Week 15 Exercises

Fys-2010

Spring 2019

Exercise 1

The goal of this exercise is to segment objects of a specified color range in a RGB-image. This is done by classifying each RGB-pixel as having a color in this range or not. To make this decision we define a similarity measure D between the RGB-vector $\boldsymbol{a}$ representing the color that we wish to segment ($\boldsymbol{a} = [a_R, a_G, a_B]$, where a_R is the red component, a_G is the green component and a_B is the blue component) and the RGB-vector of the pixel to be examined, $\boldsymbol{z}$:

$$D(\boldsymbol{z}, \boldsymbol{a}) = [(\boldsymbol{z} - \boldsymbol{a})^T C^{-1} (\boldsymbol{z} - \boldsymbol{a})]^{1/2}, \tag{1}$$

where C is the covariance matrix representing the variation of the color that we wish to segment[1]. If D is smaller or equal than some threshold D_0, the pixel is classified as *within* the range.

(a) Download the image from Figure 6.31 (6.30) in the book and select a subregion in one of the strawberries. Based on the pixels in this subregion, compute the mean RGB-vector $\boldsymbol{a}$ and the covariance matrix C.

(b) Segment the strawberries in the image using equation (1) and $\boldsymbol{a}$ and C computed in (a). The segmentation is performed by selecting the values in $D(\boldsymbol{z}, \boldsymbol{a})$ that is below a given threshold D_0. Try using different values of D_0.

Exercise 2

Refer to figure 10.14 (10.14) when answering the following questions.

(a) Assume that the Sobel masks are used to obtain g_x and g_y. Show that in this case the magnitude of the gradient computed using equations 10-17 (10-2.10) and 10-26 (10-2.20) give identical results.

(b) Show that this is true also for the Prewitt masks.

[1] $\boldsymbol{a}$ is obtained by averaging over a set of samples of the color we wish to segment and C is the covariance matrix based on these samples.

Exercise 3

Problems from the book (3rd edition): 10.2, 10.4, 10.5, 10.6 and 10.16
(4th edition): 10.3, 10.6, 10.7, 10.8 and 10.18

Exercise 4

(a) Experiment with edge detection by using the Laplacian of Gaussian (LoG) method (Marr-Hildreth edge detection) on Figure 10.16 (10.22) with different standard deviations/scales. Try also to use different thresholds when finding the zero-crossings.

(b) Experiment with the Canny edge detector method on the same image as in (a).

(c) Perform optimum global thresholding using Otsu's method on the image "blaklokke.jpg". Remember "blaklokke.jpg" can be downloaded from Canvas.