CENG466
Fundamentals of Image Processsing

Take Home Exam 3

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I. Question 1 - Object Counting

The goal of this part is the counting the number of flying jets in the images. To count these objects, we need to separate objects by using mathematical morphology methods of Minkowsky operations, such as erosion, dilation, opening and closing.

In algorithmic way, first we converted original RGB input images into grayscale images with $rgb2gray$ function to apply thresholding on them. After then, we thresholded these images with some intensity values and we got binary image. To apply morphology methods on these binary images, we created disk-shaped matrices with $disk_matrix(r)$ function with radius r, and on some of them, we used horizontal bar-shaped matrices with $cubuk_matrix(l)$ function with length l, as structuring elements.

After these steps, counting the jets is done by $bwlabel$ function. Also, the output is printed onto MATLAB by $fprintf$ function.

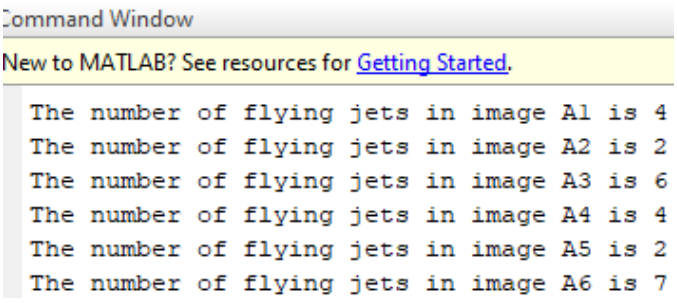

Fig. 1. The outputs of part 1.

A. A1

In A1, we thresholded image with 50 intensity value. Also, we applied closing operation with $imclose$ function with disk-shaped structuring element with radius 5.

We used closing method to fill up smooth bays and holes.

B. A2

In A2, we thresholded image between 60 and 100 intensity values. Also, we applied closing operation with disk-shaped structuring element with radius 3, then we applied opening operation with $imopen$ function with disk-shaped structuring element with radius 8, then finally we applied closing operation with disk-shaped structuring element with radius 15.

Fig. 2. Original A1 image.

Fig. 3. Output of A1.

We applied three operations to make objects in thresholded binary image more separable.

C. A3

In A3, we thresholded image with 50 intensity value. Also, we applied closing operation with disk-shaped structuring element with radius 2, then we applied closing operation with disk-shaped structuring element with radius 7, then finally

Fig. 4. Original A2 image.

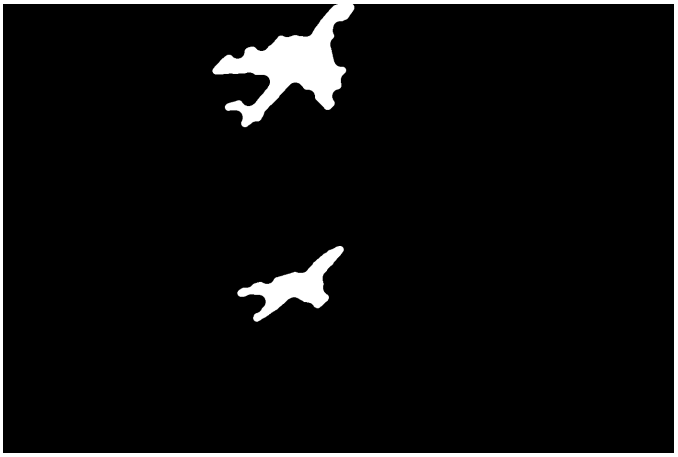

Fig. 5. Output of A2.

we applied opening operation with disk-shaped structuring element with radius 2 again.

Fig. 6. Original A3 image.

D. A4

In A4, we thresholded image with 50 intensity value. Also, we applied opening operation with bar-shaped structuring element with length 10, then we applied closing operation with disk-shaped structuring element with radius 4.

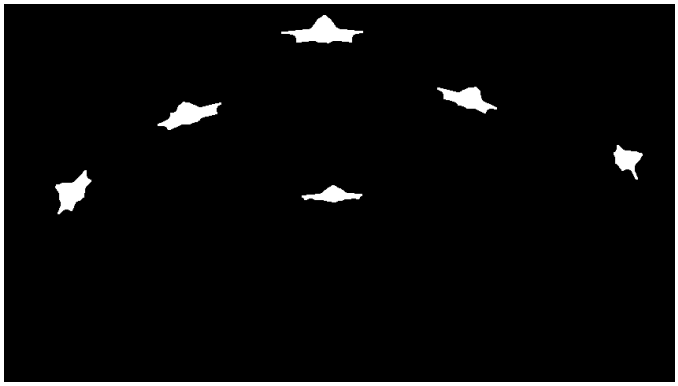

Fig. 7. Output of A3.

We used bar-shaped structuring element with opening method to get rid of remove bridges on right two jets. By using this method, we could separate these two jets.

Fig. 8. Original A4 image.

Fig. 9. Non-separated right two jets on binary image of A4.

Fig. 10. Output of A4.

E. A5

In A5, we thresholded image with 80 intensity value. Also, we applied five opening and closing operations with different dish-shaped structuring elements with different radiuses to get more accurate output.

Fig. 11. Original A5 image.

Fig. 12. Output of A5.

F. A6

In A6, we thresholded image with only intensity value of 1. Also, we applied opening operation with bar-shaped structuring element with length 8, then we applied dilation operation with $imdilate$ funciton with disk-shaped structuring element with radius 20.

With these methods, we could get rid of one more white region which is come from one mountain's shadow after thresholding and binarizing grayscaled input image.

Fig. 13. Original A6 image.

Fig. 14. Output of A6.

II. Question 2 - Segmentation

In this part, the task is to develop segmentation on images. To segment images, we used two segmentation algorithms from MATLAB, namely $Km2$ and $Ms2$. $Km2$ uses k-means method with color and spatial similarity. On the other hand, $Ms2$ uses mean shift method with color and spatial similarity.

In script, we defined k-means parameter to define cluster number. Also, we defined mean shift parameter to define mean shift bandwidth. Then, we defined color and spatial similarity and spatial threshold. Also, we defined the smallest n-cut value

(threshold) to keep partitioning and the smallest size of area (threshold) to be accepted as a segment. These values are used in $Km2$ and $Ms2$ functions.

III. Question 3 - Apple detection

The goal of this part is the detection of apples in the images. To detect the apples, first we converted images into HSV valued images with $rgb2hsv$ function. Then, we applied some thresholds to hue, saturation and value channels to get apple mask from HSV valued image, based on some histogram settings. However, we couldn't get apple completely. To achieve this completion, we applied morphology methods.

We applied dilation, closing and opening respectively with disk-shaped structuring element. At the final step, to initialize output masked image based on input image, we used $repmat$ function of MATLAB.