M1 E3A international track
Lab 2

Image and signal processing - M1 E3A - UEVE/UPSay

Spatial filtering

Exercise 1 : Generate a noisy image

1. On the image of your choice, generate a Gaussian type noise, uniform then salt and pepper using **imnoise**. Vary the density of the noise. Keep these images in reserve to evaluate the low pass filters for the next exercise.

Exercise 2 : Comparaison of spatial low pass filters

Let us define the signal to noise ratio: $SNR = 10log_{10}[\frac{\sum I(x,y)^2}{\sum (I_r(x,y)-I_0(x,y))^2}]$ where $I_r(x,y)$ is the filtered image and $I_0(x,y)$ the image before degradation with noise.

1. Filter the noisy image with a Gaussian filter of size 3×3, 7×7 then 11×11. Chose the variance in relation with n the size of the filter ($n = 6\sigma + 1$).
2. Filter the noisy image with an average filterof size 3×3, 7×7 then 11×11. Compare with Gaussian filters of same sizes.
3. Filter the noisy image with a median filter of size 3×3, 7×7 then 11×11. Compare with the previous filters.

Exercise 3 : Spatial High pass filters

1. Calculate the modulus is the orientation of the gradient using a Sobel filter on the image of your choice. Comment.
2. Convolve the image with a Laplacian 3×3. Determine zero crossings.
3. Convolve the image with a LOG then a DOG of size 5×5 suitably generated. Plot the profiles of the two filters. Determine zero crossings.

Image enhancement

Exercise 4 : Simple enhancement using histograms

1. Load these images: cameraman, kids, pout and flowers (**imread** then **imshow**). Change the colormaps using matlab colormaps Matlab (PINK, HSV, GRAY, HOT, COOL, BONE, COPPER , FLAG).
2. Display pixel values and corresponding values in the colormap in a small neighborhood (**imtool**). Focus on homogeneous regions. Conclude.
3. Compare the characteristics of these images using imfinfo: format, resolution, dynamics. Note for each image the mean, the variance as well as the min and max values. Make a link between these values and the visual quality of the images.
4. Calculate and display the histogram of each of the images. Make a link between the histogram and the content of the images when possible.

5. In order to improve contrast, apply a point function to the image: linear, exponential then logarithmic. Explain the role of each function and configure them appropriately. Apply them to the images that are best suited to each function. Compare the histograms before and after application of each function.
6. Compare previous fonctions with histogram equalization (**histeq**).
7. Use the histogram to find the best threshold for the coins, blood1 and rice images. Do the same with an image of your choice.
8. Compare the adaptive thresholding method (to be implemented) with Otsu's method (**graythresh**) on the previous images and on the image of your choice. Carefully keep the binary images obtained for the following exercise.

Segmentation

Exercise 5 : Highlighting zones

1. On the previous thresholded images (you will choose the best result obtained), apply a labeling in connected components (blob coloring) (**bwlabel** then **label2rgb**).
2. Compare 4-connected labeling with 8-connected labeling.
3. Find a simple way to calculate the area in pixels of labeled objects.
4. Perform edge detection (as in Exercise 3) starting from the labeled image. What do you deduce from this?