Lab 2-2

Bioimage Processing – image filtering

1. Image Filtering

a. Basic Low pass/ High pass filtering

We start with the construction of blurring image by using an average filter.
The difference equation is: y[i,j] = 0.5(x[i,j]+x[i,j-1]) which is similar to the 2-point moving average filter y[n]= 0.5(x[n]+x[n-1]) we have studied before. The impulse response h[n]= $0.5\delta[n] + 0.5\delta[n-1]$

```
clear;
clc;
load('d:/imgBio/blood.mat'); % you can use whos to view the loaded
variable
% h=1/10*ones(1,10); %10 point-moving average
h=[0.5,0.5]; % 2 point-moving average
y =conv2(B,h);
imshow(y,[0 255]);
```

Q1: If you change the number of points for moving average, what happened to the image?

If we change the difference equation to y[i,j]= x[i,j]-x[i,j-1], the impulse response h[n] is changed to h[n]= $\delta[n] - \delta[n-1]$

```
clear;
clc;
load('d:/imgBio/blood.mat');
h=[1,-1];
y =conv2(B,h);
imshow(y,[0 255]);
```

Q2: What is the characteristic of the image after applying “linear different” filter?

We have learned from the previous section that the result of processed image depends on the value of impulse response. The following section will introduce other type of “patterns” for impulse response that can be used in image filtering.

b. Gaussian Filtering

A Gaussian blur (also known as Gaussian smoothing) is the result of blurring an image by a Gaussian function (named after mathematician and scientist Carl Friedrich Gauss). It is a widely used effect in graphics software, typically to reduce image noise and reduce detail.

```
clear;
clc;
load('blood.mat');
subplot(1,2,1); % divide the image to panels for displaying multiple
image
imshow(B)
sd=2;
y = imgaussfilt(B, sd);
subplot(1,2,2);
imshow(y,[0 255]);
```

Q3: what happen to the image after applying Gaussian filter? What is the effect of variable “sd” in Gaussian blurring?

c. Median filtering

The Median Filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise.

medfilt2 function performs median filtering of the image I in two dimensions. Each output pixel contains the median value in a 3-by-3 neighborhood around the corresponding pixel in the input image.

```
clear;
clc;
load('saltpep.mat');
subplot(1,2,1); % divide the image to panels for displaying multiple
image
imshow(B)
y = medfilt2(B);
subplot(1,2,2);
imshow(y,[0 255]);
```

d. Edge detection

There are many types of edge detection depend on the “pattern” of impulse response.

```
clear;
clc;

load('circuit.mat');
subplot(2,2,1);  imshow (B);
y1 = edge(B,'prewitt'); % change method to Canny, Sobel
subplot (2,2,2); imshow(y1,[0 1]);

y2 = edge(B,'canny');
subplot (2,2,3); imshow(y2,[0 1]);

y3 = edge(B,'sobel');
subplot (2,2,4); imshow(y3,[0 1]);
```

- Canny edge detection
- Prewitt edge detection
- Sobel edge detection

Q4: what happen to the image after applying different methods of edge?