CENG466 Programming Homework III

Melike Selin Aydın
1678747

I. Introduction

I implemented an image processing program that remove either the yachts or wharf and breakwaters from three given images using morphological operations. The program is written with a graphical user interface using Matlab and Guide. User selects an input image and a method using the GUI, output image is shown to user.

II. background

Morphology is a technique used in image processing based on set theory. It represent objects as sets. Two main operations are used in morphological image processing; namely, erosion and dilation.

Erosion is to shrink an object by moving a structuring element through its borders. While moving, the points that intersect with the structuring element are removed.

Dilation is the operation of growing an object by moving a structuring element through its borders. While moving, for the points where the intersection of object and the structuring element is not an empty set, the pixels of the structuring element are joined to the object.

Opening is the operation of eroding and then dilating an image with the same structuring element. Closing is vice versa.

III. Methodology

User opens one of the images 'coast1.PNG', 'coast2.PNG' or 'coast3.PNG' and selects one of the methods from the listbox.

I converted all the RGB images to binary ones. I processed them using morphology and used them as masks to paint the necessary locations in the given image.

I used the built-in Matlab function 'im2bw' to convert the images to binary. I only used a threshold of 0.3 for the third picture, since the colors of the sea and the beach are similar. Then with the help of again built-in 'bwconncomp' I extracted the sea and reversed the binary image of the sea because without doing that, the buildings around the sea are affected. I did all latter operations on these sea images.

A. Creating Binary Masks for Removing Wharfs and Breakwaters

After doing the mentioned operations, I eroded the binary files with structuring elements of 'line' and different length and degree values to remove the wharfs. Then used this image as a mask to paint wharfs and breakwaters in color images.

Only for the first image, I followed a different method as there are two breakwaters bigger than almost all the yachts. I used two binary masks, one for removing wharfs and the other for breakwaters. The first one is the wharf-free binary image as mentioned above. To obtain the second one, I got rid of all the wharfs and yachts by eroding the image with different angled line structuring elements consecutively. When the only remaining parts were residuals from the breakwaters, I started dilating with the same structuring elements. Therefore, I obtained an image of the sea with only breakwaters. When I reversed this image, I got my second binary mask. I used both of these masks for the first task.

B. Creating Binary Masks for Removing Yachts

The basic idea for removing yachts was to obtain masks by subtracting wharf-free binary images created for the first task from the sea-extracted ones.

A problem occurred while subtracting. Since the parts where the houses reside appear white in the binary images, after the result of subtraction those areas also became black and as a result they would be painted in the output images. To solve this, I created another binary image with just the house parts white for each input by opening the sea-extracted images with big disk structuring elements. So I got rid of all the objects in the sea and left only with shore. I added this image to the subtracted one to obtain binary mask to remove yachts.

C. Filtering with Binary Masks

I wrote a function that masks images by painting the black areas to a specific color and leaving the areas that appear white in the mask. Since the sea always appear black in binary images and all the yachts and wharfs and breakwaters somewhere between [100,100,100] and [255, 255, 255], I checked whether the summation of the R, G and B values of a pixel is higher than 300 or not. If the value is below 250 (I decided on a lower value to guarantee), that pixel surely does not belong to any object to be removed and most probably belongs to sea.

IV. RESULTS

Wharfs and breakwaters removed from first picture

Yachts removed from first picture

Wharfs and breakwaters removed from second picture

Yachts removed from second picture

Wharfs and breakwaters removed from third picture

Yachts removed from second picture

V. WRITTEN PART

1. Opening first executes erosion and and then dilation, whereas closing does operations vice versa. While executing opening, small objects relative to the structuring element will be lost since we erode the image first. Also, small details will be lost because we kind of trim the object. Then we dilate the objects causing borders of the object to change according to the structuring element. In the case of closing, we first execute dilation operation which leads the details of the pattern to be damaged. Then, we run dilation operation. Opening operation causes small spurs to disappear and closing fills small indentations. Of course the structuring element is what shapes all these actions.

2. a) was obtained by eroding the object with a small square with the center pixel as seed. The edges of the square are shorter than the width of the object.

b) was obtained by eroding the object with a long rectangular structuring element with the top-most pixel as seed. The edges of the square are shorter than the width of the object.

c) was obtained by eroding the object with a rectangular structuring element with center pixel as seed and then dilating it by a disk.

d) was obtained by first dilating the image with a disk and then eroding it by a smaller disk.

VI. CONCLUSION

I implemented a program with GUI that removes certain objects using morphological operations. I got familiar with the basic operations, dilation and erosion, and other widely used operations opening and closing. I experienced with binary images and also learned how the extract the connected components of a binary image.