影像處理 Image Processing

Homework 3　Image Processing in the Frequency Domain

學號: _____10820109_____　　姓名: _____陳詩云_____

指導教授: 張元翔

I. Introduction

作業的目標是學習和實現頻率域中的影像處理

II. Method

利用傅立葉轉換將時間域影像轉成頻率域的複數平面

透過改變複數平面加入週期性噪聲

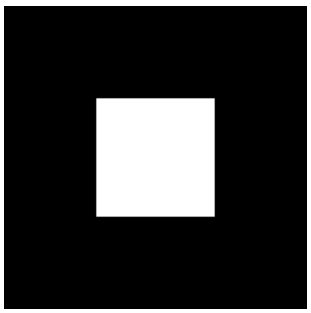
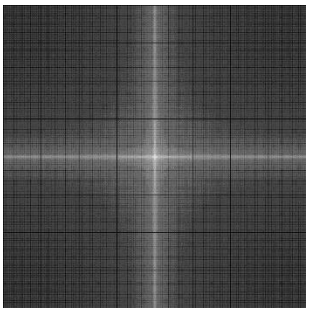
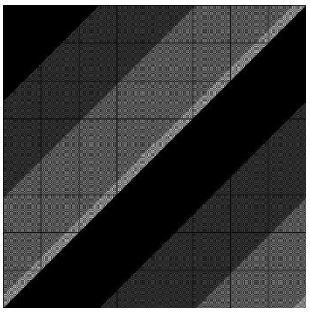
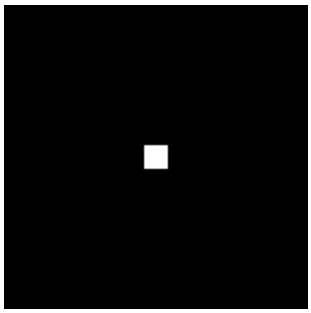
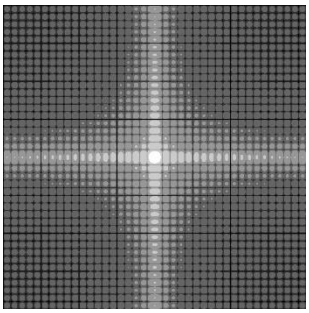
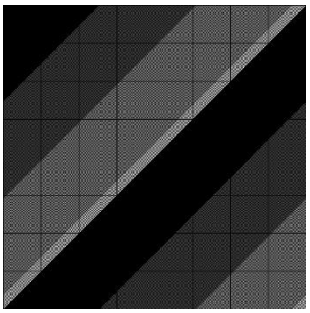
III. Results

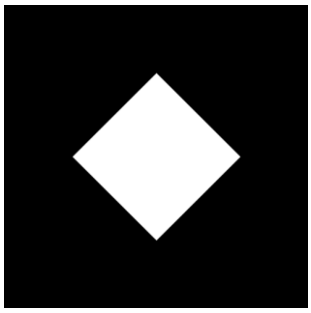
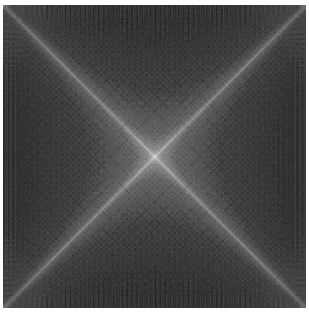
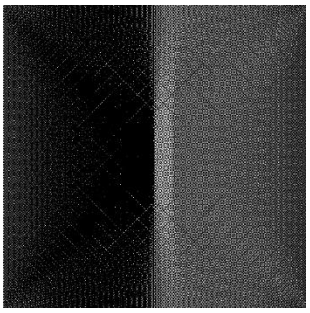
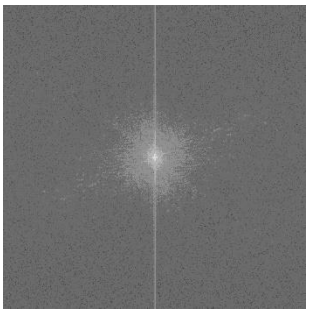
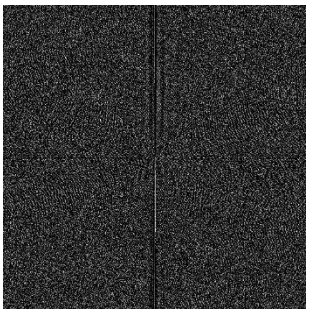
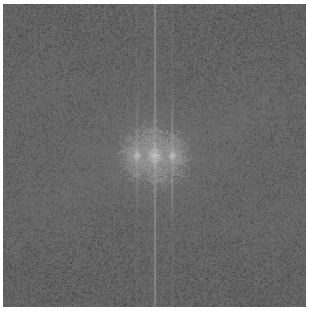
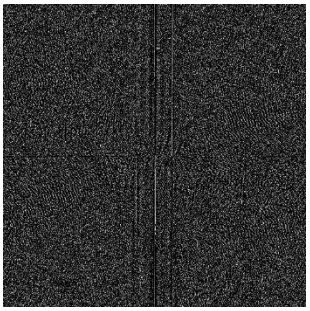
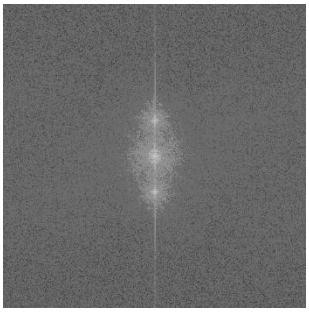
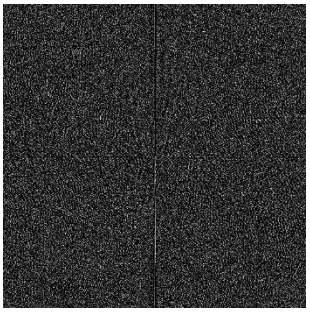
Part I

(1) Block1 和 Block2 影像只有白色區域大小的差別，頻譜相差不大

(2) Block3 的白色區域和 Block1 相比多了旋轉角度，頻譜的角度也會跟著改變

(3) Jenny1 的影像是將 Jenny 和正弦波疊加的結果，因此 Jenny1 的頻譜是由 Jenny 的頻譜和正弦波的頻譜疊加而成

	Original	Log Fourier Spectrum	Phase Spectrum
Block1			
Block2			

Block3			
Jenny			
Jenny1			
Jenny2			

Part II

(1) 右上角和左下角正弦波影像的角度不同，因此產生的噪點不同

(2) 左下角的影像和右下角相比頻率較高，因此產生的噪點較密集

IV. Discussion

Part1

從表格中的結果可以發現:

(1) 影像的大小不會改變頻率空間

(2) 影像旋轉的角度會等於頻率空間的旋轉角度

(3) 影像經過疊加後，疊加後的頻譜會由各影像的頻譜疊加而成

Part2

從表格中的結果可以發現:

(1) 每個影像都是由正弦函數組成，越靠近中心位置頻率越低，因此半徑(D0)越大頻率越大

(2) 頻率越高半徑越大，噪點越密集

VI. Appendix

Python 程式

```
#  影像處理
#  Homework 2 – part1
#  學號: ___10820109_____
#  姓名: ___陳詩云_______
import numpy as np
import cv2
import math
from numpy.fft import fft2, ifft2
import matplotlib.pyplot as plt

img = cv2.imread( "../Resource/Jenny.bmp", -1 )

nr, nc = img.shape[:2]

F = fft2(img)  #離散傅立葉轉換(複數陣列)
F = np.fft.fftshift( F )

G = F.copy()

for x in range( nr ) :
      for y in range( nc ) :
            G[x,y] = math.log(1+abs( F[x,y] ),10)

g = np.zeros( [nr,nc] )
g = np.uint8(np.clip(G,0,255))

G2 = F.copy()

for x in range( nr ) :
      for y in range( nc ) :
            G2[x,y] = math.atan2( F[x,y].imag, F[x,y].real )

g2 = np.zeros( [nr,nc] )
g2 = np.uint8(np.clip(G2,0,255))

plt.subplot(131), plt.imshow(img, 'gray'), plt.title('Original image')
```

```
plt.axis('off')
plt.subplot(132), plt.imshow(g, 'gray'), plt.title('log Fourier spectrum')
plt.axis('off')
plt.subplot(133),plt.imshow(g2, 'gray'), plt.title('phase spectrum')
plt.axis('off')
plt.show()
cv2.destroyAllWindows()
```

Python 程式

```
#  影像處理
#  Homework 2 – part2
#  學號: ___10820109_____
#  姓名: ___陳詩云_______
import cv2
import numpy as np
import math

def SinWaveImg( img, alpha, D0, sita) :
    nr, nc = img.shape[:2]
    m = int(nr/2)
    n = int(nc/2)
    mag = alpha * np.real(img[m,n])
    for i in range (int(360/sita)):
        x = np.int(D0 * math.sin(sita*i/180*np.pi))
        y = np.int(D0 * math.cos(sita*i/180*np.pi))
        img[x+m,y+n] = mag
    return img

img = cv2.imread("../Resource/FutureWorld.bmp", 0)
nr, nc = img.shape[:2]
f = np.fft.fft2(img)
fshift = np.fft.fftshift( f )

sin = SinWaveImg( fshift, 0.1, 100, 90 )

noise = np.fft.ifft2( sin )
out = np.zeros( noise.shape )
out = np.uint8( np.clip(np.real(noise), 0, 255) )
```

```
cv2.imshow("output",out)
cv2.imwrite("Future2.bmp",out)
cv2.waitKey(0)
cv2.destroyAllWindows()
```