Digital Image Processing & Pattern Recognition
UPEC - Optics, Image, Vision and Multimedia

1. Histogram

1.1. Moments

Compute the mean and standard deviation values of an image using *mean2* and *std2*. Compute the median value using *median*.

1.2. Vizualization

Using the image *chro*, *imhist* permits to visualize its histogram. Change the number of bins to 64 and 16 and see the differences.
Use *cumsum* to create its cumulative histogram. Use plot or bar to display it. How to use the cumulative histogram to obtain the median value? If wanted, try to obtain it using *find* and *max* for example directly from the cumulative histogram.
Rotate the image with an angle of 90° using *rotate* function, is the histogram modified? Modify your image with *imcomplement* and see the influence on the histogram, what is the rule of this function?

1.3. Histogram stretching

Implement your own algorithm to realize histogram stretching. Compare with the results obtained directly using *skimage*, with and without specifying output interval.

1.4. Histogram equalization

Using the function *exposure.equalize_hist* from the *skimage* library, operate all the images *'elaine*'*, and comment the results. Influence on the mean and standard deviations values.
Then considering the images *'neck'* and *'covering'*, is your conclusion similar after equalizing?
For the color image '*rocks'*, equalize the R, G and B images separately as previously and convert the images back to jpg format. Comments? What about '*umbrella"*?

2. Thresholding

2.1. Manual setting

Considering the image '*gdr'*, try to binarize it using *the correct function*. Try different values: is there any adapted threshold to isolate each object? Same question with *'objects'*.
What is the default value if there is no specification of the level using *im2bw*?

2.2. Otsu's method

Taking all the graylevel images ('*gdr', 'objects', 'bacteria', 'cell', 'chro', 'gear-wheel', 'fibers', 'fibers2', 'I10', 'I12'*): test the Otsu's automatic thresholding method (*graythreshhold* + *binary*). Analyze the efficiency of the results considering the shape of the histograms. And imagine the images where the binary image seems operated…

2.3. Histogram stretching influence

Try to segment this modified image using your own algorithm for stretching (paragraph 1.3) and its original version using Otsu's method. Do not only compare the value but the result images. Are the comments identical using histogram equalization to modify the image?

2.4. Color images

Considering the image '*pills2'*, write an image processing algorithm that measures the surface area of the green pills in pixels. The pills pixels must be isolated as white pixels while the rest of the image must be colored in black. If necessary, use the hue from the hsv transform to better isolate the green color. The function is *rgb2hsv* in Matlab, you can use *skimage.color.rgb2hsv* from the *skimage* library.

What kind of information should be needed to be able to estimate the size of each pill surface in square millimeters?

3. Labeling

3.1. From now on, we would like to count the number of objects automatically, using the connected component analysis method. Taking the image '*chro'*, how to know the number of objects? Try to visualize the labeled image using directly *imshow*. Try to show it more distinctively with the map jet and a black background using the label2rgb function.

3.2. Try to automatically count the number of differences between previous images '*original'* and '*original2'*.