影像處理導論 HW3

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Project goal

According to the DFT property of *Laplacian*, it appears we may implement Laplacian operation by designing a digital filter with frequency response $H(u,v) = K(u2+v2)$ where K is a scaling factor to make the magnitude of$H(u,v)$ in the range [0, 1]. Use this frequency domain scheme to find the Laplacian image for the bird image.

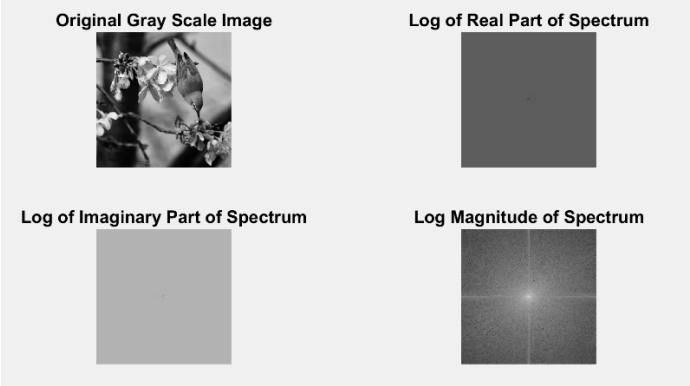
1. Figures of the Fourier magnitude (using log scale after centering) and phase spectrum (after centering)

   在做 Fourier magnitude 時，我先將原始圖的 gray scale 作 padding，然後再用 fft 的 function 後 shift 移至中心，

註:

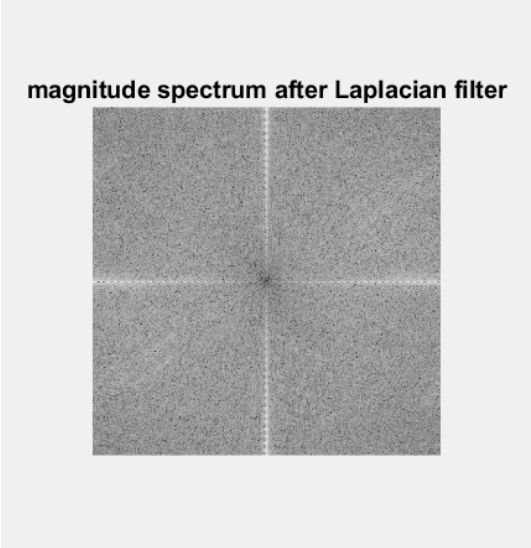
Y = fftshift(X)通過將零頻分量移動到數組中心，重新排列傅里葉變換 X。

- 如果 X 是向量，則 fftshift 會將 X 的左右兩半部分進行交換。
- 如果 X 是矩陣，則 fftshift 會將 X 的第一象限與第三象限交換，將第二象限與第四象限交換。
- 如果 X 是多維數組，則 fftshift 會沿每個維度交換 X 的半空間。



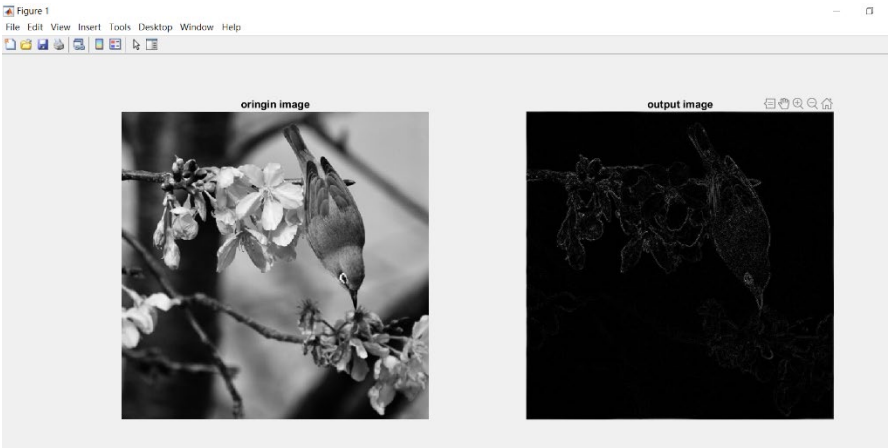
2. Figures of the Fourier magnitude spectra of the *bird* image after applying Laplacian filtering

此處



3. Figure of the Fourier magnitude of Laplacian filter $H(u,v)$

4. Figure of the output image



5. Table of top 25 DFT frequencies (u,v) after Laplacian filtering

	frequency	u	v
1	33336.1947662107	512	3
2	33336.1947662107	512	1021
1	32977.2262149754	512	1
4	32977.2262149754	512	1023
5	32621.7622137203	512	7
6	32621.7622137203	512	1017
7	31957.4559552902	512	13
8	31957.4559552902	512	1011
9	31538.1146104059	512	9
10	31538.1146104059	512	1015
11	31315.4941806038	512	17
12	31315.4941806038	512	1007
13	31310.6466979876	512	11
14	31310.6466979876	512	1013
15	31228.9218102309	512	5
16	31228.9218102309	512	1019
17	30931.8379418139	512	15
18	30931.8379418139	512	1009
19	30719.8540104983	512	21
20	30719.8540104983	512	1003
21	30561.3730992668	512	23
22	30561.3730992668	512	1001
23	30530.8588578354	512	27
24	30530.8588578354	512	997
25	30142.3727544918	512	19

Source codes

本次實驗使用 Matlab 軟體分析(含註解)

```
% 2D Laplacian Demo
clc;      % Clear the command window.
close all;   % Close all figures (except those of imtool.)
imtool close all;   % Close all imtool figures.
clear;   % Erase all existing variables.
workspace;   % Make sure the workspace panel is showing.

% Read in image.
grayImage = imread('Bird 1.tif');
[rows columns numberOfColorChannels] = size(grayImage);
if numberOfColorChannels > 1
    grayImage = rgb2gray(grayImage);
end
%%Process   2D DFT to origin image
fft_inti_img = fftshift(fft2(grayImage, 1024, 1024));

% Figures of the Fourier magnitude spectra of the bird image
%after applying Laplacian filtering
%1024*1024*2 = 2097152, 512*512*2 = 524288, 256*256*2 =
for u = 0:1023
    for v = 0:1023
        H(u+1, v+1) = ((u-512).^2 + (v-512).^2)/524288;
    end
end
%%process laplacian in frequency   domain
fft_filter_img = fft_inti_img.*H;
abs_filter_img = abs(fft_filter_img);

%Table of top 25 DFT frequencies (u,v) after Laplacian filtering
freq_table = sort(abs_filter_img(:), 'descend');
location = find(abs_filter_img >= freq_table(25));
for i= 1:25
  %location = find(abs_filter_img == freq_table(i));
    data(i, 1) = freq_table(i);
    data(i, 2) = location(i);
    data(i, 3) = mod(location(i),1024)-1;
```

```
    data(i, 4) = fix(location(i)/1024);
end
%inverse fft
img = ifft2(ifftshift(fft_filter_img));
output_img = img(1:512, 1:512);

%Figure of the output image
figure;
subplot(1,2,1), imshow(grayImage), title('oringin image');
subplot(1,2,2), imshow(abs(output_img),[]), title('output image');
figure;
subplot(1,2,1), imshow(H.*255, []), title('magnitude of Laplacian filter');
subplot(1,2,2), imshow(log(1+abs_filter_img), []), title('magnitude spectrum after
Laplacian filter');
```