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Morphological Operation and Region Growth

Experiment Report

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Major	Pattern Recognition and Intelligent System
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1 Introduction

Sometimes we could use morphological operation to do filtering.It performs much better when filling the hole in object or remove the spot on background than other operations.Region growth is a image segmentation method,which makes the same region of image has similar properties.Morphological operation and region growth are two kinds of image processing method in common use.

2 Objective

The goals of the experiment are as follows:

(1) To know several basic morphological operations.

(2) To learn to use region growth to label regions.

(3) To review otsu threshold segmentation.

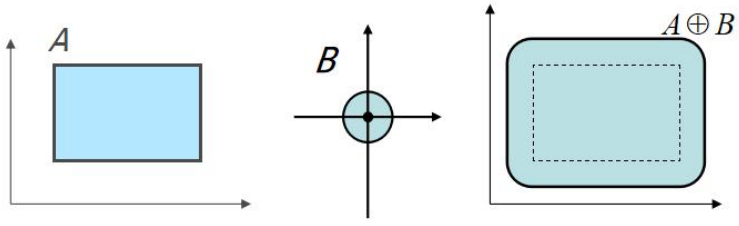
3 Theory

(1)**Morphology Operation**

(a)Dilation

Dilation is a process that all the background point touching the object will be merged together.The mathematical expression is following.

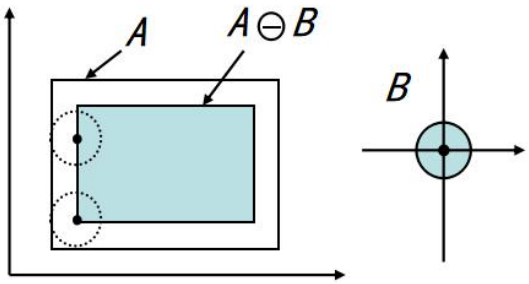
$$A \oplus B = \bigcup \{A + b : b \in B\}$$



(b)Erosion

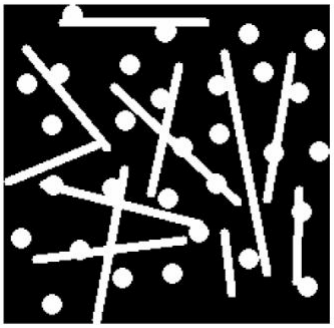
Erosion a process that all the point on object touching the background will be merged to background.The mathematical expression is following.

$$A \ominus B = \{x: B + x \subset A\}$$

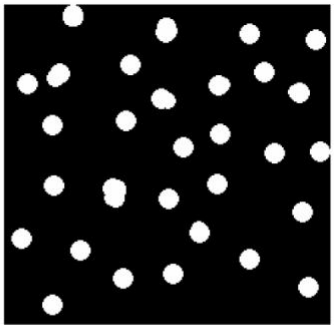


(c)Opening operation

Opening operation is doing erosion and then doing dilation.Opening operation generally smooth the outline of the object, break the narrow neck and eliminate the fine protrusions.



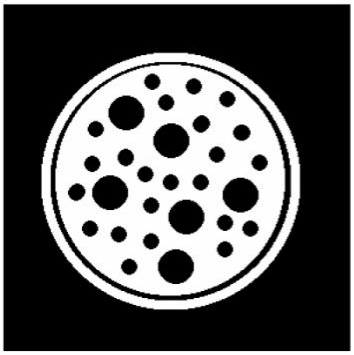
Before opening



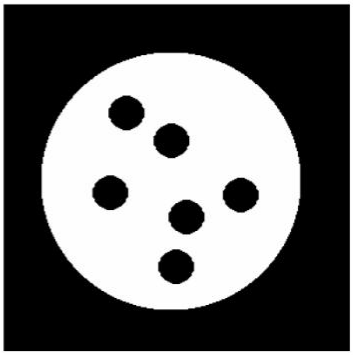
After opening

(d)Closing operation

Closing operation is doing dilation and then doing erosion.The closing operation also smooth part of the contour, usually bridging the narrow gap and slender gully, eliminating small holes and filling the cracks in the contour.



Before closing



After closing

(2)**Region Growth**

Region segmentation is based on the spatial properties of the image, and it is considered that the pixels that belong to the same area should have similar properties.

Regional growth method: firstly,find a seed pixel as the starting point for each region that needs to be divided, and then merge the pixels with the similar properties in the neighborhood of the seed pixels to the region where the seed pixels are located. These new pixels are used as new seed pixels to continue the above process until the pixels that are not meeting the conditions can be included.

1	0	4	7	7
1	0	4	7	7
0	1	5	5	5
3	0	5	6	5
3	3	5	6	4

1	1	5	5	5
1	1	5	5	5
1	1	5	5	5
1	1	5	5	5
1	1	5	5	5

4 Content

(1) Filter the “cell2.bmp” image with mean,median and morphological operation ,contrast their effect and select the best one to use for filtering.

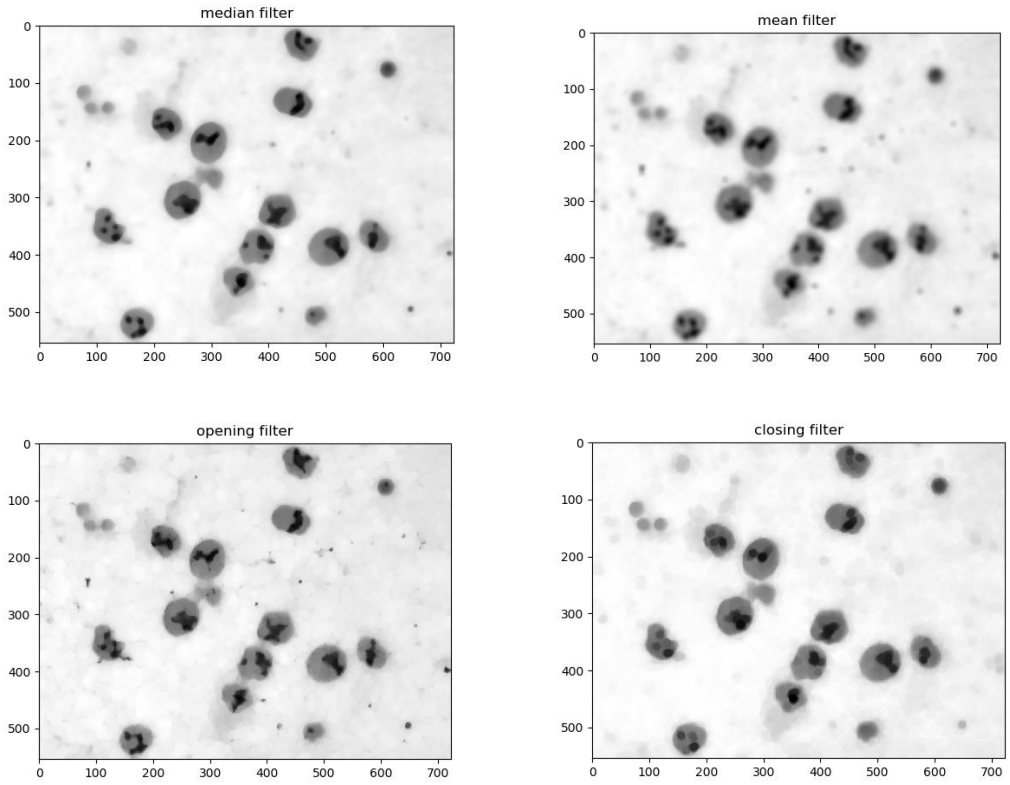
(2)Segment the image with method of Otsu Threshold Segmentation.Observe the noise and edge of object.

(3)Label the connected regions with region growth.

(4)Segment nucleus and nucleolus,measure the ratio of area of the both and then detect abnormal cells.

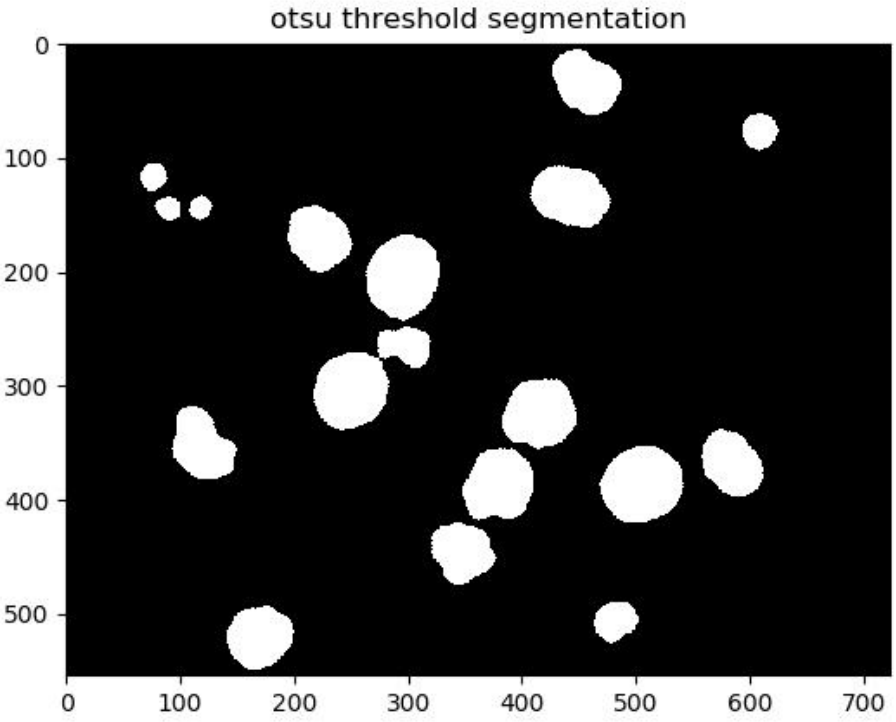
5 Results and Analyzation

(1)Filtering effect of mean,median,opening and closing operation are following:

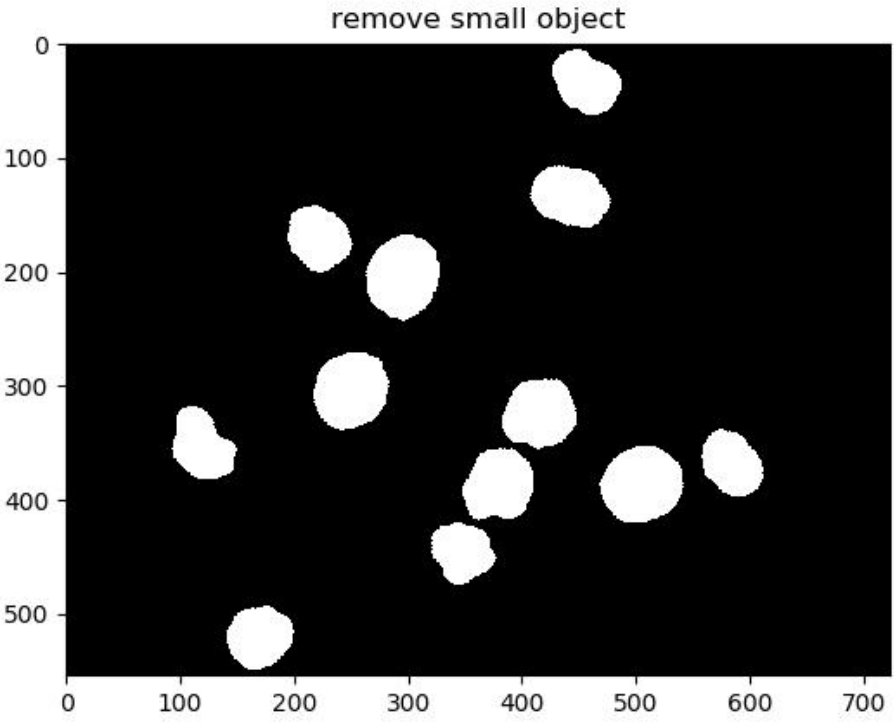


As you can see,the filtering effect of closing operation are best.It get rid of some spots because of its dilation first.Thereby,I takes closing operation as my filter.

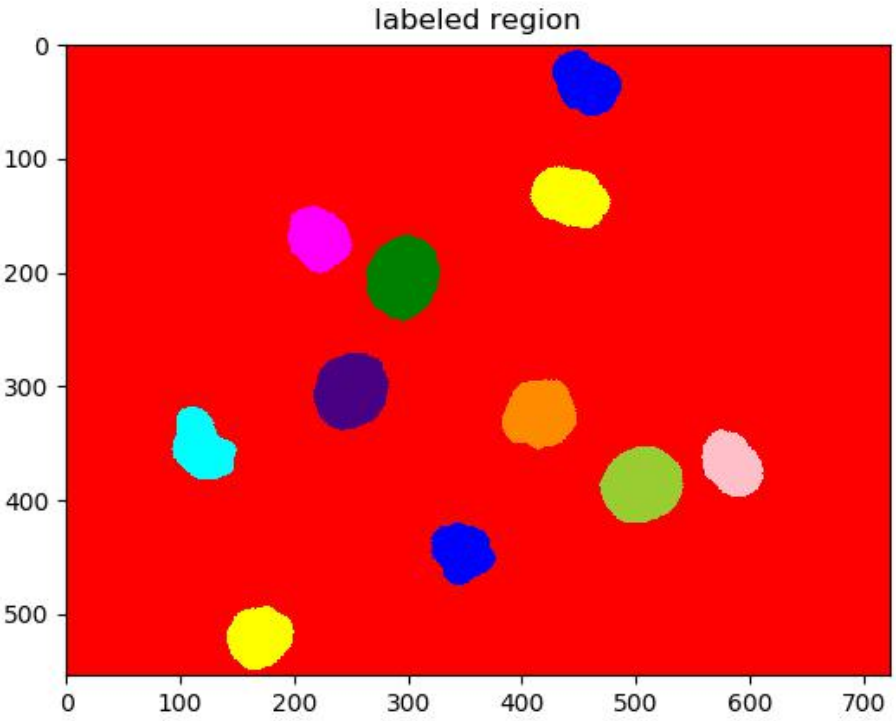
(2)I segmente cells from background with method of Otsu Threshold Segmentation,getting a binary image as following.Black is the background and white is the object.



(3)I remove the small object .Because they may not be cells or complete cells at least,they make no sense,as the following picture.



Then label the regions.I show the following picture,in which each region is colored.Maybe someone note that a cell is lost.In fact,the “lost” cell isn’t lost,which is just colored in red like the background.



(4)Segment the nucleolus from nucleus with Otsu Threshold Segmentation again.Calculate the ratio of nucleolus and nucleus and analyse if the cells are normal.We assume the ratio varying from 0.1-0.5 normal and others abnormal.According the results,only The first cell is abnormal

```
C:\Users\yangxixi\Anaconda3\python.exe
ratio: 0.594496155402671
ratio: 0.23710978603998598
ratio: 0.3243132431324313
ratio: 0.2077711818672423
ratio: 0.2651386530843237
ratio: 0.2385737439222042
ratio: 0.4983948635634029
ratio: 0.21303043291898843
ratio: 0.25092153765139547
ratio: 0.17515407071034705
ratio: 0.20680393912264997
ratio: 0.32753036437246963

Process finished with exit code 0
```

6 Summary

Morphological operation and region growth are two image processing method in common use.We need to handle them.

All the code and instruction files are on my github.You can run them if you want: https://github.com/Deep-Lan/Morphological-Operation-and-Region-Growth.git