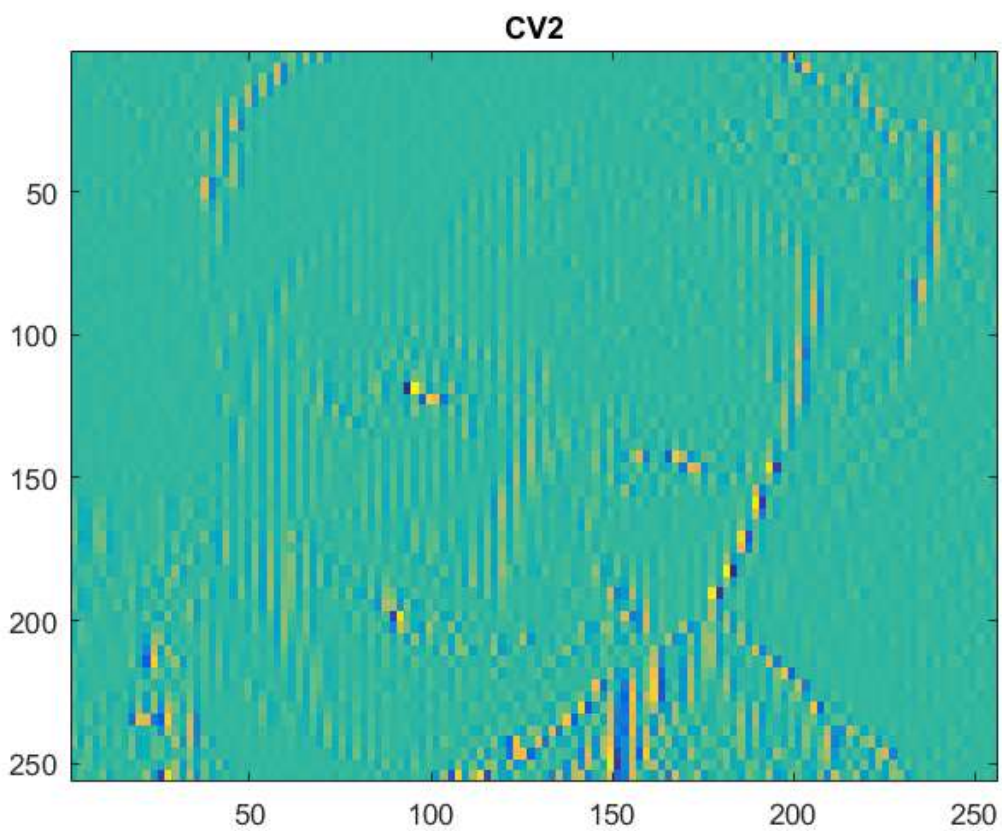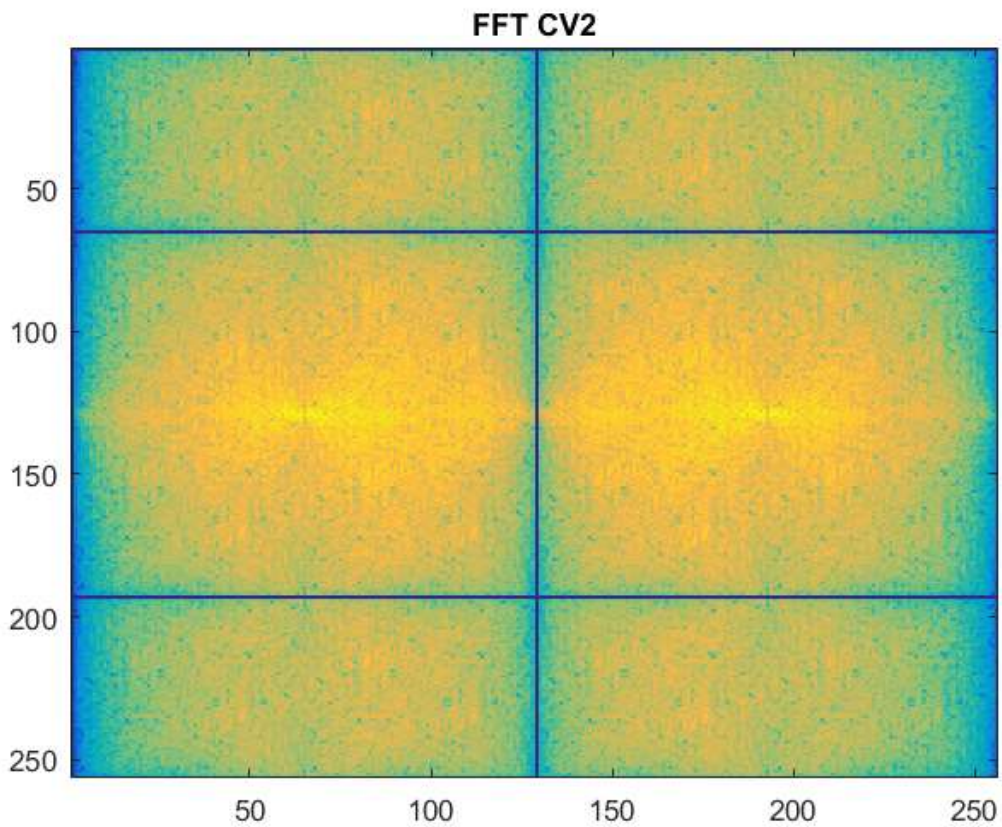
CH2

FFT CH2

CV2

```
CA_1 = idwt2(z2, z2, CV2, z2, 'haar', 'mode', 'per');
CA_0 = idwt2(CA_1, z3, z3, z3, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('CV2');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CV2');
```
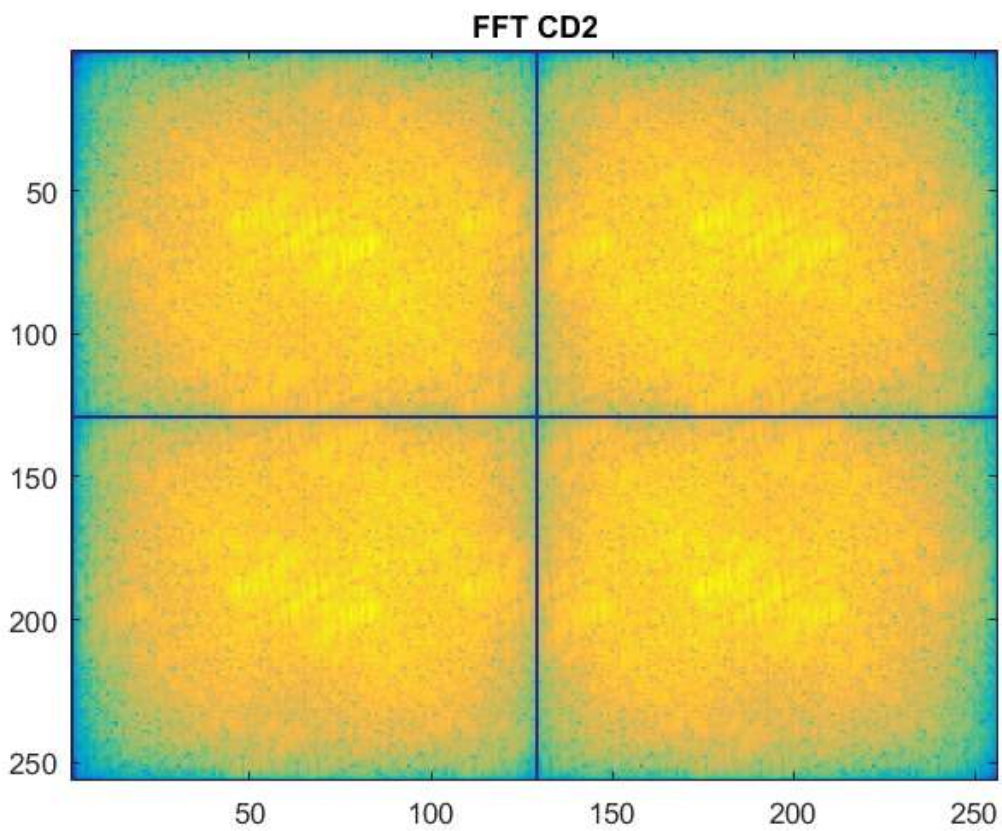

CV2

FFT CV2

CD2

```matlab
CA_1 = idwt2(z2, z2, z2, CD2, 'haar', 'mode', 'per');
CA_0 = idwt2(CA_1, z3, z3, z3, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('CD2');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CD2');
```
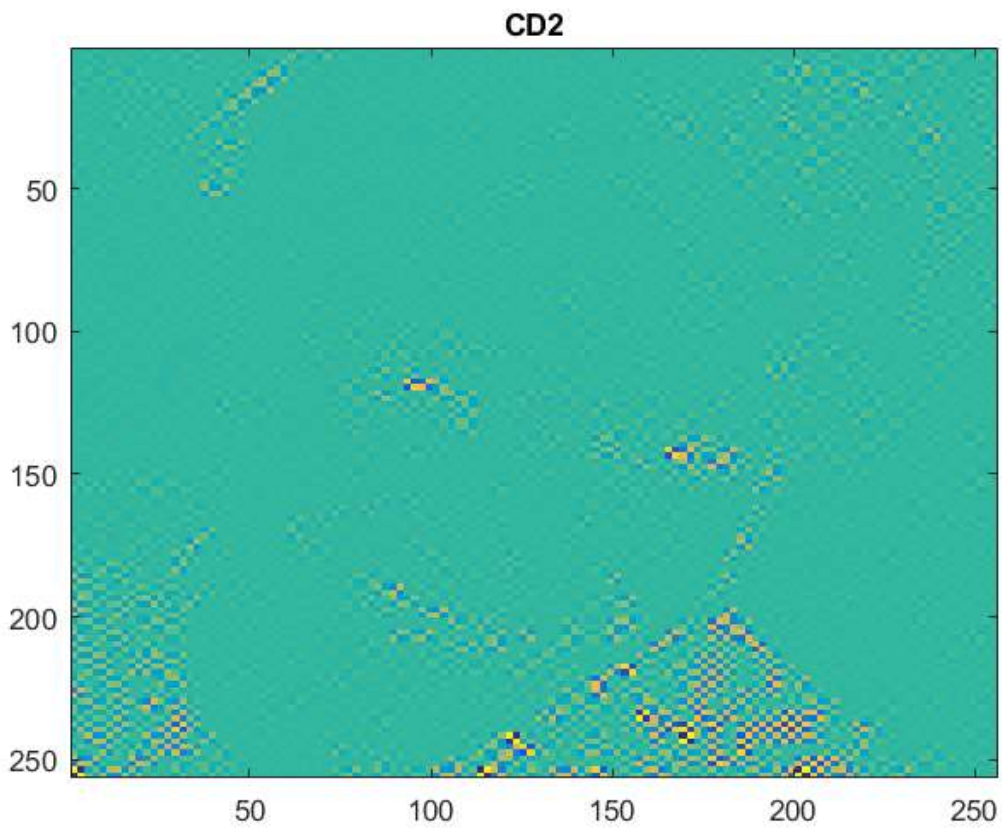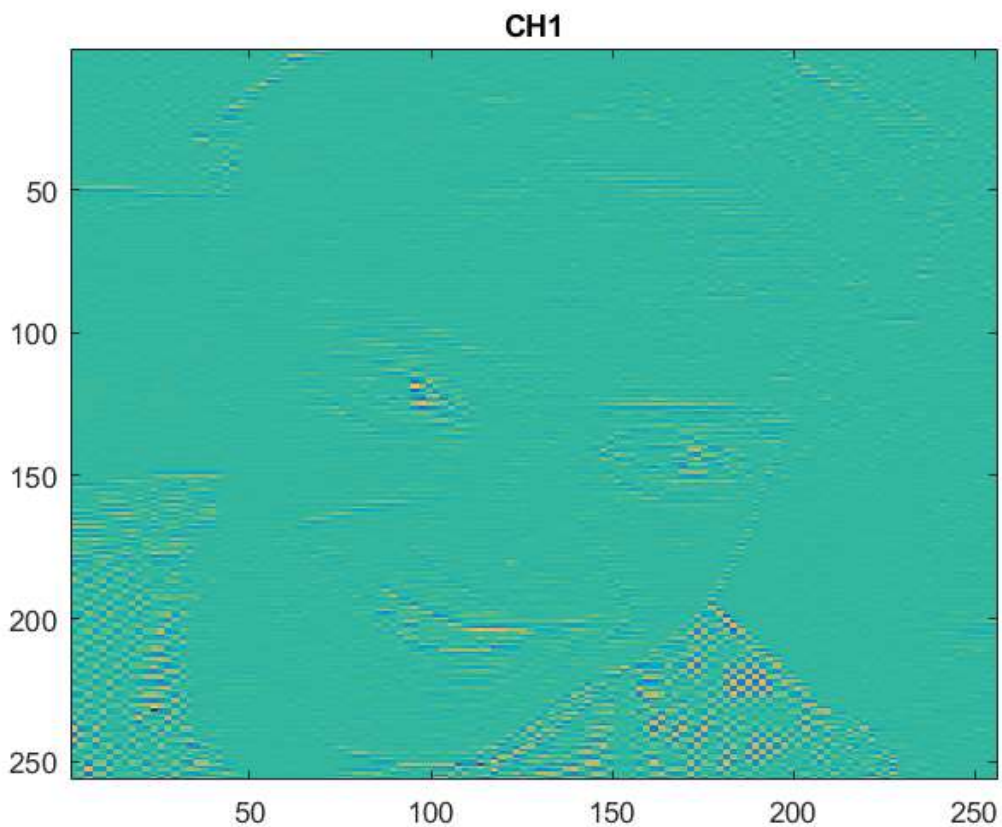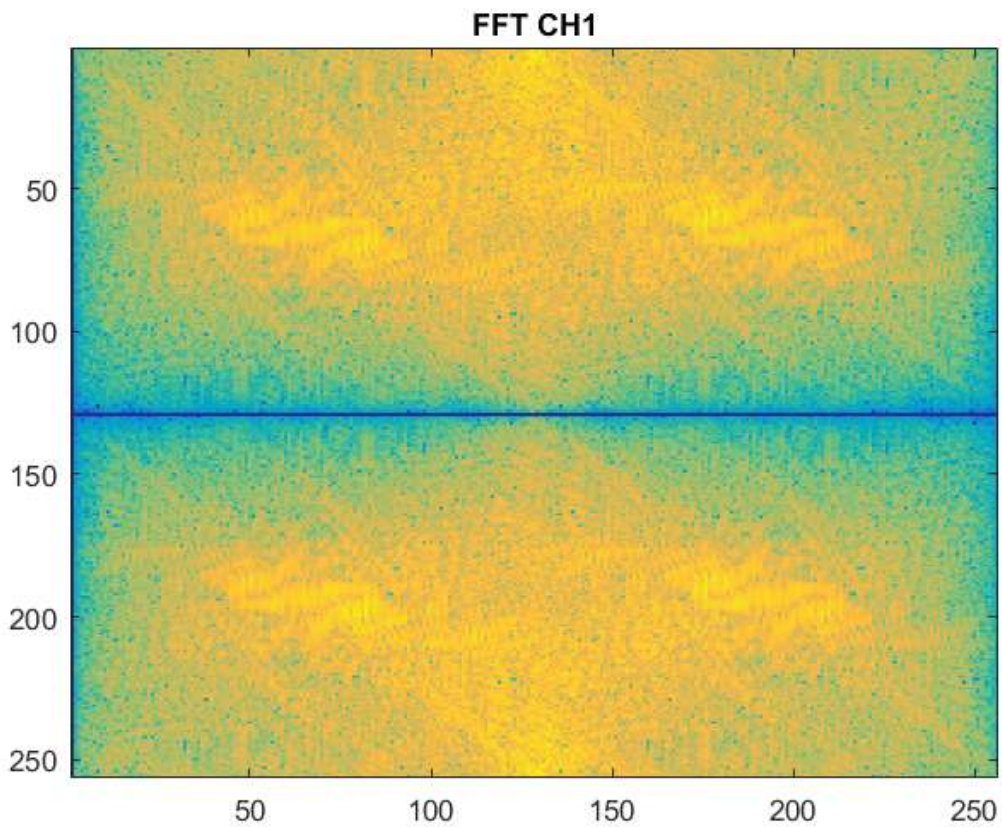
CD2

FFT CD2

CH1

```matlab
CA_0 = idwt2(z3, CH1, z3, z3, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('CH1');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CH1');
```


CH1

FFT CH1

CV1

```matlab
CA_0 = idwt2(z3, z3, CV1, z3, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('CV1');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CV1');
```
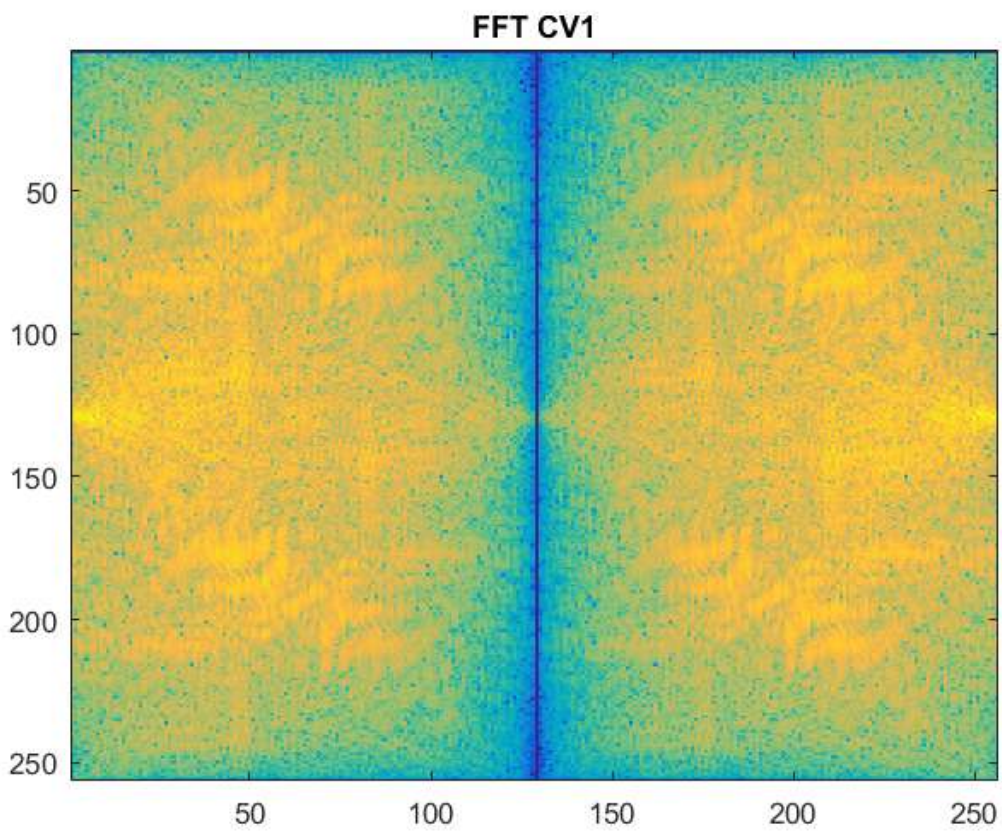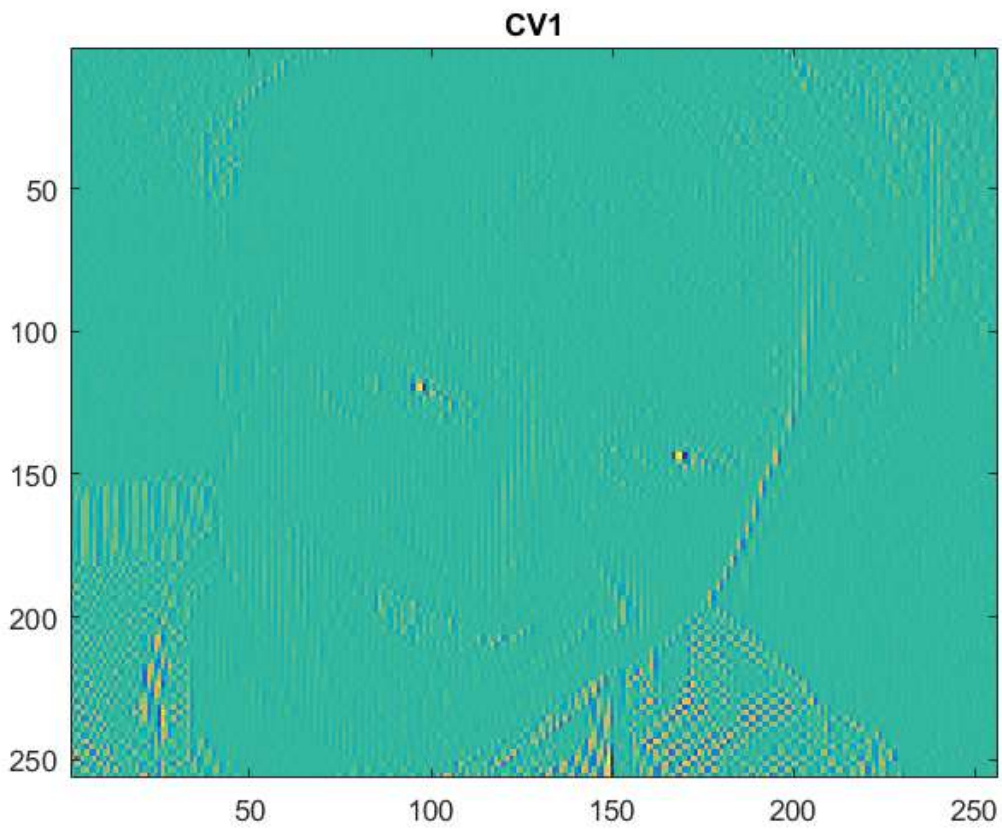
CV1

FFT CV1

CD1

```
CA_0 = idwt2(z3, z3, z3, CD1, 'haar', 'mode', 'per');

figure;
imagesc(CA_0);
title('CD1');
figure;
imagesc(log(abs(fftshift(fft2(CA_0)))));
title('FFT CD1');
```


CD1

FFT CD1