Chapter 13 Exercises

Problem 13.2

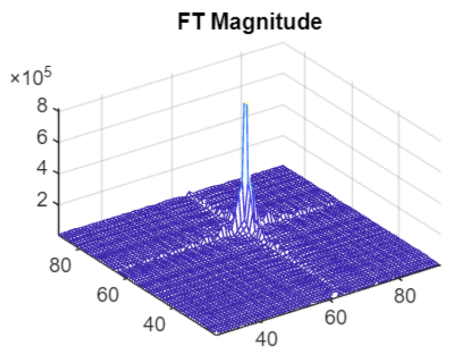
Load double_chirp. Take the Fourier transform and plot as in Problem 13.1. Rather than subtract the mean of the image, simply remove the first point before applying fftshift. Show the original image and use mesh to plot the magnitude of the Fourier transform

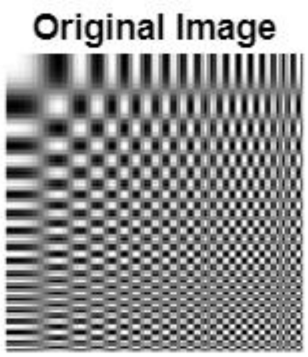
Solution

```
%Matlab code
[I, map] = imread('C:\dev\biomedeng\Associated Files\Chapter
13\double_chirp.tif')


I = I(2:100, 2:100) %Remove the first point


F = fft2(I, 128, 128)%take the Fourier transform


F = fftshift(F)%shift


imshow(I)
title('Original Image')
figure

mesh(abs(F))
title('FT Magnitude')
figure
```

Results

Removing the first point makes





Problem 13.4

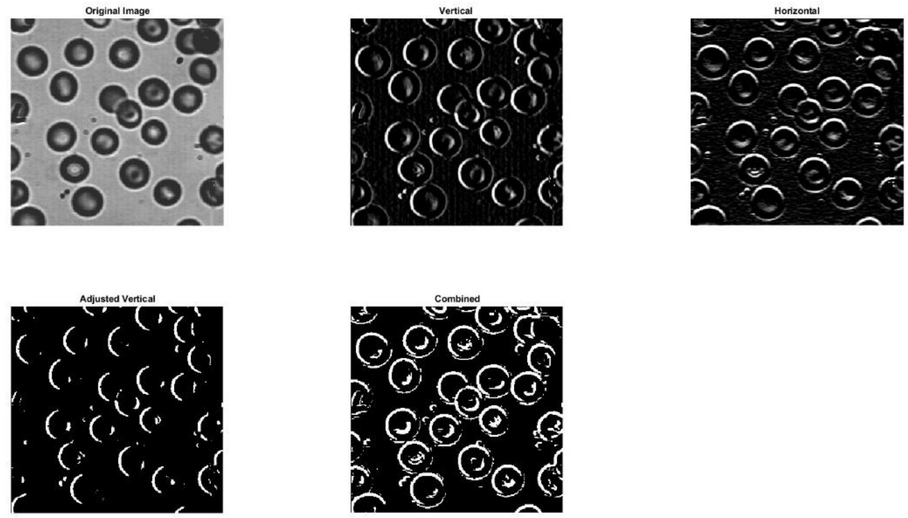
Load the blood.tif image and apply both vertical and horizontal edge detection filters to turn edges from dark to light. Combine the filters and apply to the image. Adjust the intensity of the vertical filter to improve the edge detection. Display all the images in a plot. In another plot the magnitude spectrum of the horizontal and vertical filters.

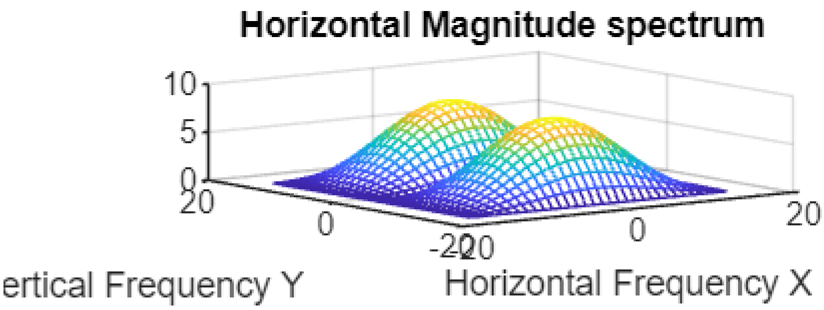
Solution

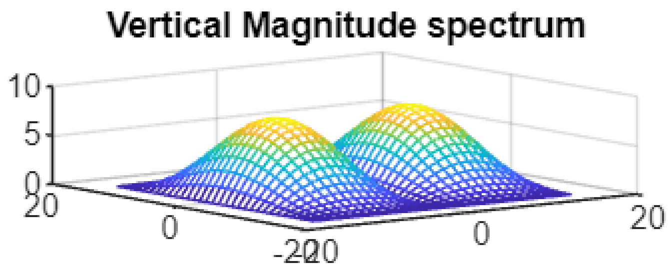
```
[I, map] = imread('C:\dev\biomedeng\Associated Files\Chapter 13\blood1.tif')

b_s = [1 2 1;0 0 0;-1 -2 -1]; %3x3 Horizontal edge filter

I_s_h = imfilter(I, b_s)
I_s_v = imfilter(I, b_s')

I_s_c = imbinarize(I_s_h) | imbinarize(I_s_v)%combined

I_s_v_bin = imbinarize(I_s_v, 0.5)%Convert the vertical to binary and adjust
subplot(2,3,1);
imshow(I)
title('Original Image')

subplot(2, 3, 2)
imshow(I_s_v)
title('Vertical ')

subplot(2, 3, 3)
imshow(I_s_h)
title('Horizontal')

subplot(2, 3, 4)
imshow(I_s_v_bin)
title('Adjusted Vertical')

subplot(2, 3, 5)
imshow(I_s_c)
title('Combined')
figure;

subplot(2, 1, 1)
F = fftshift(abs(fft2(b_s, 32, 32)));%FT of the combined filter
mesh (-16:15,-16:15,F);
title('Horizontal Magnitude spectrum')
xlabel('Horizontal Frequency X')
ylabel('Vertical Frequency Y')

subplot(2, 1, 2)
F = fftshift(abs(fft2(b_s', 32, 32)));%FT of the combined filter
mesh (-16:15,-16:15,F);
```

```
title('Vertical Magnitude spectrum')
```

Results







Problem 13.6

Load blur_brain image and apply an unsharp-filter using the fspecial function. Do this twice and plot the results. Additionally, plot the magnitude spectrum of the filter and note its propertires.

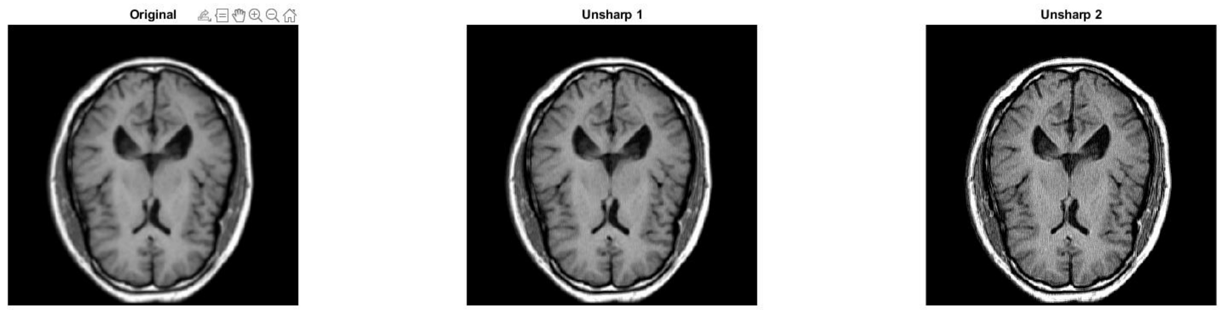
Solution

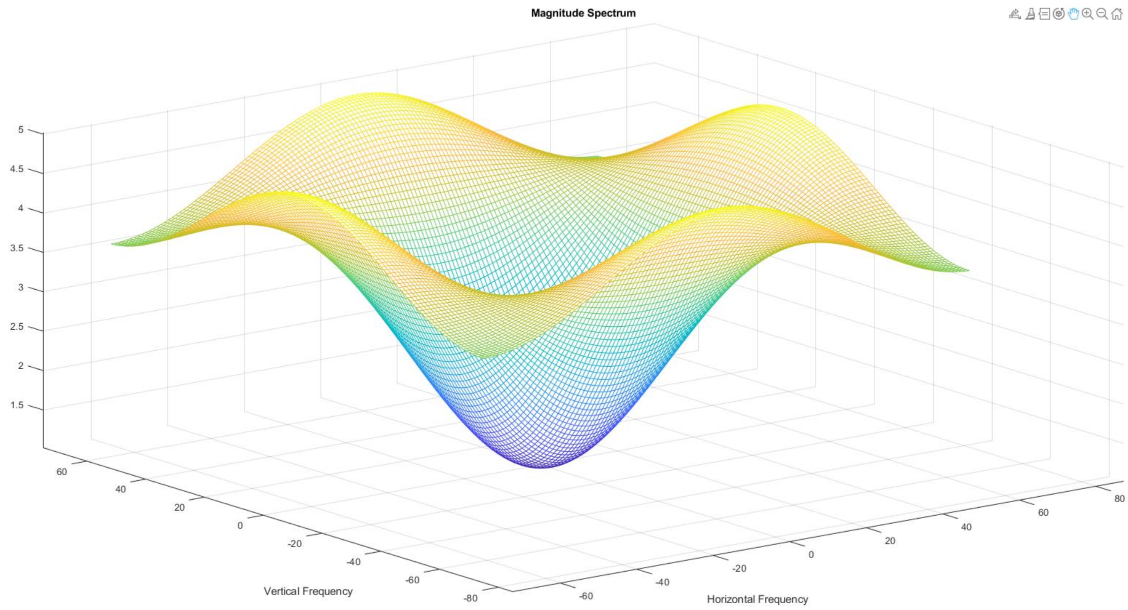
```
[I, map] = imread('C:\dev\biomedeng\Associated Files\Chapter 
13\blur_brain.tif')

b = fspecial('unsharp')%filter

I2 = imfilter(I, b)%first filtering

I3 = imfilter(I2, b)%second filtering
```

```
[H, fx, fy] = freqz2(b, 128, 128);

subplot(2, 3, 1)
imshow(I)
title('Original')

subplot(2,3,2)
imshow(I2)
title('Unsharp 1')

subplot(2,3,3)
imshow(I3)
title('Unsharp 2')

subplot(1,1,1)
F = fftshift(abs(fft2(b, 128, 128)))
mesh(-64:63, -64:63, F)

title('Magnitude Spectrum')

xlabel('Horizontal Frequency'); ylabel('Vertical Frequency')
```

Results

The image is progressively sharpened, the second iteration is a lot sharper than the first. The magnitude spectrum correctly displays highpass filter qualities, note the middle of the axes is 0.





Problem 13.8

Load the noise_brain2 image. Apply a gaussian filter to reduce the noise. Minimize the loss of sharpness. Plot both the original and filtered images.

Solution

```
[I, map] = imread('C:\dev\biomedeng\Associated Files\Chapter 13\noise_brain2.tif')


b = fspecial('gaussian', 4, 2)


I2 = imfilter(I, b)


subplot(1,2,1)
imshow(I)
title( 'Original')
```

```
subplot(1,2,2)
imshow(I2)
title('Filtered')
```

Results

To minimize loss of sharpness the hsize of the guassian filter was set to 4 with 2 sigma. Increasing the hsize drastically increases the loss of sharpness. A sigma lower than 0.5 drastically decreases the noise reduction.