TD: Image enhancement

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UE "Image and signal processing", Upsay / UEVE

Exercise 1 : Histogram equalization (from Gonzales et Woods)

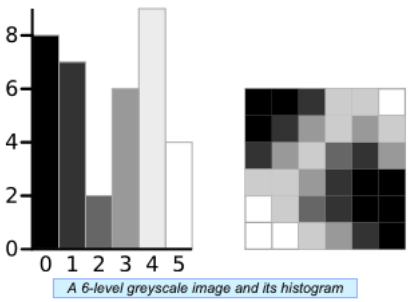
Let be the histogram of an image of size 64×64 coded according to 8 classes also distributed between 0 and 1 according to the following figure:

Class	0	1	2	3	4	5	6	7
Level	0	1/7	2/7	3/7	4/7	5/7	6/7	1
Number of occurrences	790	1023	850	656	329	245	122	81

1. Calculate the probability of each class and plot the normalized histogram (probability density function) before equalization.
2. Calculate the cumulative distribution function.
3. Apply the equalization algorithm. Deduce the classes that were merged.
4. Plot the new probability density function.
5. Plot the new cumulative distribution function, compare it with that of an equally likely histogram.
6. Is the new histogram flat?

Exercise 2 : Thresholding using Otsu method

1. Consider the histogram below. What is the number of bits necessary for the encoding of the image? Find the dynamic range as well as the average of the gray levels of the image from the histogram.



A 6-level greyscale image and its histogram

0	0	1	4	4	5
0	1	3	4	3	4
1	3	4	2	1	3
4	4	3	1	0	0
5	4	2	1	0	0
5	5	4	3	1	0

2. In the so-called Otsu thresholding method, the optimal threshold is that which maximizes the inter-class variance. We then consider two classes (regions) in the image: the background and the object (foreground). The goal is to find the threshold that allows the best separation. Complete the table below and find the optimal threshold.

k	0	1	2	3	4	5
$P_1(k)$						
$P_2(k)$						
$m_1(k)$						
$m_2(k)$						
σ_B^2						

Exercise 3 : Region growing

2	16	14	16	14	4	14	12
14	15	13	15	12	15	13	15
16	16	13	21	22	21	22	13
14	17	21	22	24	23	23	13
7	16	21	22	30	23	27	13
16	16	20	22	7	24	12	16
17	15	16	20	22	22	13	15
14	17	13	13	13	18	12	14
14	15	17	15	14	15	14	15

1. Achieve the 4-connected region growing of the image considering as the starting point the point (x = 5, y = 4) and a threshold of 4.
2. Carry out growth with the point (4,3) with first a threshold of 2 then a threshold of 6.

Exercise 4 : Blob coloring

1. Carry out a a connected component labeling using 4-connected neighbors then 8-connected neighbors of the image below. Compare and conclude.

1	1	1	0	1	1	0	1
1	1	0	1	1	0	1	1
1	0	1	1	0	1	1	1
1	1	1	0	1	1	1	1
0	0	0	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1