

CS270 Digital Image processing

Homework 3: Frequency Domain Filtering

Due date: Nov 8th, 2018

作业结果提交纸质版，课堂提交或送至信息学院 2 号楼 302G 办公室（请务必同时在名单上签名）

程序代码每题一个文件夹，请加入注释，最后压缩打包发送至助教陈宏宇邮箱：chenhy3@shanghaitech.edu.cn。请在邮件和附件的标题中注明姓名和学号。

1. Image resize and resampling

Please resize the image "Test1.mat"



- 1) Reduce the image to 25% of its original size by pixel deletion.
- 2) Blur the image with 3*3 averaging filter before resize, and then reduce the image to 25% of its original size.

Compare the two reduced images and comment on the use of average filter.

- 3) Zoom the image of 1) to 400% of its size by pixel replication
- 4) Zoom the image of 1) to 400% of its size by bilinear interpolation method

Compare the two zoomed images and comment on the interpolation method.

2. Frequency domain filtering

Enhance the blurred image by applying a IHPF, BHPF, GHPF in the frequency domain and Laplacian filter in the spatial domain.

Note: the equation as below should be implemented when filters are applied

$$g(x, y) = f(x, y) + c[\nabla^2 f(x, y)]$$

Let $c=1$, cutoff frequency is 50, $n=2$ for BHPF,

1. In figure(1)
 - 1) Display the original image f in `subplot(3,2,1)`
 - 2) Apply a 3*3 spatial Laplacian operator and display the filtered in `subplot(3,2,3)`.
 - 3) Apply the IHPF and display the filtered in `subplot(3,2,4)`.
 - 4) Apply the BHPF and display the filtered in `subplot(3,2,5)`.
 - 5) Apply the GHPF and display the filtered in `subplot(3,2,6)`.
2. In figure(2), repeat Part 1 with cutoff frequency of 100.
3. In figure(3), repeat Part 1 with cutoff frequency of 150.
Comment on the influence of the cutoff frequency
4. Choose proper coefficient c for IHPF, BHPF, GHPF respectively, and display the filtered image in subplot as Part 1; Comment on the influence of the coefficient c
5. Please comment on the behaviors of the four sharpening filters (Spatial Laplacian, IHPF, BHPF and GHPF)

Hint: You can design $D(u, v)$ in frequency domain as follows:

```
>> [k1,k2]=meshgrid(0:P-1);
```

```
>> D(u,v)=(u-P/2).^2+(v-P/2).^2;
```

For frequency filter H , the filtered image g is:

```
>> g = ifft2(fft2(f,P,P) .* fftshift(H));
```

3. Water mark recovery

A secret message is hidden in the original image. The DCT coefficients of the hidden image were aligned to a row, scaled by 0.01 and added to the highest DCT coefficients of the **ORIGINAL IMAGE**. The hidden message is a 106x312 image. Please find out the hidden message

- 1) Please list the steps of the processing.
- 2) Show the hidden image

Original image (“I_org.mat”)



Image with hidden message (“I_logo.mat”)

