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

A graph of a graph showing a graph

Description automatically generated with medium confidence A black and white image

Description automatically generated

# 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

A close-up of several circles

Description automatically generatedA diagram of a spectrum

Description automatically generated with medium confidence

# 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.

## A close-up of a brain scan Description automatically generated

A colorful lines on a graph

Description automatically generated

# 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.

A close-up of a brain scan

Description automatically generated