影像處理導論

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Project goal

Apply For the bird image below, compute the 512×512 DFT and determine the frequencies (u,v) of the largest 25 DFT magnitudes.

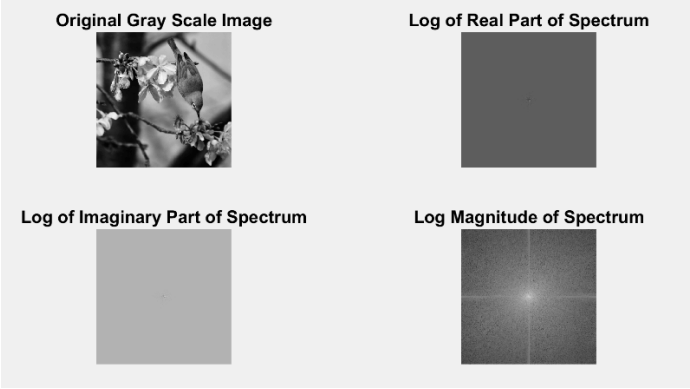
1. Figures of the Fourier magnitude (using log scale after centering) and phase spectrum (after centering)

   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:

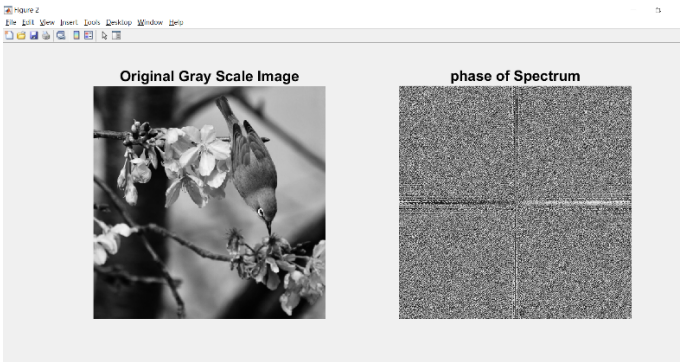
Y = fftshift(X)通過將零頻分量移動到數組中心，重新排列傅里葉變換 X。

- 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 phase spectrum (after centering)

   此處用 angle 的函數取出其相角



3. Table of top 25 DFT frequencies (*u*,*v*)

	frequency	u	v
1	27969071	1	1024
2	19121545.1463803	2	1
1	19121545.1463803	1024	1
4	18778260.6414633	1	2
5	18778260.6414633	1	1024
6	13678309.1126368	2	2
7	13678309.1126368	1024	1024
8	11798906.0349677	2	1024
9	11798906.0349677	1024	2
10	6187170.27831592	1	6
11	6187170.27831592	1	1020
12	5026761.92972146	4	1
13	5026761.92972146	1022	1
14	4463423.53626522	1	5
15	4463423.53626522	1	1021
16	4191128.63013627	2	6
17	4191128.63013627	1024	1020
18	4064473.30463883	4	2
19	4064473.30463883	1022	1024
20	4054158.45883519	1	3
21	4054158.45883519	1	1023
22	3951252.11355008	1024	6
23	3951252.11355008	2	1020
24	3819357.68652558	2	3
25	3819357.68652558	1024	1023

Source codes

本次實驗使用 Matlab 軟體分析(含註解)

```
% 2D DFT 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.
format longg;
format compact;
fontSize = 20;

% Read in image.
grayImage = imread('Bird 1.tif');
[rows columns numberOfColorChannels] = size(grayImage)
if numberOfColorChannels > 1
    grayImage = rgb2gray(grayImage);
end
%zero padding
padding_grayImage=zeros(1024,1024);
for i = 1:1024
    for j = 1:1024
        if i <= 512 && j<= 512
            padding_grayImage(i,j) = grayImage(i,j);
        else
            padding_grayImage(i,j) = 0;
        end
    end
end

% Display original grayscale image.
input_phase=zeros(1024,1024);
input_shiftedFFT=zeros(1024,1024);
subplot(2, 2, 1);
imshow(grayImage)
title('Original Gray Scale Image', 'FontSize', fontSize)

% Perform 2D FFTs
fftOriginal = fft2(double(padding_grayImage));
shiftedFFT = fftshift(fftOriginal);
subplot(2, 2, 2);
scaledFFTr = 255 * mat2gray(real(shiftedFFT));
imshow(log(scaledFFTr), []);
title('Log of Real Part of Spectrum', 'FontSize', fontSize)
subplot(2, 2, 3);
```

```
scaledFFTi = mat2gray(imag(shiftedFFT));
imshow(log(scaledFFTi), []);
title('Log of Imaginary Part of Spectrum', 'FontSize', fontSize)


% Display magnitude of 2D FFTs
subplot(2, 2, 4);
input_magnitude=log(abs(shiftedFFT )+1);
imshow(log(abs(shiftedFFT )),[]);
colormap gray
title('Log Magnitude of Spectrum', 'FontSize', fontSize)
% Enlarge figure to full screen.
set(gcf, 'units','normalized','outerposition',[0 0 1 1]);

% Display phase of 2D FFTs
figure;
subplot(1, 2, 1);
imshow(grayImage)
title('Original Gray Scale Image', 'FontSize', fontSize)
input_phase=angle(shiftedFFT);
subplot(1, 2, 2);
imshow(angle(shiftedFFT),[]);
title('phase of Spectrum', 'FontSize', fontSize)

%count top 25 frequency
top_25_freq=zeros(1,25);
top_25_freq=maxk(abs(fftOriginal(:)),25)
```