

EE 152 Lab4: Multiscale Representation and Image Enhancements - Victoria Hall, 861154075

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- L4.1 Multiscale image representation:

L4.1 Multiscale image representation:

Part a

```
G = imread('portrait.jpg');
G_gray = rgb2gray(G);

figure;
imshow(G_gray, 'InitialMagnification', 'fit');
title('Portrait Image');

G0 = imresize(G_gray, [256 256]);

figure;
imshow(G0, 'InitialMagnification', 'fit');
title('Portrait Resized to 256x256');

% G0r = G0(:,:,1);
% G0g = G0(:,:,2);
% G0b = G0(:,:,3);
%
% hist_r = hist(double(G0(:)),255);
% hist_g = hist(double(G0g(:)),255);
% hist_b = hist(double(G0b(:)),255);

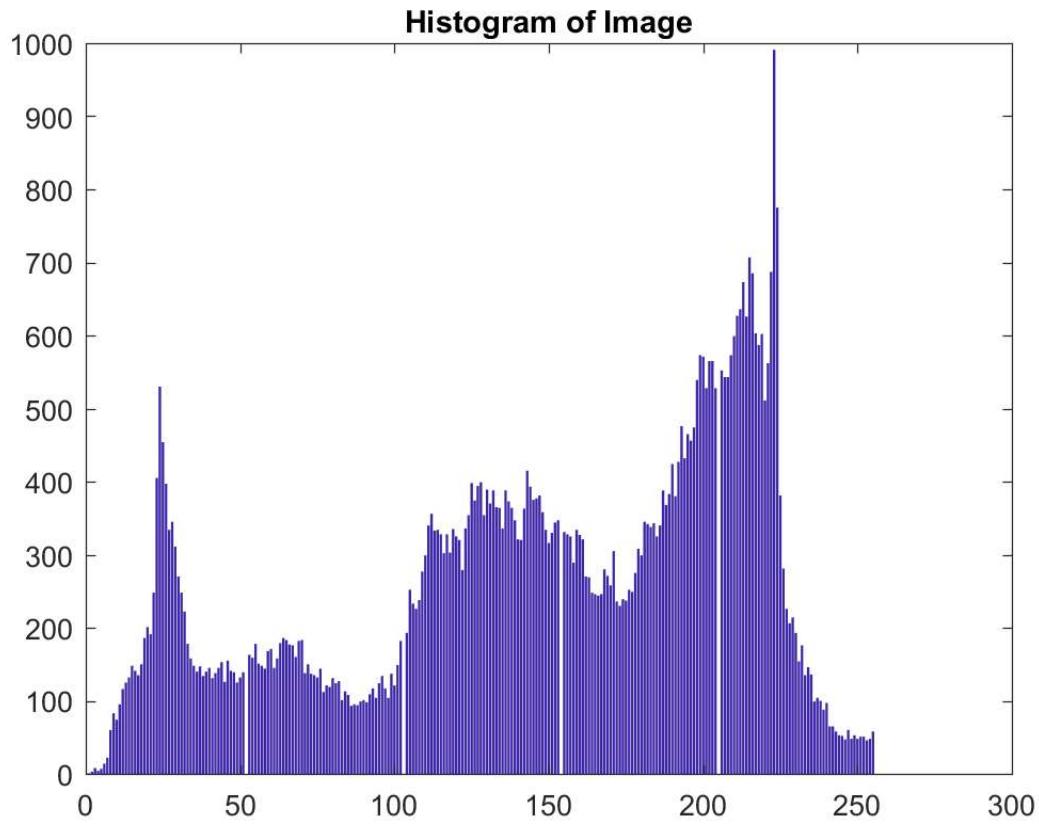
figure;
bar(hist(double(G0(:)),255));
title('Histogram of Image');
```

Portrait Image



Portrait Resized to 256x256



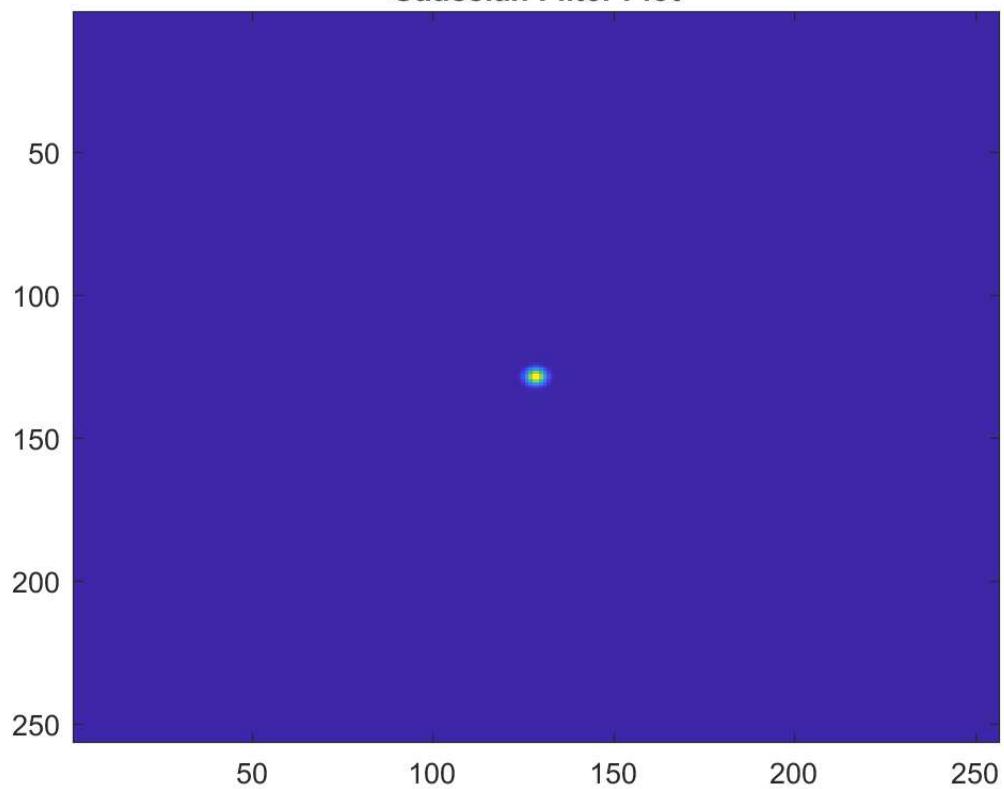


Part b

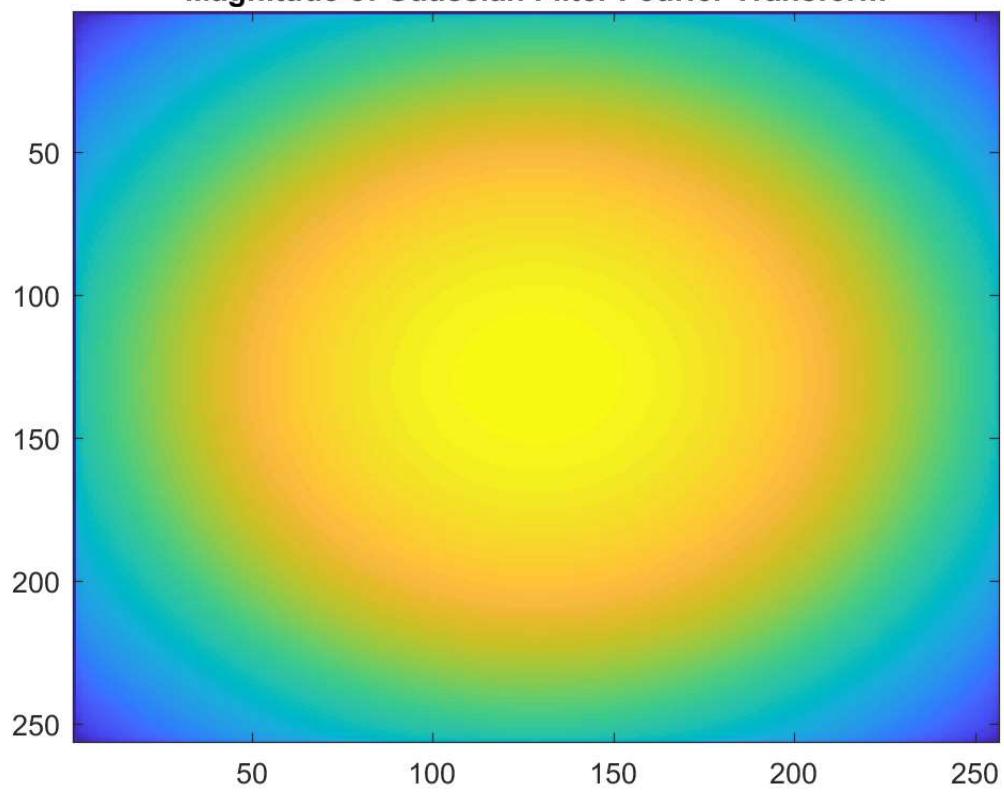
```
g = fspecial('gaussian', 128, 1.7); % filter of half image size
g_pad = padarray(g, [64 64]); % zero padding to make filter 256x256
g_fft = fftshift(fft2(g_pad));
% g_pad = padarray(g_pad, [1 1], 'replicate', 'post');
% G0_filt = imfilter(G0, g_pad);

figure;
imagesc(g_pad);
title('Gaussian Filter Plot');
figure;
imagesc(log(abs(g_fft)));
title('Magnitude of Gaussian Filter Fourier Transform');
figure;
imagesc(angle(g_fft));
title('Angle of Gaussian Filter Fourier Transform');
```

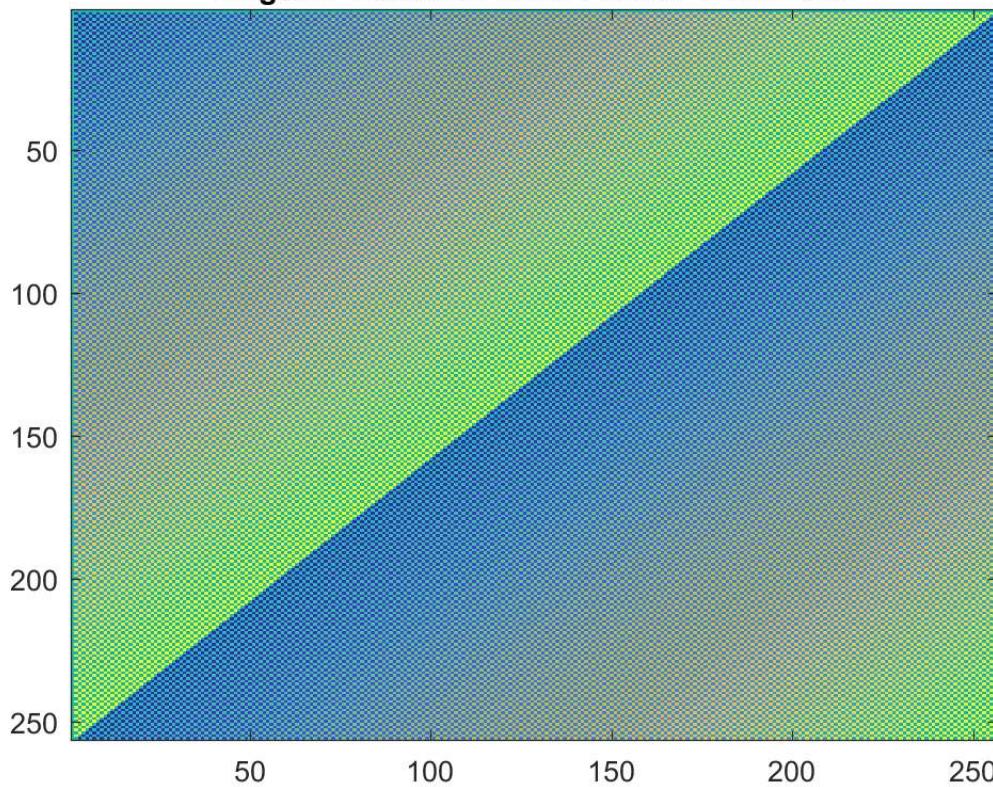
Gaussian Filter Plot



Magnitude of Gaussian Filter Fourier Transform



Angle of Gaussian Filter Fourier Transform



Part c

```
g1 = g_pad;
g2 = conv2(g_pad, g_pad);
g3 = conv2(g2, g_pad);

G1 = imfilter(G0, g1);    % blurred image
G1_fft = fftshift(fft2(G1));
G1_size = imresize(G1, [128 128]);

figure;
imshow(G1, 'InitialMagnification', 'fit');
title('Blurred Image G1');
figure;
imagesc(log(abs(G1_fft)));
title('Blurred Image G1 Fourier Transform Magnitude');
figure;
imshow(G1_size, 'InitialMagnification', 'fit');
title('G1 Scaled to 128x128');

G2 = imfilter(G1, g2);    % blurred image
G2_fft = fftshift(fft2(G2));
G2_size = imresize(G2, [64 64]);

figure;
imshow(G2, 'InitialMagnification', 'fit');
title('Blurred Image G2');
figure;
imagesc(log(abs(G2_fft)));
```

```
title('Blurred Image G2 Fourier Transform Magnitude');
figure;
imshow(G2_size, 'InitialMagnification', 'fit');
title('G2 Scaled to 64x64');

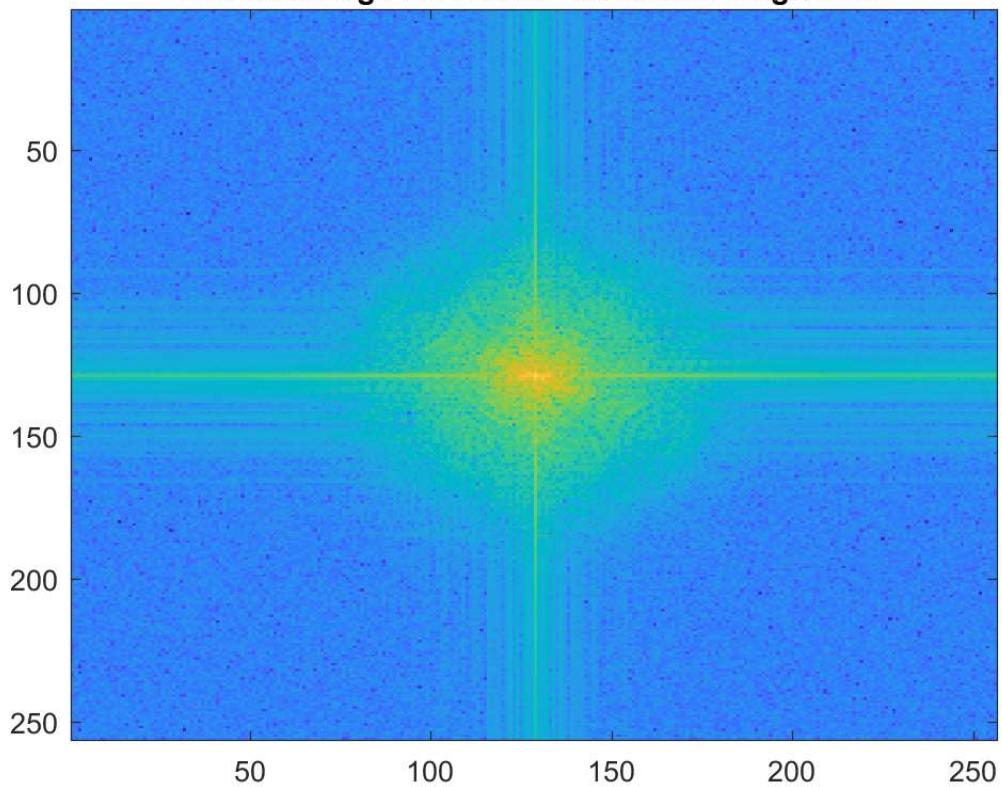
G3 = imfilter(G2, g3);    % blurred image
G3_fft = fftshift(fft2(G3));
G3_size = imresize(G3, [32 32]);

figure;
imshow(G3, 'InitialMagnification', 'fit');
title('Blurred Image G3');
figure;
imagesc(log(abs(G3_fft)));
title('Blurred Image G3 Fourier Transform Magnitude');
figure;
imshow(G3_size, 'InitialMagnification', 'fit');
title('G3 Scaled to 32x32');
```

Blurred Image G1



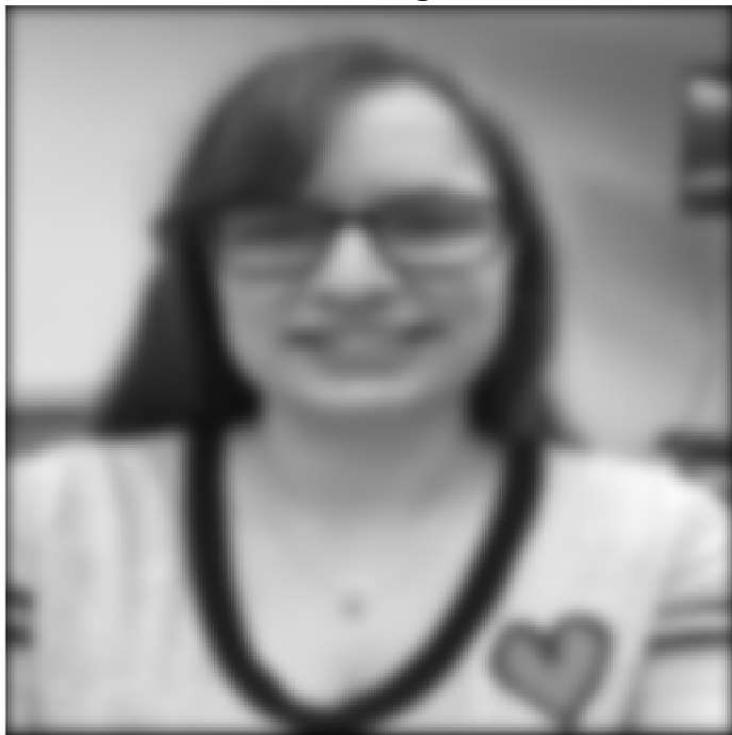
Blurred Image G1 Fourier Transform Magnitude



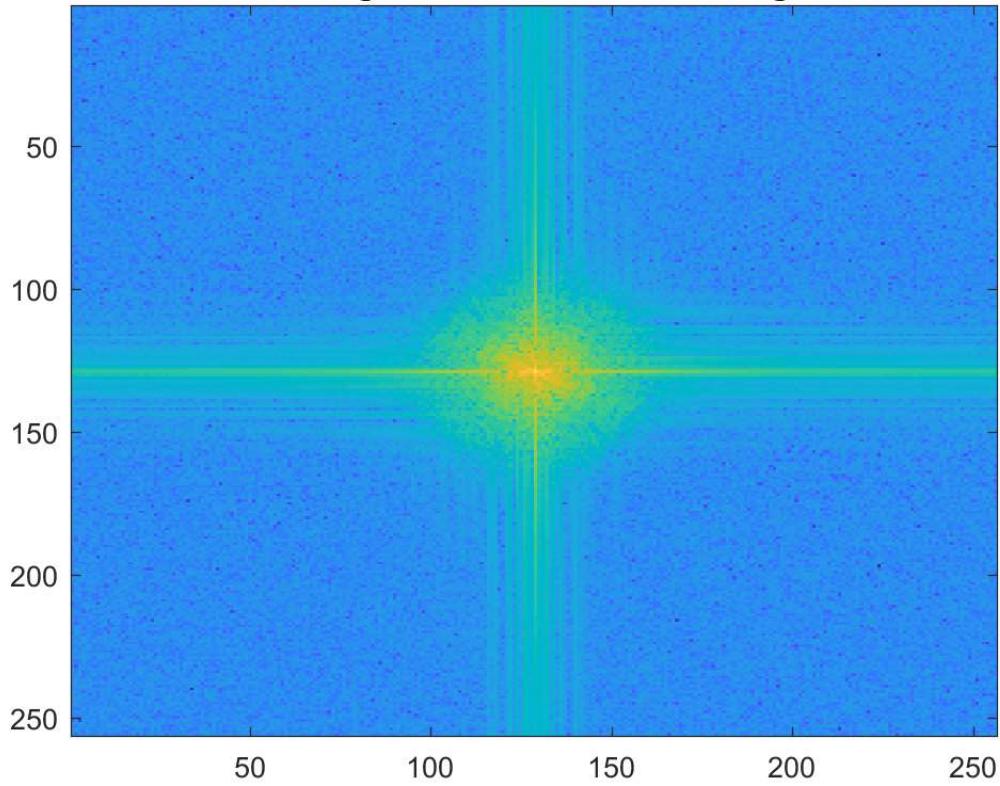
G1 Scaled to 128x128



Blurred Image G2



Blurred Image G2 Fourier Transform Magnitude



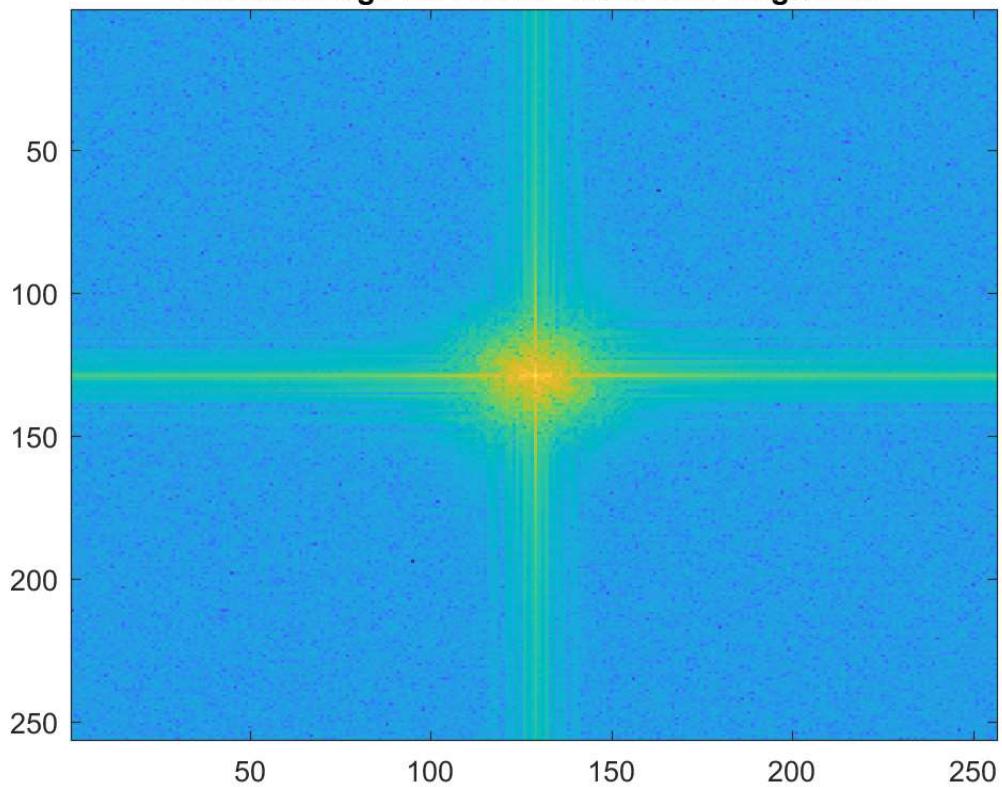
G2 Scaled to 64x64



Blurred Image G3



Blurred Image G3 Fourier Transform Magnitude



G3 Scaled to 32x32



Part d

```

L0 = imsubtract(G0, G1);
L1 = imsubtract(G1, G2);
L2 = imsubtract(G2, G3);

L0_fft = fftshift(fft2(L0));
L1_fft = fftshift(fft2(L1));
L2_fft = fftshift(fft2(L2));

L0_size = imresize(L0, [128 128]);
L1_size = imresize(L1, [64 64]);
L2_size = imresize(L2, [32 32]);

figure;
imshow(L0, 'InitialMagnification', 'fit');
title('L0 Image');
figure;
imagesc(log(abs(L0_fft)));
title('L0 Fourier Transform Magnitude');
figure;
imshow(L0_size, 'InitialMagnification', 'fit');
title('L0 Scaled to 128x128');

figure;
imshow(L1, 'InitialMagnification', 'fit');
title('L1 Image');
figure;
imagesc(log(abs(L1_fft)));
title('L1 Fourier Transform Magnitude');
figure;
imshow(L1_size, 'InitialMagnification', 'fit');
title('L1 Scaled to 64x64');

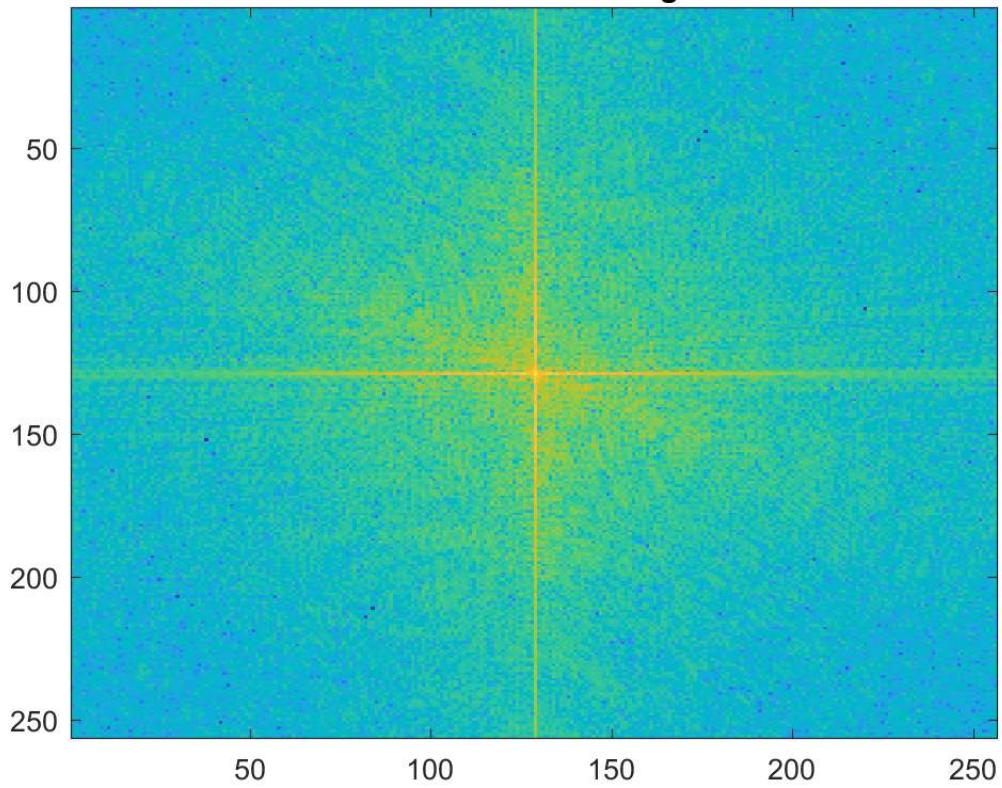
figure;
imshow(L2, 'InitialMagnification', 'fit');
title('L2 Image');
figure;
imagesc(log(abs(L2_fft)));
title('L2 Fourier Transform Magnitude');
figure;
imshow(L2_size, 'InitialMagnification', 'fit');
title('L2 Scaled to 32x32');

```

L0 Image



L0 Fourier Transform Magnitude



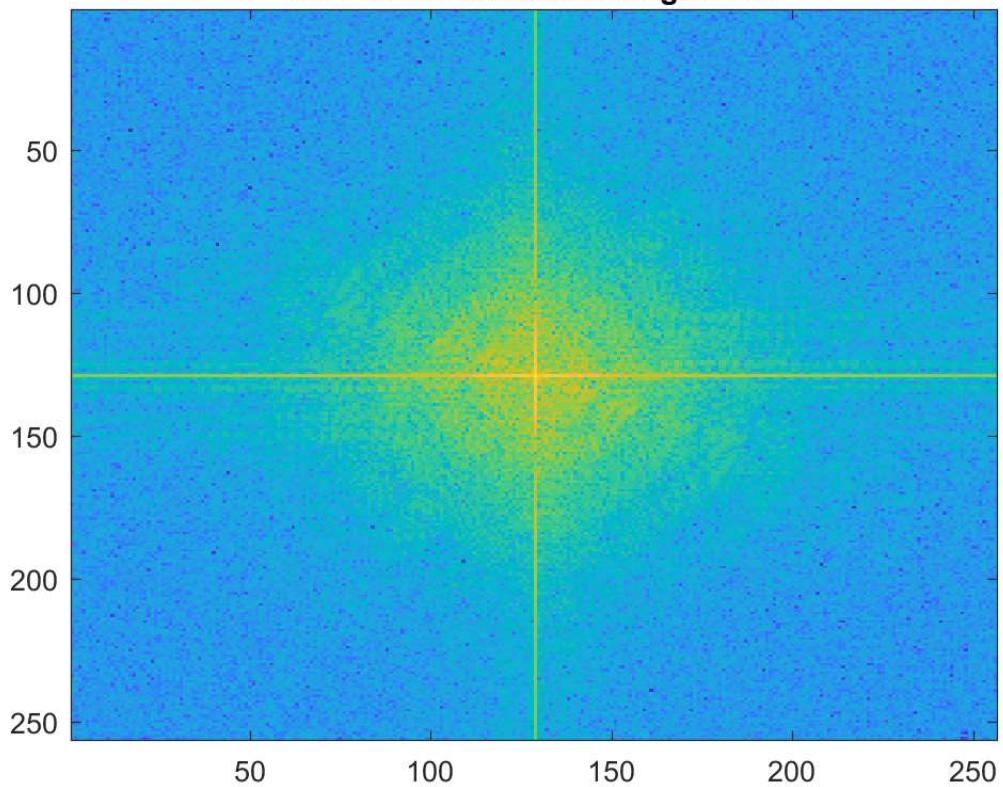
L0 Scaled to 128x128



L1 Image



L1 Fourier Transform Magnitude



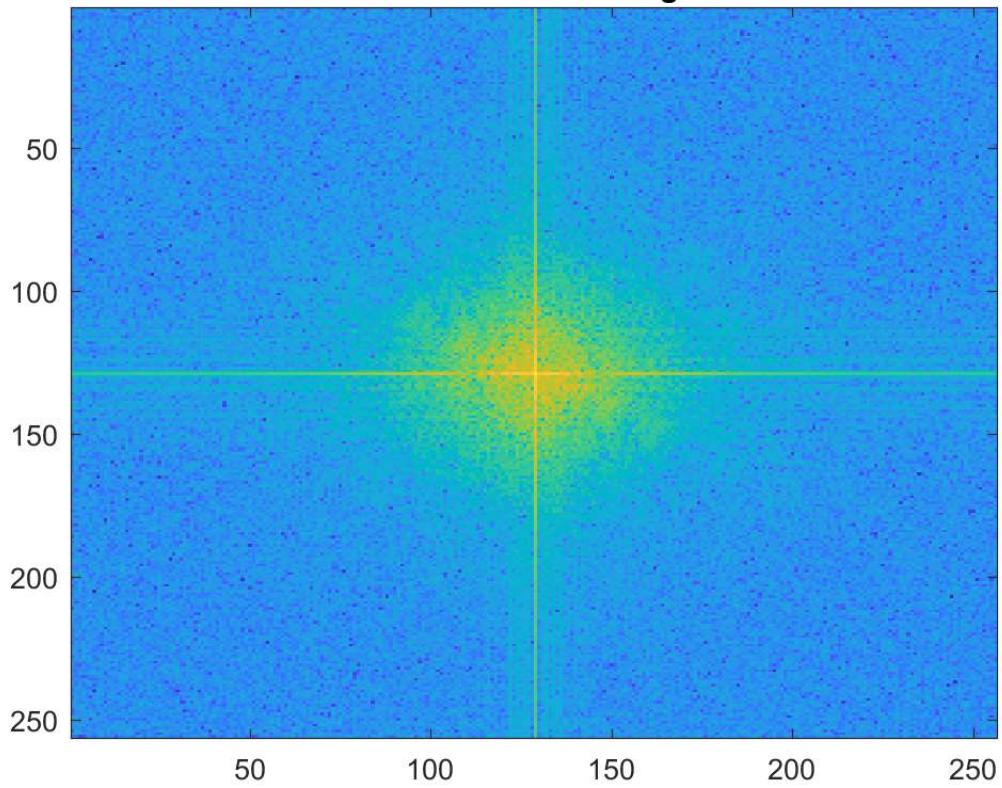
L1 Scaled to 64x64



L2 Image



L2 Fourier Transform Magnitude



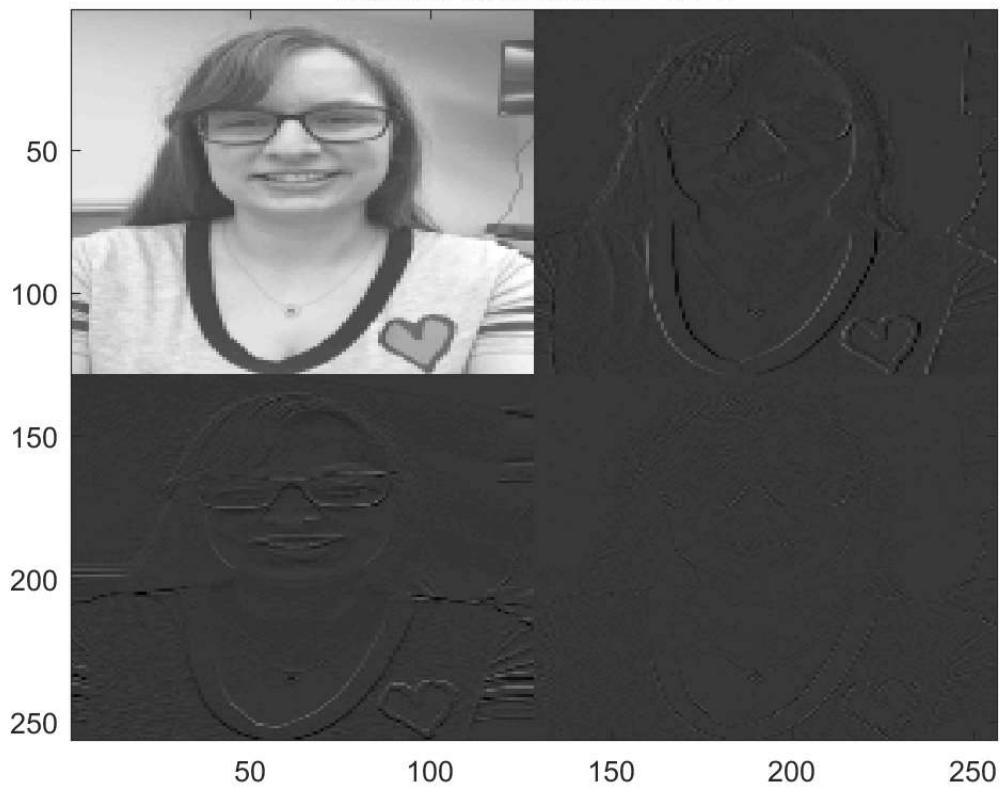
L2 Scaled to 32x32



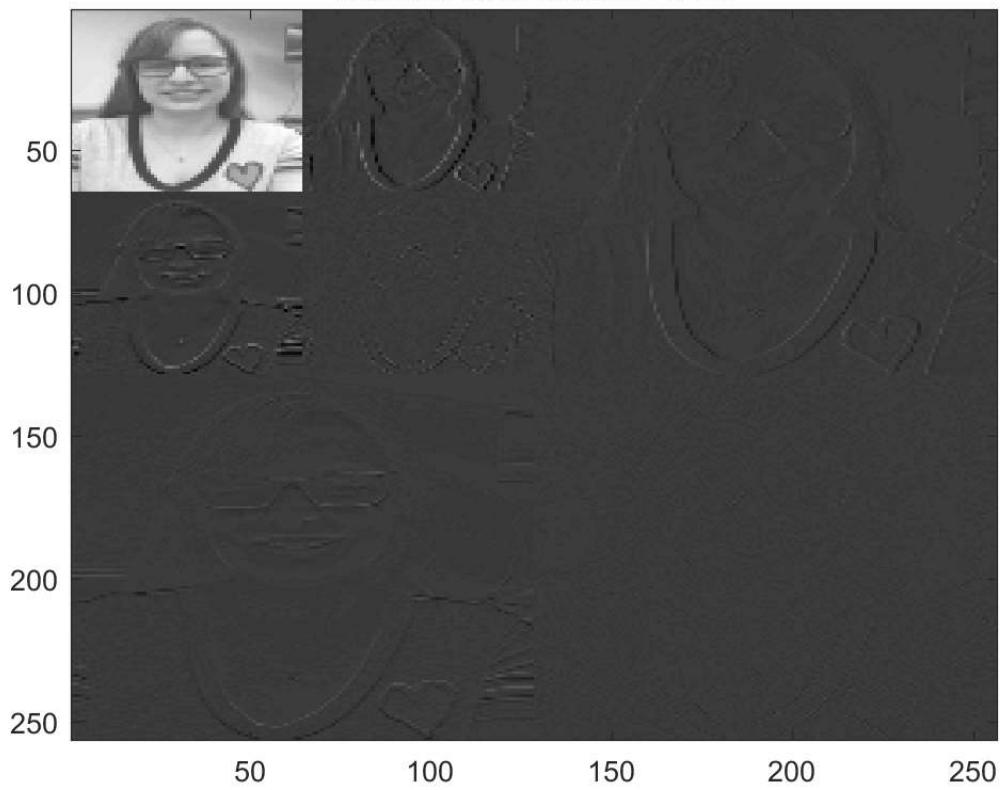
Part e

```
C = zeros(256,256,3);
for i = 1:3
    if i == 1
        [CA1, CH1, CV1, CD1] = dwt2(G0, 'haar', 'mode', 'per');
        CT1 = [CA1 CH1; CV1 CD1];
    elseif i == 2
        [CA2, CH2, CV2, CD2] = dwt2(CA1, 'haar', 'mode', 'per');
        CT2 = [CA2 CH2; CV2 CD2];
        CT1 = [CT2 CH1; CV1 CD1];
    elseif i == 3
        [CA3, CH3, CV3, CD3] = dwt2(CA2, 'haar', 'mode', 'per');
        CT3 = [CA3 CH3; CV3 CD3];
        CT2 = [CT3 CH2; CV2 CD2];
        CT1 = [CT2 CH1; CV1 CD1];
    end
    C(:,:,:,i) = CT1;
    figure;
    colormap gray;
    imagesc(C(:,:,:,i));
    title(['Wavelet Coefficients Plot ' num2str(i)]);
end
```

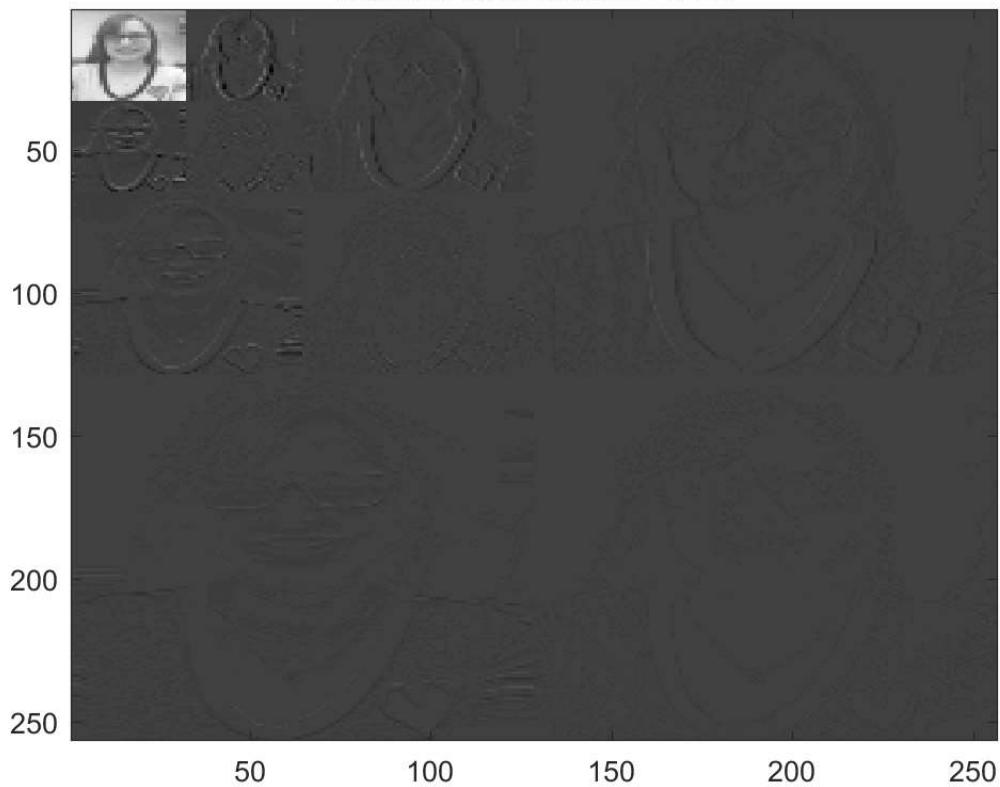
Wavelet Coefficients Plot 1



Wavelet Coefficients Plot 2



Wavelet Coefficients Plot 3

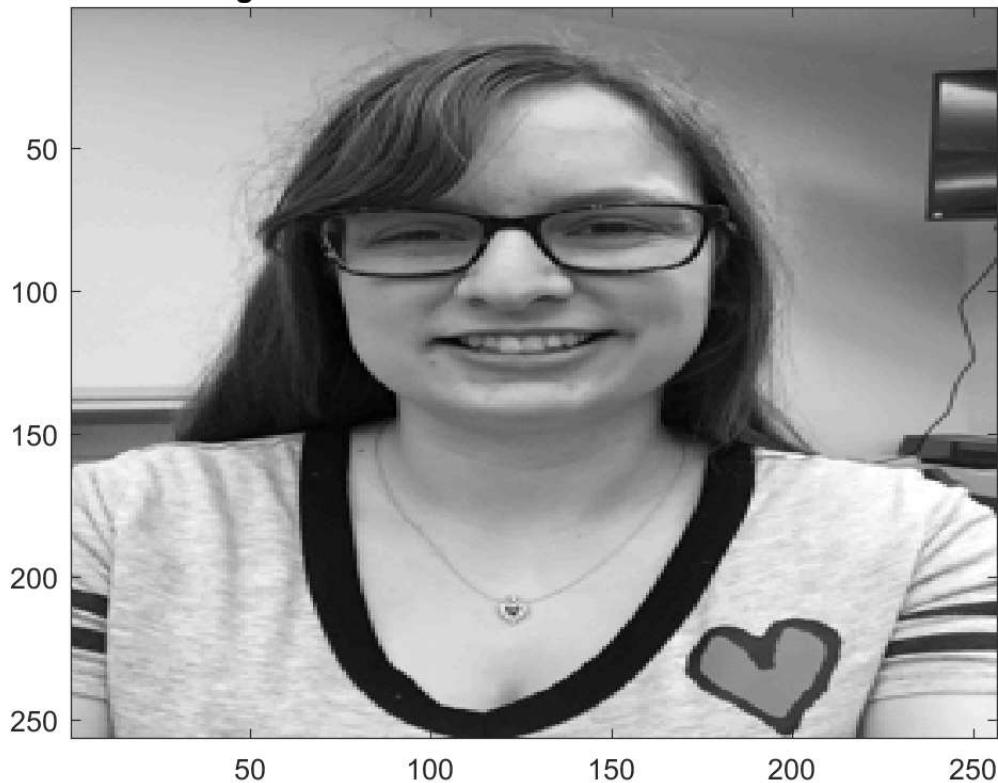


Part f

```
CAt2 = idwt2(CA3, CH3, CV3, CD3, 'haar', 'mode', 'per');
CAt1 = idwt2(CAt2, CH2, CV2, CD2, 'haar', 'mode', 'per');
CAt0 = idwt2(CAt1, CH1, CV1, CD1, 'haar', 'mode', 'per');

figure;
colormap gray;
imagesc(CAt0);
title('Image Reconstructed from Wavelet Coefficients');
```

Image Reconstructed from Wavelet Coefficients



Part g

```
z32 = zeros(32,32);
z64 = zeros(64,64);
z128 = zeros(128,128);

% for CA3
CAt2 = idwt2(CA3, z32, z32, z32, 'haar', 'mode', 'per');
CAt1 = idwt2(CAt2, z64, z64, z64, 'haar', 'mode', 'per');
CAt0 = idwt2(CAt1, z128, z128, z128, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

figure;
colormap gray;
imagesc(CAt0);
title('Reconstructed Image Using CA3');
figure;
imagesc(log(abs(CAt0_fft)));
title('Fourier Transform Magnitude For Reconstructed Image Using CA3');

% for CH3
CAt2 = idwt2(z32, CH3, z32, z32, 'haar', 'mode', 'per');
CAt1 = idwt2(CAt2, z64, z64, z64, 'haar', 'mode', 'per');
CAt0 = idwt2(CAt1, z128, z128, z128, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

figure;
colormap gray;
imagesc(CAt0);
```

```

title('Reconstructed Image Using CH3');
figure;
imagesc(log(abs(CAt0_fft)));
title('Fourier Transform Magnitude For Reconstructed Image Using CH3');

% for CV3
CAt2 = idwt2(z32, z32, CV3, z32, 'haar', 'mode', 'per');
CAt1 = idwt2(CAt2, z64, z64, z64, 'haar', 'mode', 'per');
CAt0 = idwt2(CAt1, z128, z128, z128, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

figure;
colormap gray;
imagesc(CAt0);
title('Reconstructed Image Using CV3');
figure;
imagesc(log(abs(CAt0_fft)));
title('Fourier Transform Magnitude For Reconstructed Image Using CV3');

% for CD3
CAt2 = idwt2(z32, z32, z32, CD3, 'haar', 'mode', 'per');
CAt1 = idwt2(CAt2, z64, z64, z64, 'haar', 'mode', 'per');
CAt0 = idwt2(CAt1, z128, z128, z128, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

figure;
colormap gray;
imagesc(CAt0);
title('Reconstructed Image Using CD3');
figure;
imagesc(log(abs(CAt0_fft)));
title('Fourier Transform Magnitude For Reconstructed Image Using CD3');

% for CH2
CAt1 = idwt2(z64, CH2, z64, z64, 'haar', 'mode', 'per');
CAt0 = idwt2(CAt1, z128, z128, z128, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

figure;
colormap gray;
imagesc(CAt0);
title('Reconstructed Image Using CH2');
figure;
imagesc(log(abs(CAt0_fft)));
title('Fourier Transform Magnitude For Reconstructed Image Using CH2');

% for CV2
CAt1 = idwt2(z64, z64, CV2, z64, 'haar', 'mode', 'per');
CAt0 = idwt2(CAt1, z128, z128, z128, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

figure;
colormap gray;
imagesc(CAt0);
title('Reconstructed Image Using CV2');
figure;
imagesc(log(abs(CAt0_fft)));

```

```

title('Fourier Transform Magnitude For Reconstructed Image Using CV2');

% for CD2
CAt1 = idwt2(z64, z64, z64, CD2, 'haar', 'mode', 'per');
CAt0 = idwt2(CAt1, z128, z128, z128, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

figure;
colormap gray;
imagesc(CAt0);
title('Reconstructed Image Using CD2');
figure;
imagesc(log(abs(CAt0_fft)));
title('Fourier Transform Magnitude For Reconstructed Image Using CD2');

% for CH1
CAt0 = idwt2(z128, CH1, z128, z128, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

figure;
colormap gray;
imagesc(CAt0);
title('Reconstructed Image Using CH1');
figure;
imagesc(log(abs(CAt0_fft)));
title('Fourier Transform Magnitude For Reconstructed Image Using CH1');

% for CV1
CAt0 = idwt2(z128, z128, CV1, z128, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

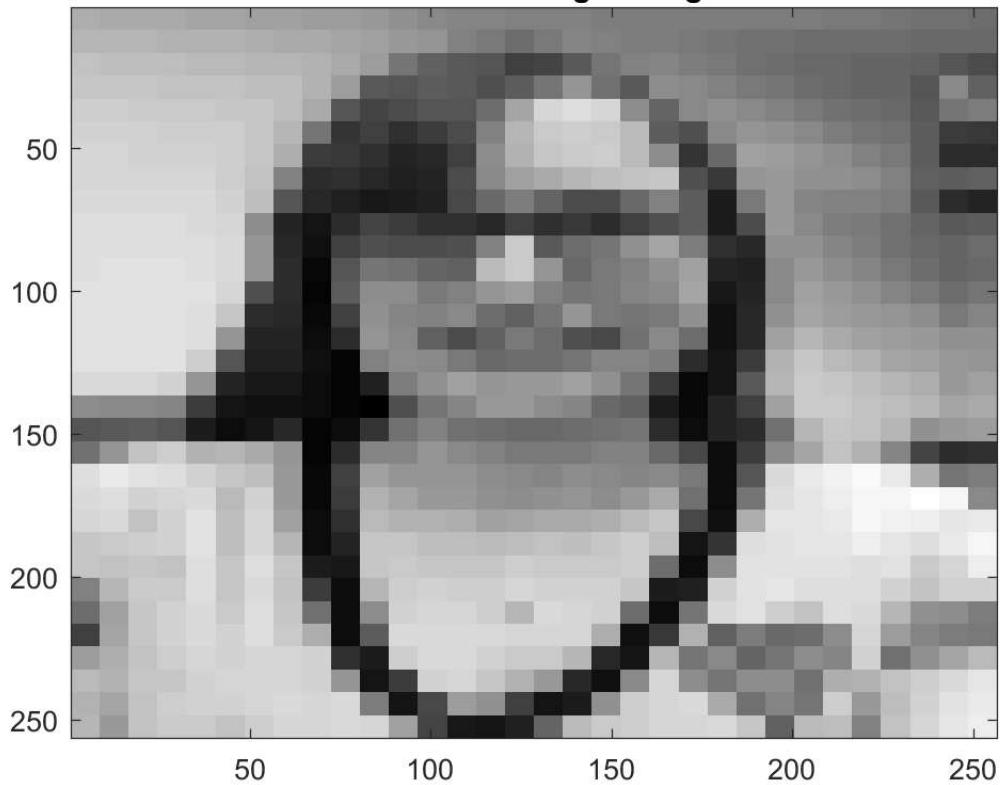
figure;
colormap gray;
imagesc(CAt0);
title('Reconstructed Image Using CV1');
figure;
imagesc(log(abs(CAt0_fft)));
title('Fourier Transform Magnitude For Reconstructed Image Using CV1');

% for CD1
CAt0 = idwt2(z128, z128, z128, CD1, 'haar', 'mode', 'per');
CAt0_fft = fftshift(fft2(CAt0));

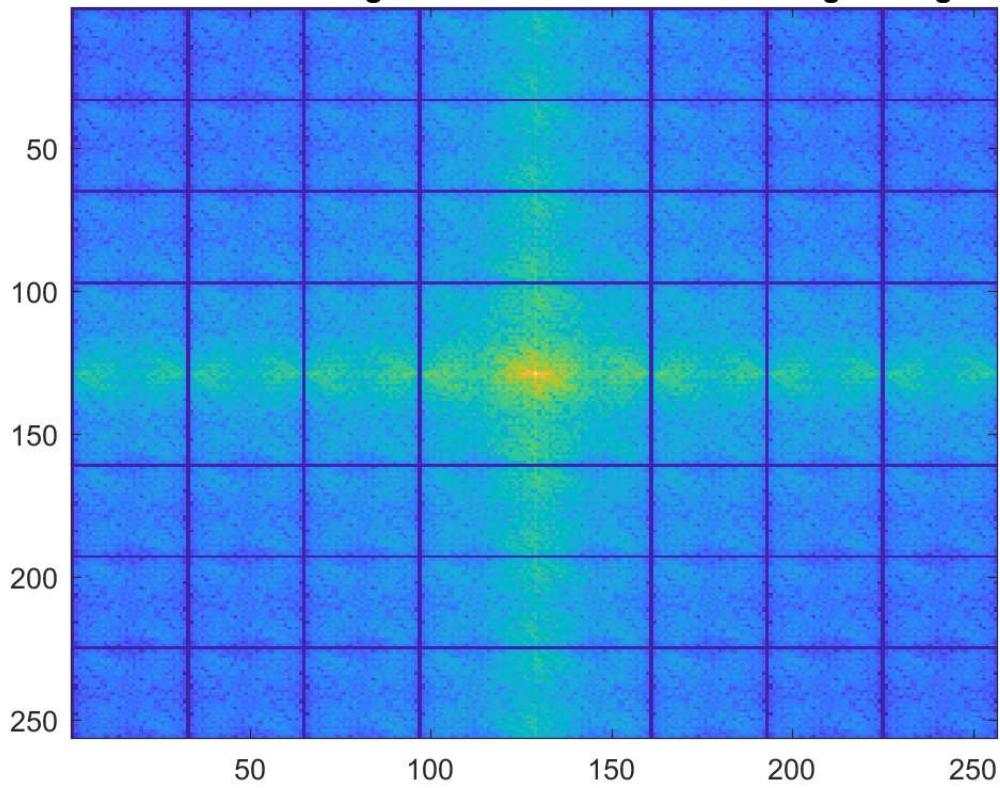
figure;
colormap gray;
imagesc(CAt0);
title('Reconstructed Image Using CD1');
figure;
imagesc(log(abs(CAt0_fft)));
title('Fourier Transform Magnitude For Reconstructed Image Using CD1');

```

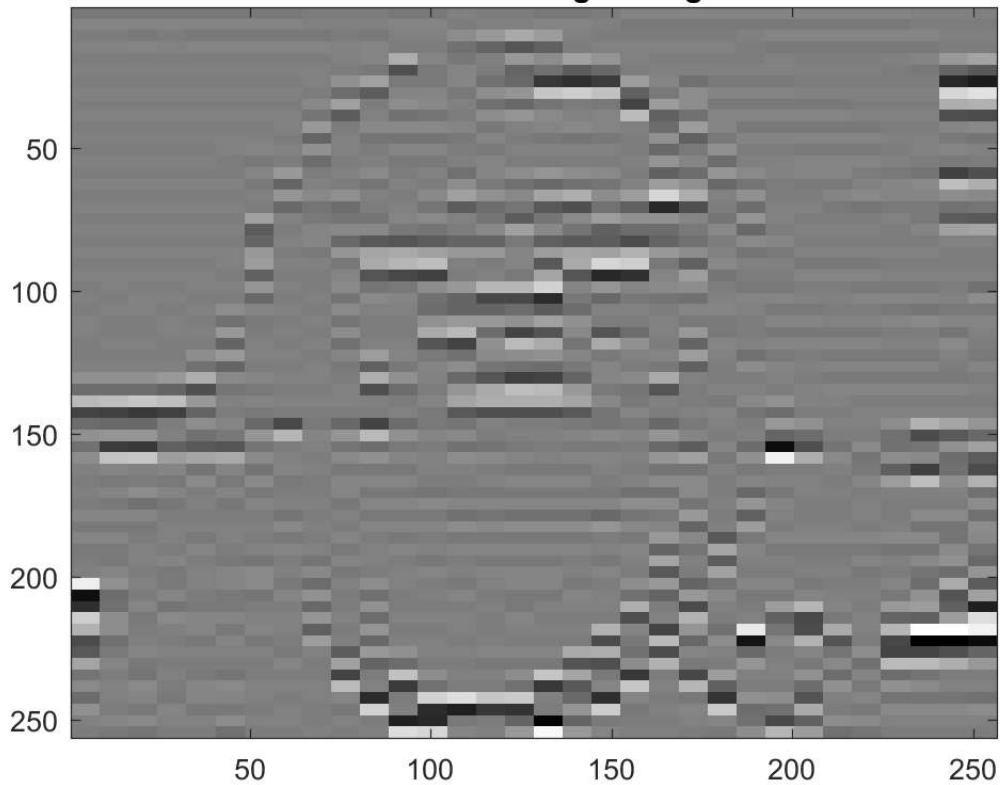
Reconstructed Image Using CA3



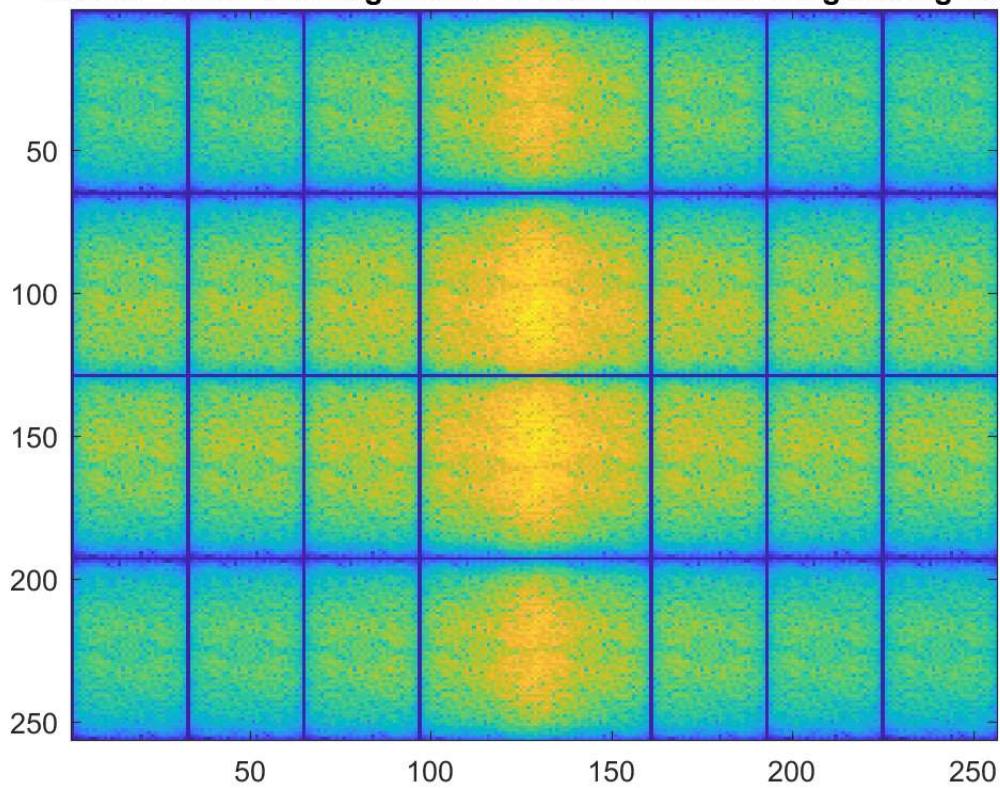
Fourier Transform Magnitude For Reconstructed Image Using CA3



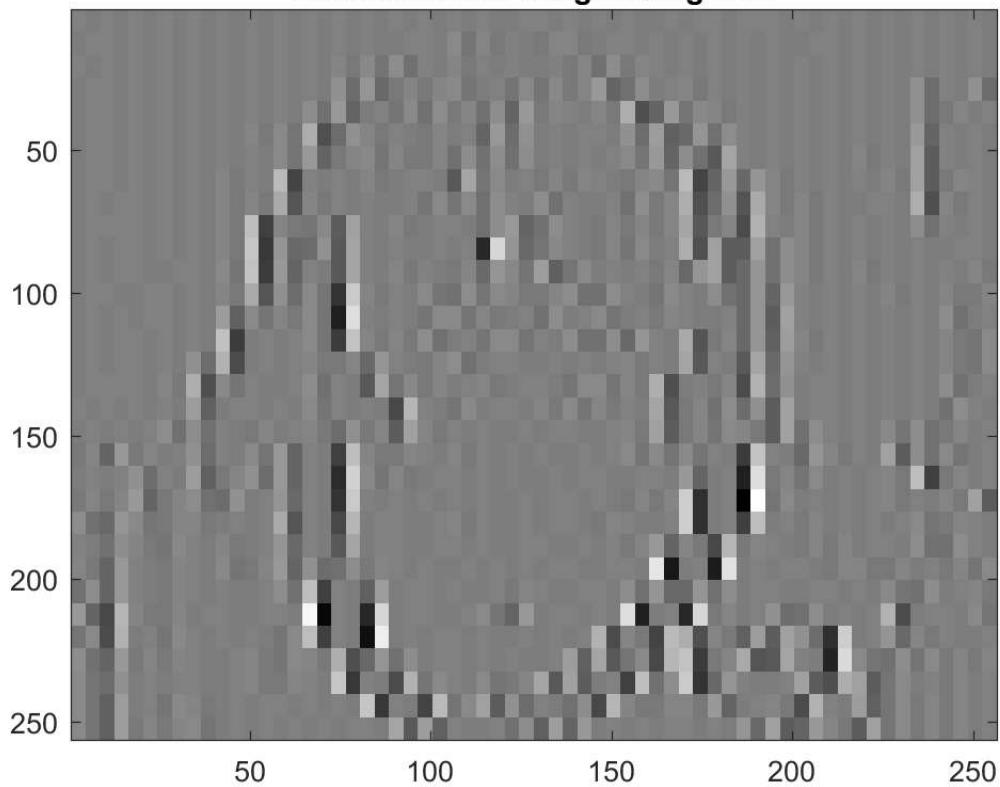
Reconstructed Image Using CH3



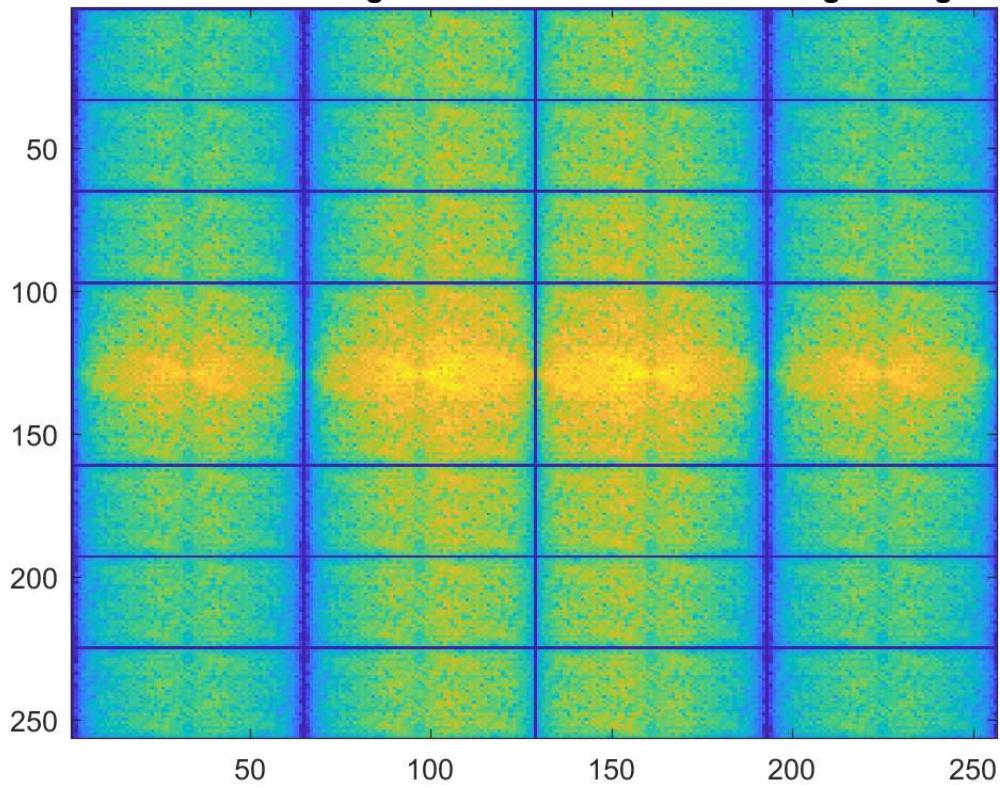
Fourier Transform Magnitude For Reconstructed Image Using CH3



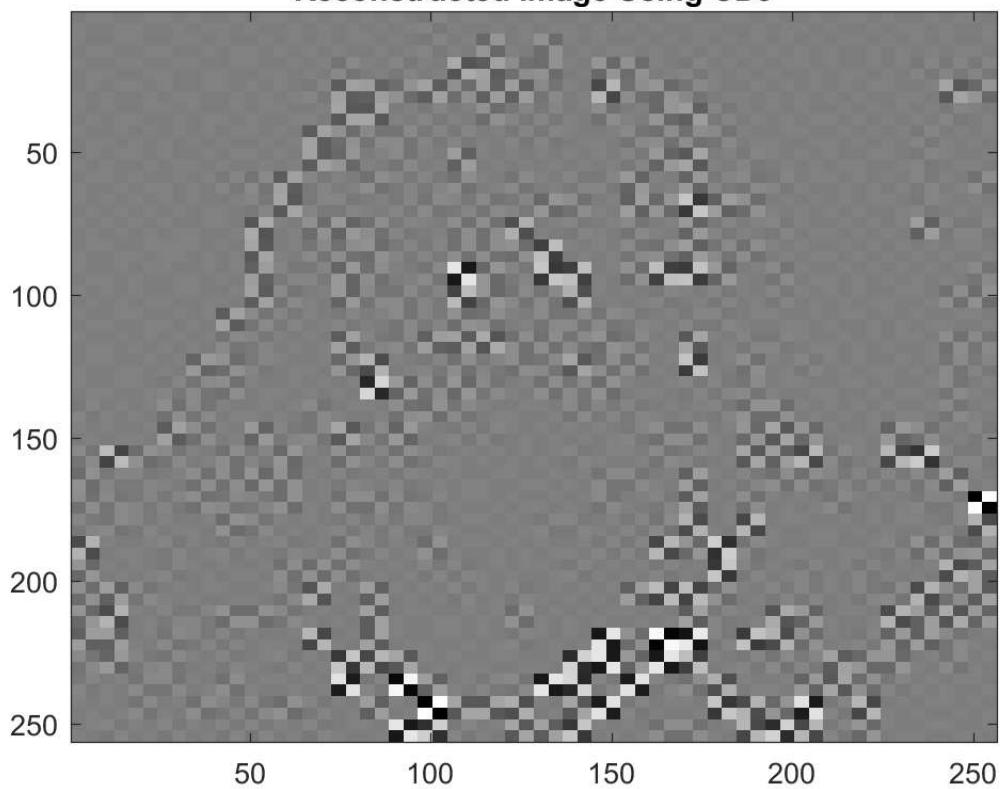
Reconstructed Image Using CV3



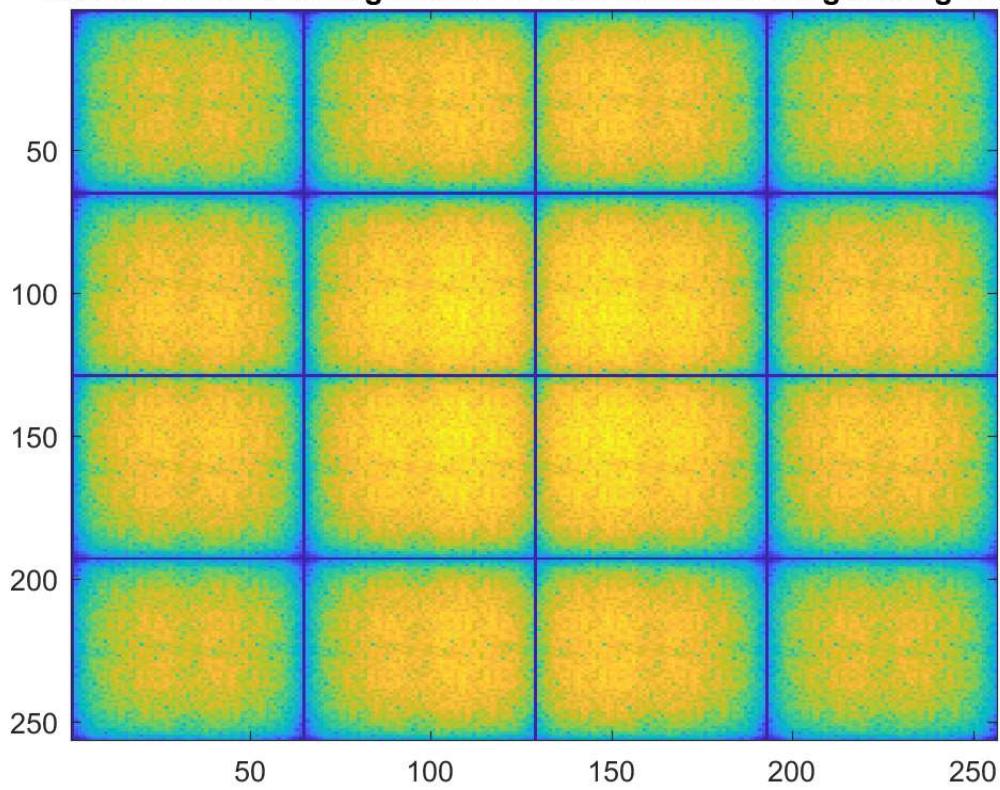
Fourier Transform Magnitude For Reconstructed Image Using CV3



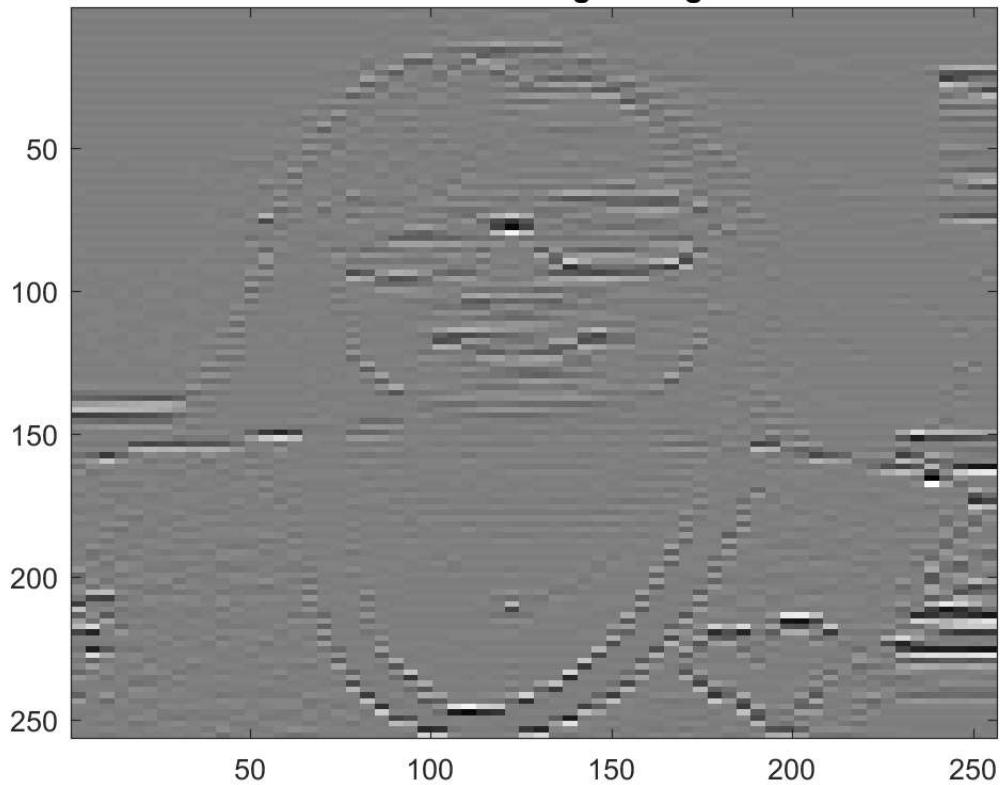
Reconstructed Image Using CD3



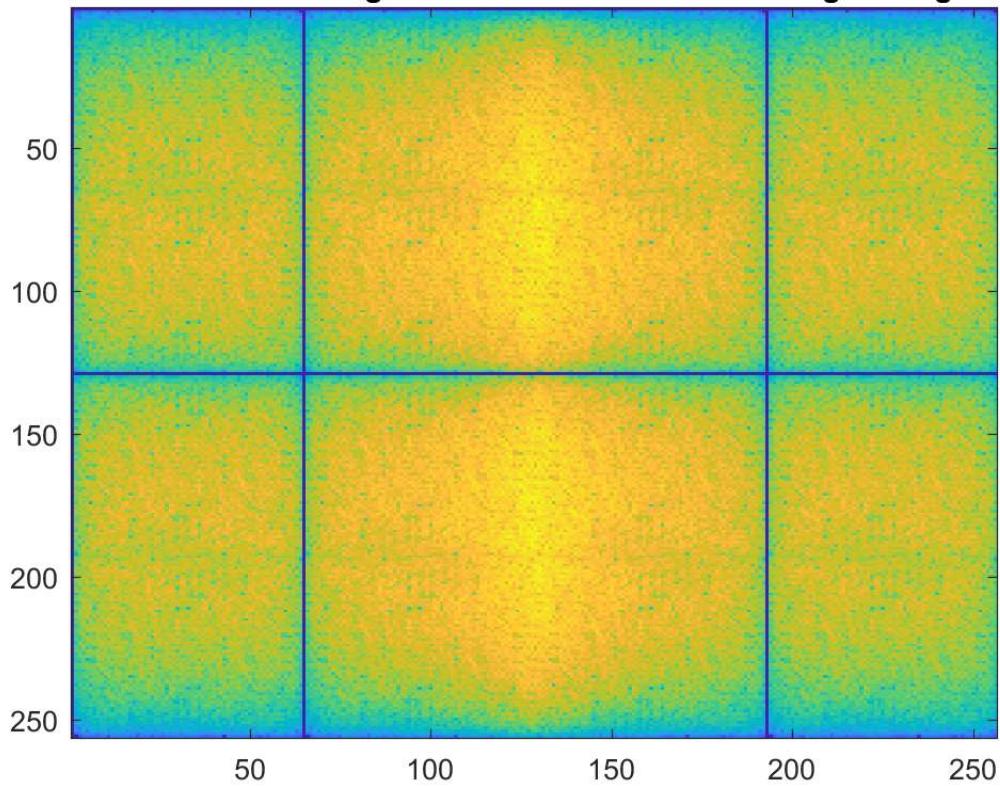
Fourier Transform Magnitude For Reconstructed Image Using CD3



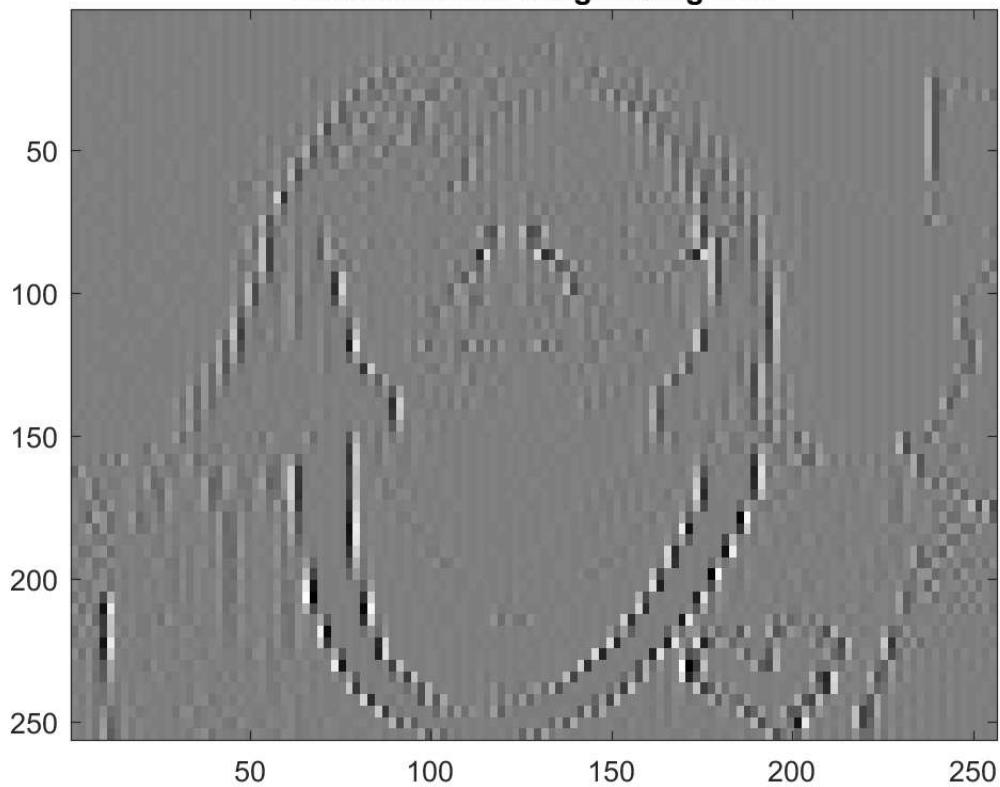
Reconstructed Image Using CH2



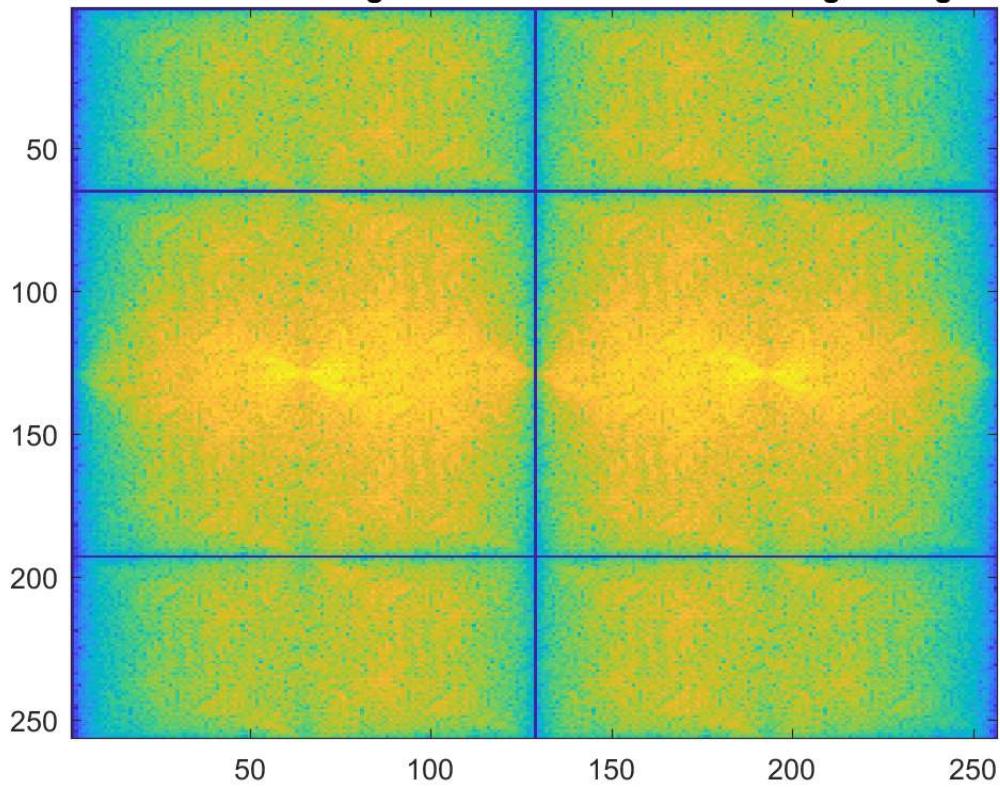
Fourier Transform Magnitude For Reconstructed Image Using CH2



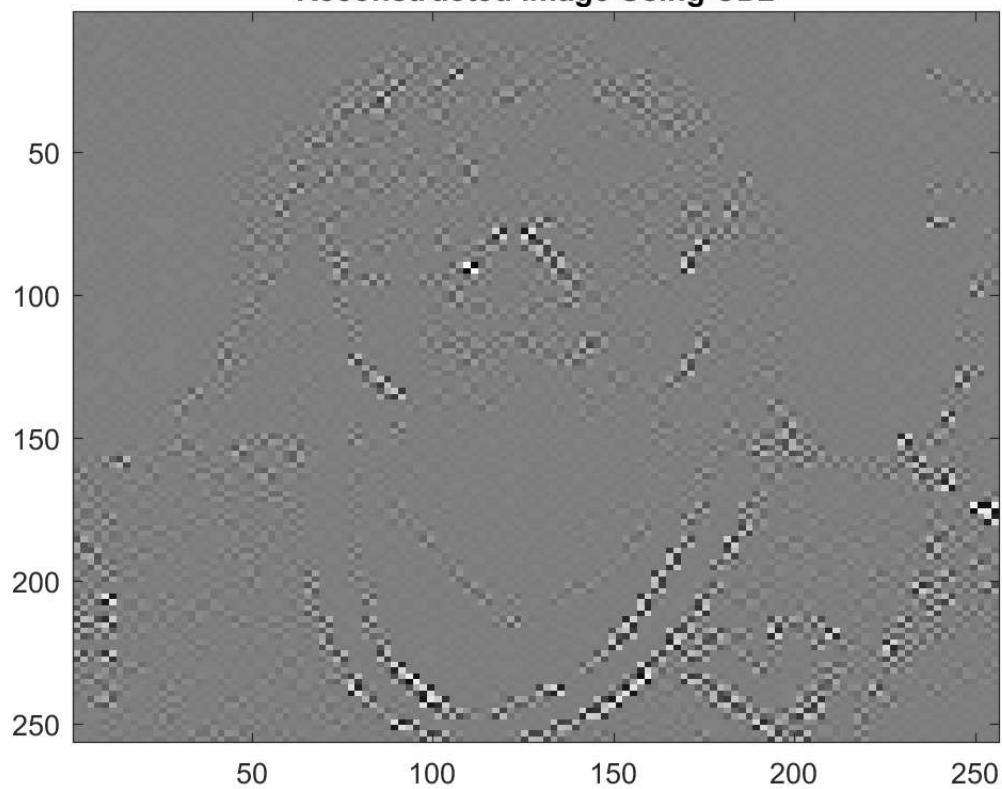
Reconstructed Image Using CV2



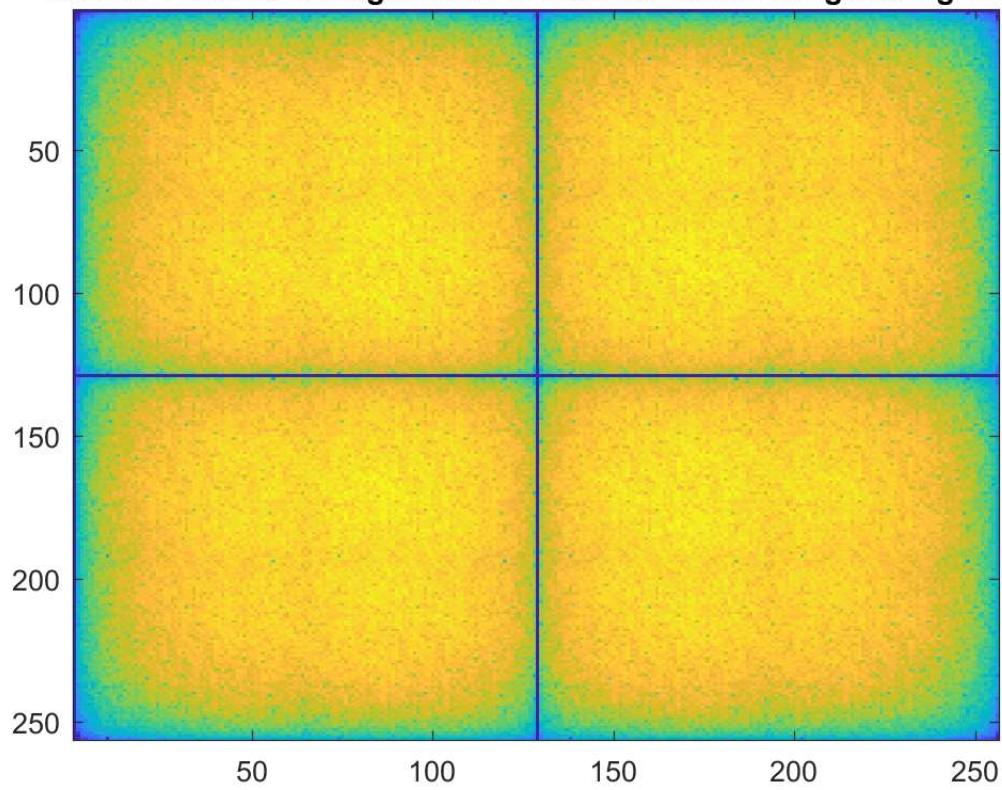
Fourier Transform Magnitude For Reconstructed Image Using CV2



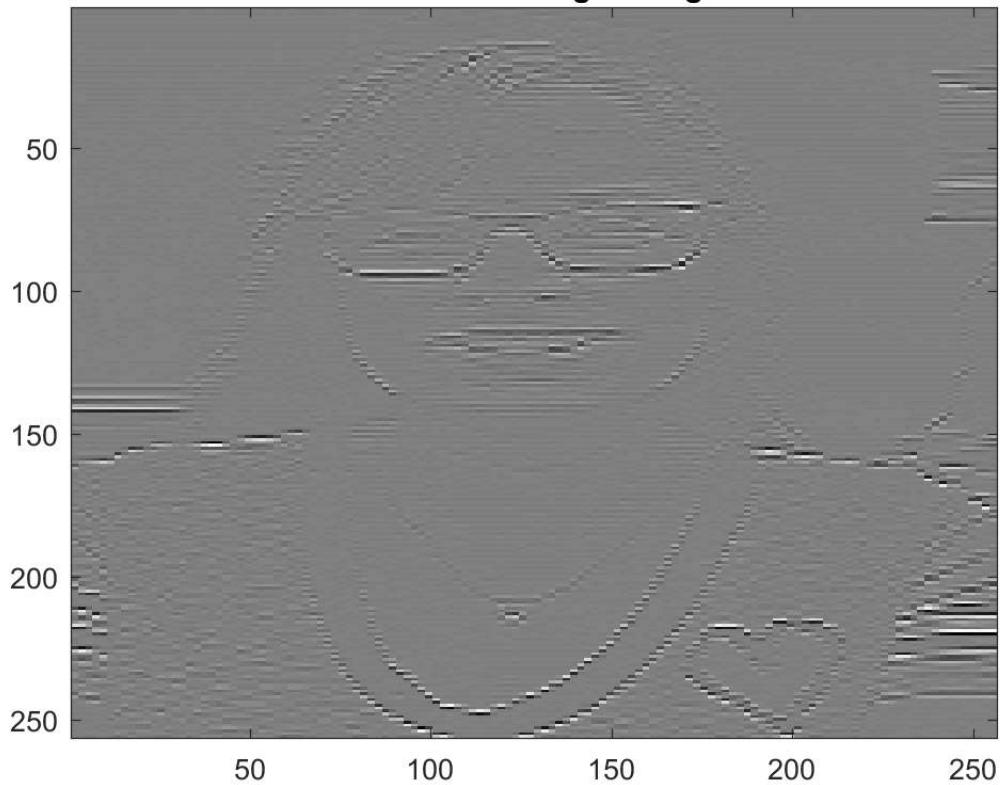
Reconstructed Image Using CD2



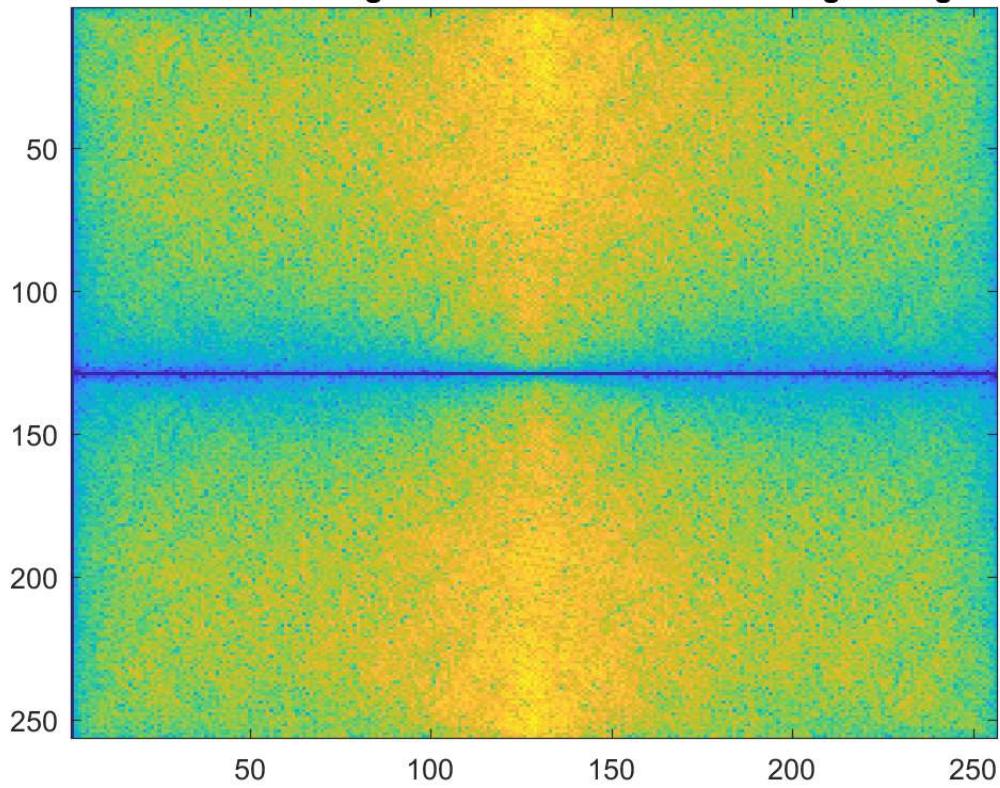
Fourier Transform Magnitude For Reconstructed Image Using CD2



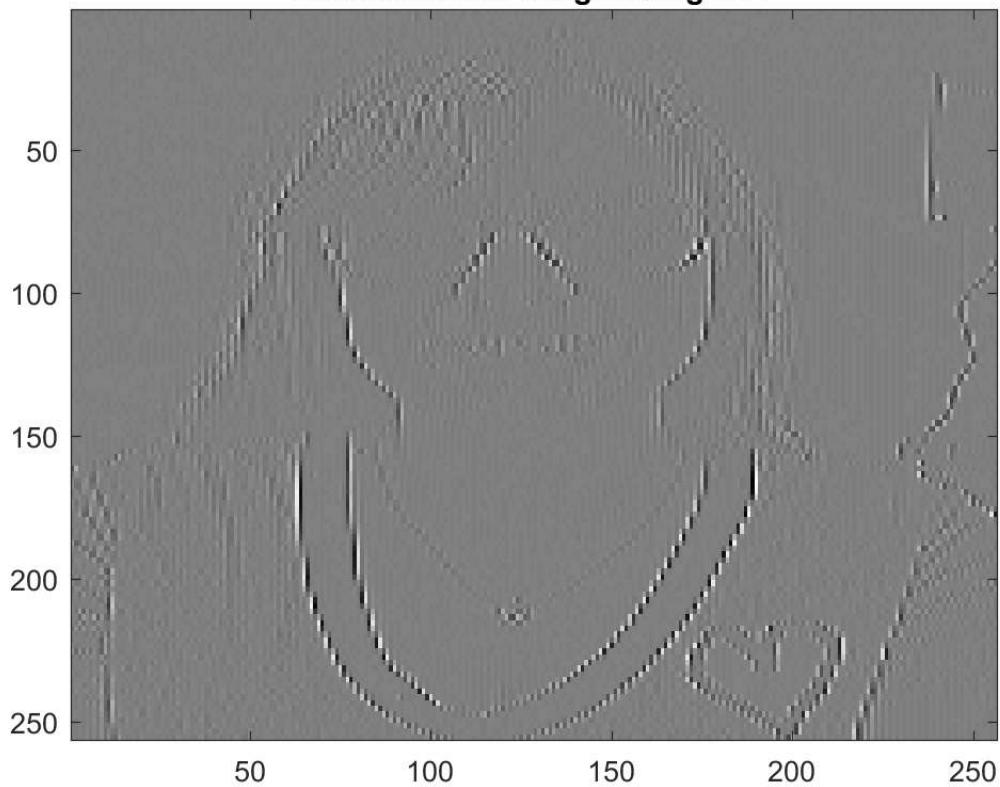
Reconstructed Image Using CH1



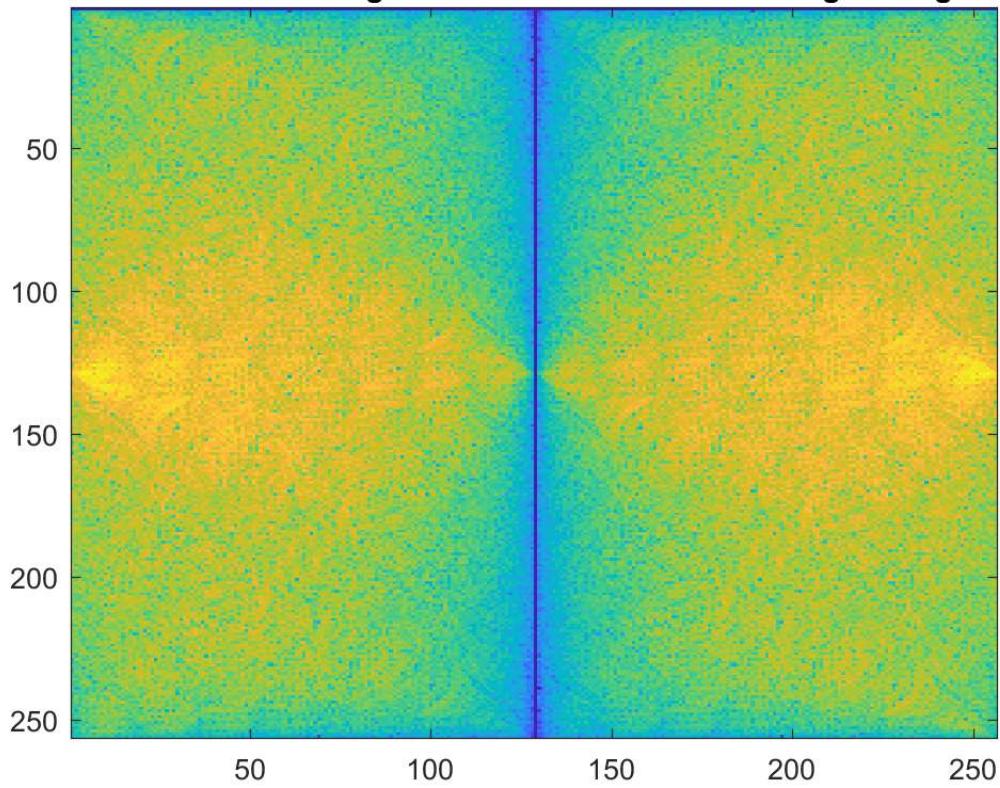
Fourier Transform Magnitude For Reconstructed Image Using CH1



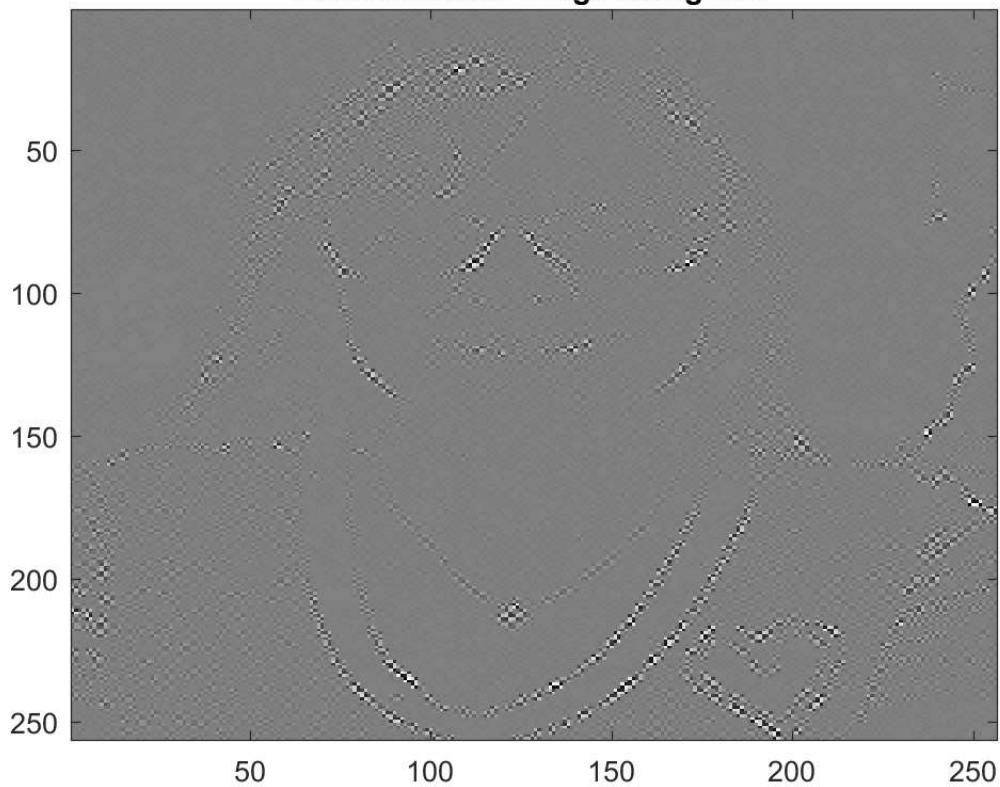
Reconstructed Image Using CV1



Fourier Transform Magnitude For Reconstructed Image Using CV1



Reconstructed Image Using CD1



Fourier Transform Magnitude For Reconstructed Image Using CD1

