# LAB 2
# Filtering Image

1. Frequency content of an Image
   Load and display "lena512.mat" and plot the value of the 20th row, the value of the 100th row, the value of the 250th row in the same graph (you can use subplot function). Compare the graph of these 3 rows and answer the following question:
   **Questions**
   a. From the plot of signal from these 3 rows, which one has the highest frequency and which one has the lowest frequency?
   b. Compare the plots of these signals, and explain the characteristic of image having low and high frequency?
   c. From a) and b), what is the meaning of frequency in image?

2. Filtering Image (Blurring)

   *One dimension filtering*
   After we extract a sequence of value for one row from the entire image, we can filter this sequence with a "filter" function. The following are the MATLAB statement for filtering. The following statement is the example of filtering signal of row 200 for image lena512:

   Lab2_1.m

```
clear;
clc;
load('lena512.mat');
show_img(lena512,1,1);
lena20=lena512(200,:);
B=……; % B parameter of filter function
A=……; % A parameter of filter function
y_lena20=filter(B,A,lena20);
subplot(2,1,1)
plot(lena20);
subplot(2,1,2)
plot(y_lena20);
```

   **Questions**
   a. Given the different equation: y[n]=1/6(x[n]+x[n-1]+ x[n-2]+ x[n-3]+ x[n-4]+x[n-5]. What is the impulse response of this system?
   b. Compare the plots of signal lena20 and y_lena20. Observe whether or not the filtered waveform is smoother than the input?
   c. Use "freqz" function to display the magnitude of frequency response of the above system. What kind of filter (lowpass, highpass, bandpass)for this system?

*Two dimension filtering*

In order to filter the entire image, you can use for loop to filter all the rows. This would create a new image made up of the filtered rows:

y[m,n]=1/6(x[m,n]+x[m,n-1]+ x[m,n-2]+ x[m,n-3]+ x[m,n-4]+ x[m,n-5])

However,this image y[m,n] would only be filtered in the horizontal direction. Filtering the columns would require another for loop, and finally you would have the completely filtered image:

yy[m,n]=1/6(y[m,n]+y[m-1,n]+ y[m-2,n]+ y[m-3,n]+ y[m-4,n]+ y[m-5,n])

In this case, the image yy[m, n] has been filtered in both directions by a 6point average.

Fortunately, Matlab has a built-in function conv2 that will do this with a single call. It performs a more general filtering operation than rowcolumn filtering and it will be very helpful in this lab.

For example: To filter the image in the horizontal direction using a 6 point average, we set up a row vector of filter coefficients as:

Lab2_2.m

```
clear;
clc;
load('lena512.mat'); % you can use whos to view the loaded variable
B=[1/6 1/6 1/6 1/6 1/6 1/6];
y_lena=conv2(lena512,B);
show_img(y_lena,1,1);
```

To filter the image in the vertical direction using a 6 point average, we set up a column vector of filter coefficients as:

Lab2_3.m

```
clear;
clc;
load('lena512.mat'); % you can use whos to view the loaded variable
B=[1/6 1/6 1/6 1/6 1/6 1/6]'; transpose to make B be a column vector
y_lena=conv2(lena512,B);
show_img(y_lena,1,1);
```

**Questions**

a. Compare the output image from lab3_4.m, lab3_5.m, and the original image, what are differences?
b. Read help of “conv2” function, and implement the code that performs both horizontal and vertical filtering using the 6 point average method.
c. What happen to the output image if we increase the number of point average of the impulse response?
d. Why you can blur the image by using a point average filtering?

3. Edge of image

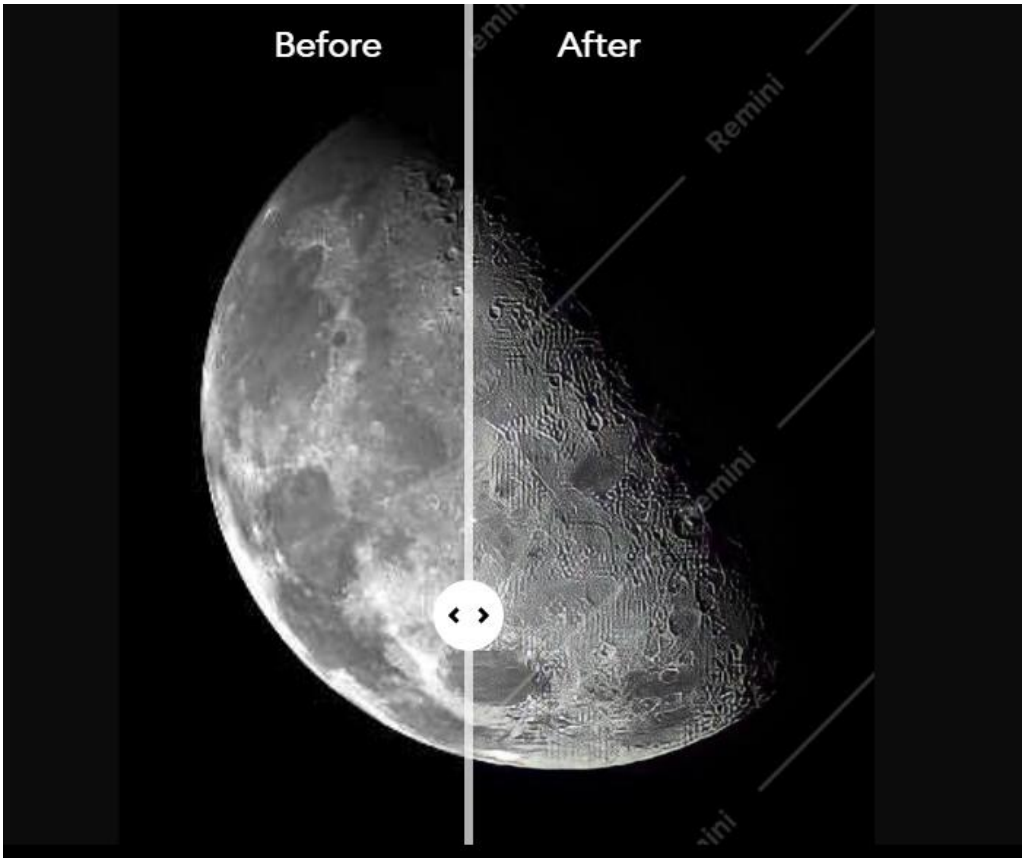
   The concept of edge detection is the extraction of the difference between two concatenated pixels. One of the methods is evaluating the gradients generated along two orthogonal directions. An edge is judged present if the gradient of the image exceeds our defined threshold value, t = T. The gradient can be computed as the derivatives along both orthogonal axes.

   **Questions**

   a) From the study of one-dimension image filtering and blurring image, how to extract the edge of the image?
   b) Identify the difference equation and the impulse response for the edge detection filter.
   c) Use the image “echart.mat”, to show the result of edge extraction from the method that you proposed in a)

4. Image sharpening

   The goal of image sharpening is to increase the resolution of the image by enhancing the “detail” of the image.




   a) Explain your idea to do image sharpening?

b) Identify the steps of your proposed image sharpening and identify the difference equation and the impulse response for the sharpening filter.
c) Use the image “moon.mat”, to show the result of edge extraction from the method that you proposed in a)
   * to display the image you can use function imshow