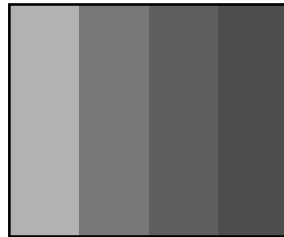


Exercises for Image Processing 1 - WiSe 2012/13

Exercise 4

1. An image of size 512 x 512 pixel is shown with 4 rectangular stripes of equal size having grayvalues 50, 100, 150, 200 (s. drawing).
 - a) Which grayvalues do the stripes have after Histogram equalization?
 - b) Describe the optical effect.
 - c) What happens when using grayvalues 20, 40, 60, 80 instead of the initial ones?
 - d) Implement a method for histogram equalization and verify your results. (4 Points)



2. Show that the empirical Variance σ^2 of the grayvalues g of an image is given by:

$$\sigma^2 = 1/N \sum g^2 - (1/N \sum g)^2$$

(2 Points)

3. Given the weighted sum z of N independent random variables x_i

$$z = \sum w_i x_i$$

where the x_i have mean value m and variance σ^2 , and where the weights sum up to 1, what is the mean value and the variance of z ? How do the weights have to be chosen such that the variance is minimized for fixed N ? Try to find an optimal set of weights for $N=4$. Test at least 5 different sets of weights. Alternatively, derive analytically the optimal set of weights for arbitrary N . (3 Points)

4. When isolated pixels differ more than a certain value R from their neighborhood, this is called "salt and pepper"-noise (dark pixels are pepper and bright pixels are salt). In the image TV-Testbild-mit-Rauschen.png (1024x768) there are 10000 noise points included with $R=10$. Implement an algorithm for removing the salt-and-pepper-noise in the image by using simple window-operations. Check the correctness by comparing it with the original image Testbild-ohne-Rauschen.png (see online). How many pixels are different when comparing both images? (2 Points)