

## Lab 2 - Image Processing EEE330

Report is due **two weeks** from the date of running this lab

### Objectives:

- 1- To master how to use different histogram enhancement techniques.
- 2- To master how to use different spatial filtering techniques.

### Matlab functions:

Check the following *Matlab* functions :

`Imhist, histeq, Imfilter, fspecial, medfilt2`

Hint: read the help about each of the previous functions and any other function you might use. Some Matlab functions have a section describing the *Algorithm(s)* they use; it is worth reading this section.

### Hint:

Divide big task into smaller sub-tasks, and write a function for each sub-task.

While designing your functions try to make them as general as possible, you may need to use them for other tasks in future.

Use **meaningful names** for your functions and their variables, don't use names such as `a`, `aa`, ...

Save all your functions in a folder and include it in the Matlab path

### Tasks:

1. Task 1 (**10'**):

Write a function to measure the Peak Signal to Noise Ratio (*PSNR*) between two gray images ( $im_1$  and  $im_2$ ) in *dB*. For the peak value use 255.

$$PSNR(dB) = 10 \log_{10} \left( \frac{255^2}{mse} \right)$$

Where  $mse$  is the mean square error, and it is evaluated as:

$$mse = \frac{1}{N} \sum_{\forall ri} \sum_{\forall ci} (im_1(ri, ci) - im_2(ri, ci))^2$$

## 2. Task 2 (30'):

Download from ICE the file [lab2-material.zip](#) which includes:

- A monochrome image lenna512.bmp (load it into Matlab as `im`) which will be used as reference.
- Add Gaussian white noise with zero mean and variance 10 to the image `im` and display the noisy image. Name it as `im_wn`.
- Add salt & pepper noise with noise density 10% to the image `im` and display the noisy image. Name it as `im_SP`.
- Load the image `lenna512_low_dynamic_range.bmp` into Matlab as `im_low_dynamic_range`.
- Evaluate the PSNR of the previous images with respect to the reference image `im` and complete the following table:

Image	<code>im_wn</code>	<code>im_SP</code>	<code>im_low_dynamic_range</code>
PSNR (dB)			

Check the histogram of all the previous images, compare them with the histogram of the reference image, comments and **briefly** explain your finding. (If you cannot generate the images of `im_wn` and `im_sp`, you can load them from the [lab2-material.zip](#), but only **20** marks can be got maximally and you should note them in the evaluation of PSNR)

## 3. Task 3 (20'):

Write a function to generate a piece-wise linear mapping transform to enhance the contrast of `im_low_dynamic_range`, verify the effectiveness of several mapping transform in the following terms: **subjectively**, and **objectively** by evaluating the PSNR with respect to the reference image. Include also in your report the best intensity mapping function you obtained.

4. Task 4 (20’):

Write a function of histogram equalization to enhance the contrast of the image `im_low_dynamic_range`. Compare the current result with the one obtained in Task 3. Comment and briefly explain your finding. (If you just use the Matlab command `histeq`, only 10 marks can be got maximally.)

5. Task 5 (20’):

Apply the median filter with a 3X3 window and a 5X5 window on the image `im_SP`. Display and evaluate the PSNR of the obtained images. For each window size, comment on how effectively the noise is reduced while sharp edges and features in the image are preserved.

Use the average filter 3X3 to filter the image `im_SP`. Compute the PSNR and display the filtered image. As you experimented with the mean and median algorithms what different “performance” did you notice? Was the average or median filter better, and why?

## Lab Report

**Write** a **short** report which should contain a **concise description** of your results and observations and explanations. **Include** listings of the **Matlab scripts** that you have written. **Describe each of the images** that you were asked to display.

Submit the report electronically and a hardcopy version into the white collecting box beside the office EB310 (Hand written reports are not accepted).

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