Image Processing, assignment 2

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October 17, 2018

1 Comparing images X, Y and Z

Figure 1: Image W

Figure 2: Image X

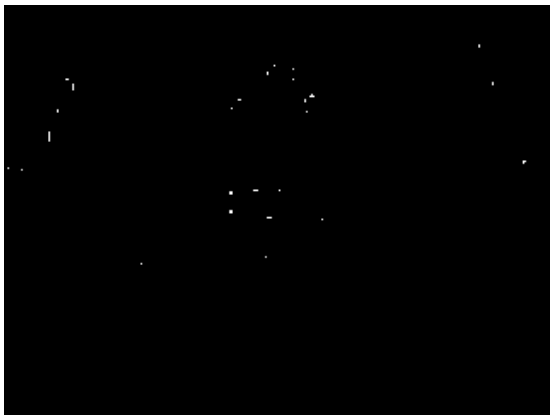

Figure 3: Image Y

Figure 4: Image Z

Image W is the result of applying a Gaussian filter to the 'starting image' of the last assignment, then detecting edges and thresholding to get the most prominent edges. Images X and Y are, respectively, dilation and erosion, using a 3×3 square structuring element. Image Z is the result of applying an AND-function to image X and the complement of image Y. This effectively means that image Z is image X, without the foreground pixels of image Y.

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2 Number of shades using dilation with varying structuring element sizes

In figure 6, the number of distinct shades is plotted against the size of the square structuring element used when Dilating image A. Two things are visible; the graph is going downwards, and it is doing so with decreasing speed. The decrease of the number of distinct shades can be explained by realising that dilation is effectively taking the whitest value of a pixel's neighbourhood. This means that the whitest colours spread and 'overwrite' the darker pixels. The decreasing speed at which the number of distinct shades decreases is caused by the fact that the necessary structuring element size to make a shade disappear is equivalent to the maximum of the distances between each pixel of this shade and its closest darker pixel. Since in most images, similar colours are grouped together, a very large structuring element can be needed to lose a shade altogether. In image A, the right bottom corner, will most likely be converted to the brightest colour last.

Figure 5: Image A

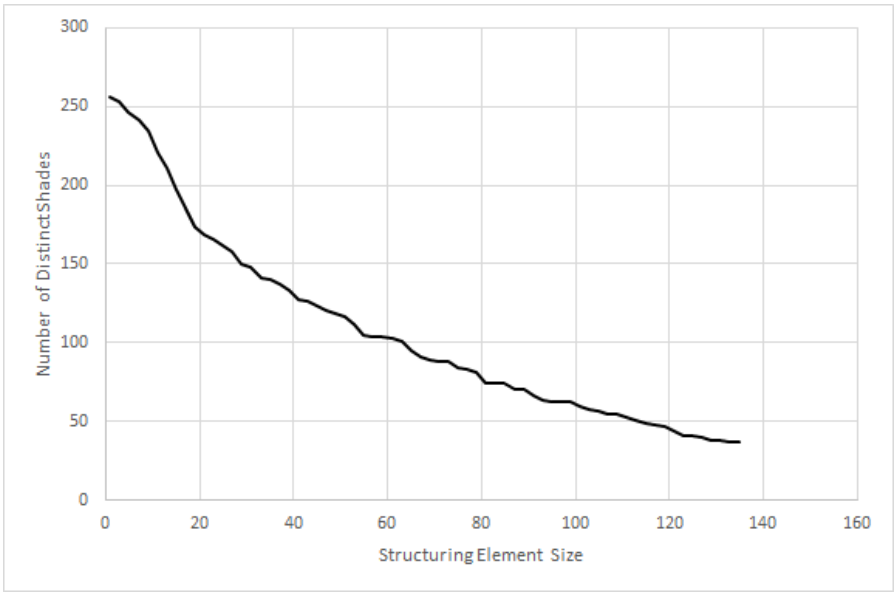

Figure 6: A plot of information explained in the text

3 Comparing Fourier descriptors

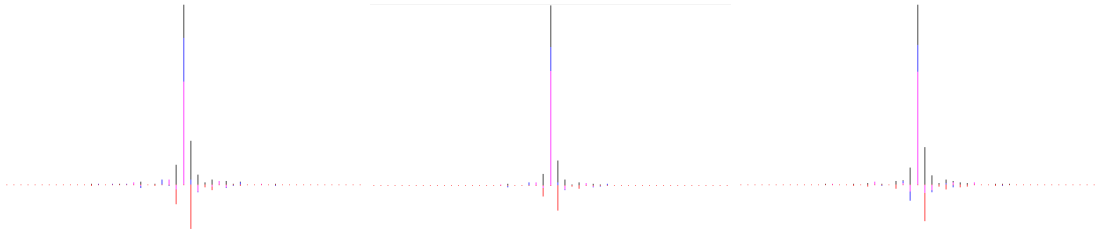

Figure 7: Descriptor of G1 Figure 8: Descriptor of G2 Figure 9: Descriptor of G3

In figures 7 through 9, plots of the Fourier descriptors of images G1 through G3 are visible. The black lines represent the moduli (lengths), the blue lines represent the real parts and the red lines represent the imaginary parts. We left out all but the middle 51 descriptors, as they were not visible anyway. Our expectations predicted that the descriptors of G1 and G2 would look identical, as the lengths of the lines were plotted relative to the longest line, and the only difference between the shapes in images G1 and G2 is their size. We predicted that the argument (angle) of the descriptors would be invariant to resizing of the image. Similarly, we expected G3 to have varying arguments but invariant moduli compared to G2, because G3 is a rotated version of G2. However, we have found no clear connection between the descriptors except for the fact that they look quite similar.

4 Comparison of G1 to its closed version (bonus 2)

Honestly, we can find no logical explanation for difference between the descriptors of G1 and its closed version. Some of the descriptors are changed slightly, but not in a consistent way. We expected a more compact graph as a result of the closed version, because the newly acquired shape is less complex and more round in shape than the original, as it doesn't have most of its original holes and gaps anymore.

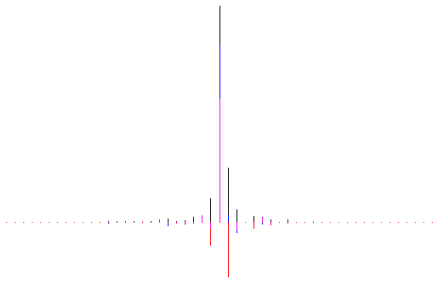

Figure 10: Descriptor of G1 closed

5 Sample density (bonus 3)

A Fourier function was applied to image G1 using every n^{th} pixel in the boundary, with n varying from 1 to 8. However, the Fourier descriptors of these results do not need to be shown here, since they are identical. Again, this is against our prediction. The reconstructions actually look completely different, so we are not sure why the descriptors look identical.

6 Other bonuses

Bonus 1 is implemented. It can be activated by uncommenting the part of the code in line 113 (just like all other functions at the lines above it) and filling in a desired maximum amount of descriptors, or leaving it blank for recreating the original image.
Bonus 4 is implemented as well. It is automatically activated when two images are loaded, and erosion or dilation is activated. It works for both grayscale images and binary images.