Digital Image Processing, 2017

Exercise 4

C. Melsheimer, G. Spreen

May 5, 2017
submit by 10 May, 12:00

Problem 13:   Segmentation by thresholding

Below is the histogram of a 20-grey-level image of one fruit on a contrasting background. The pixel spacing is 2 mm. Is the fruit a cherry, a grapefruit, or a pumpkin?

[0 101 205 297 500 599 495 303 200 99 201 490 3009 8067 20113 7953 2952 531 110 0]

Problem 14:   Segmentation by edge detection

Suppose you want to segment an image into objects and background and you do this by edge detection: If your edge-detection method works well, it produces an image that just shows the edges, i.e., high pixel values at the boundaries between objects and background, and low pixel values for the interior of the objects and for the background.

How do you decide what is object and what is background? (there might be more than one approach...)

Problem 15:   Template matching

Calculate the normalized cross correlation D_{gf} of the image f

$$
f = \begin{bmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\
0 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 2 & 2 & 2 & 0 & 0 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 \\
0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1
\end{bmatrix}
$$

and the template g

$$g = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

where D_{gf} should be defined as:

$$D_{gf}(u, v) = \frac{\int_A g(x, y) f(x + u, y + v) \mathrm{d}x\mathrm{d}y}{\left[\int_A g^2(x, y)\mathrm{d}x\mathrm{d}y \int_A f^2(x + u, y + v)\mathrm{d}x\mathrm{d}y\right]^{1/2}}$$

and the "integration" is actually just the sum over the domain A covered by the template g.

As we are looking for the maximum of D_{gf}: Give the result as decimal number (do not round to integer values).

a) Where is the maximum value of D_{gf}? Why?

b) What kind of object or structure will this template find?

c) What template do we need to just find short horizontal line segments of fixed length, say, 4 pixels?