Pathological Image Analysis of Cervical Cancer

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Introduction

Histopathology is considered to be the only standard in clinical diagnosis, therefore, we called it ‘golden standard’.However, it is tiring and boring for humans to look at all of these. Meanwhile, many errors are inevitable when doctors diagnosis.In this project, using Matlab and Imaging Processing knowledge, We developed one computed aided diagnosis tool for the pathologist and realized the functions:
①Cell segmentation; Remove the background and leave the cells.
②Determine the cell boundaries; Make the marks at the center and boundary.
③Exclude fragmental cell, impurity; Distinguish normal cells from abnormal ones.
④Overlapped cells seperation; Count cell number.

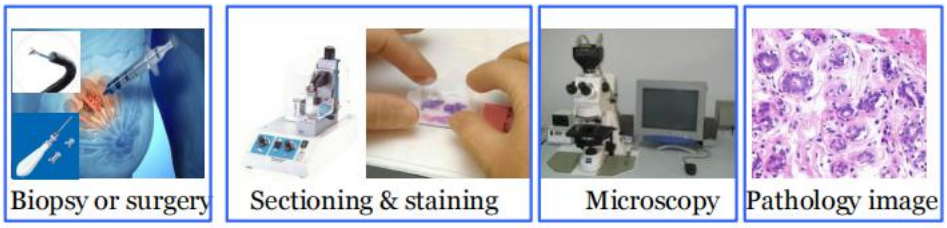
Methodology

Cytopathology

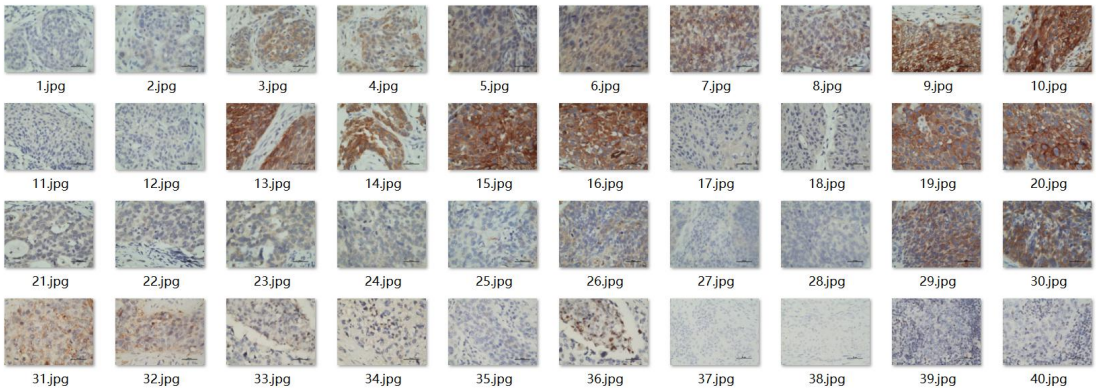
Cytopathology often uses free cells or tissue micro-fragments. With an injection needle, cells are absorbed from that area and spread out on small microscopy glass plates. With a special cutting device, bits of mucous membrane are taken from the edge of that ulcer.

Histopathology

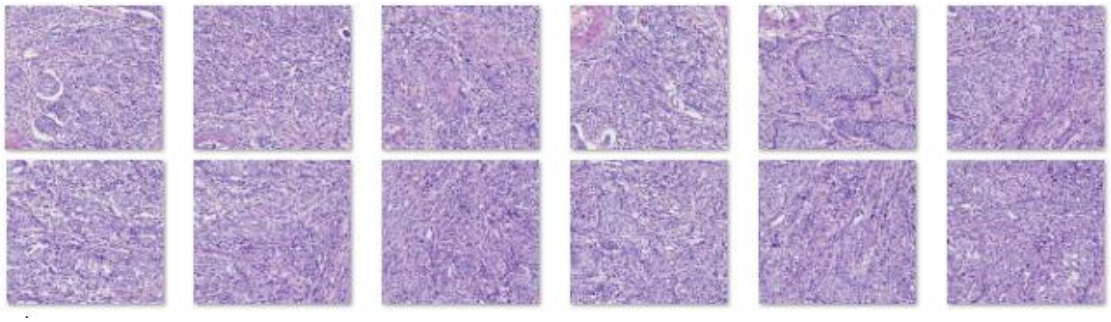
Histopathology is histological section from biopsy or surgery, which is the diagnosis and study of diseases of the tissues, and involves examining tissues or cells under a microscope. Histopathologists are responsible for making tissue diagnoses and helping clinicians manage a patient's care.



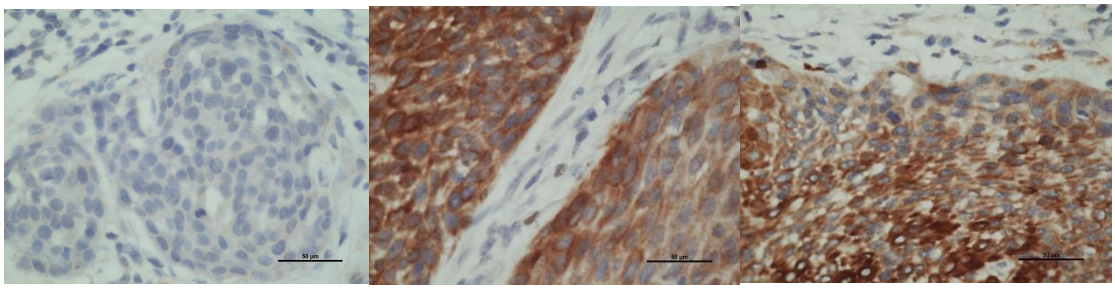
Assets



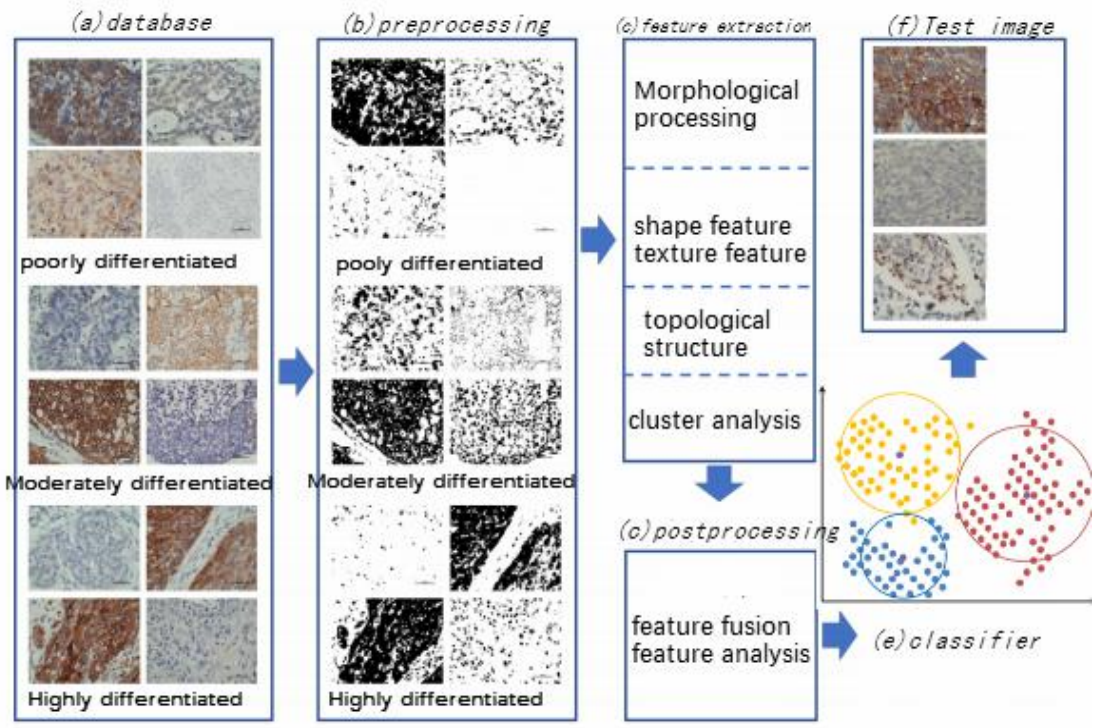
The topic of cervical cancer selected for this project was similar to the direction of my graduation project, but all data sets and algorithms were different. The histopathological images in the figure above used immunohistochemical staining (IHC-DAB).However, the data used in my graduation project was HE staining as shown below.



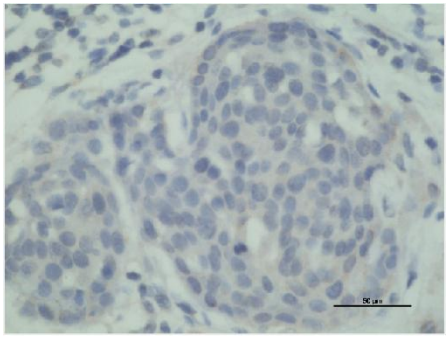
Select three typical pictures to zoom in. The IHC staining images are as follows:



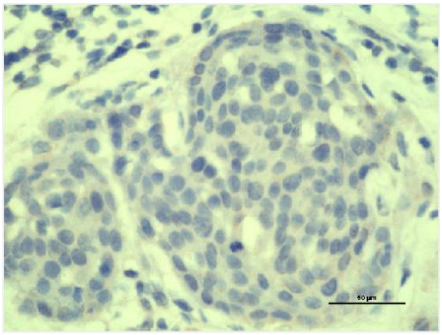
Procedure



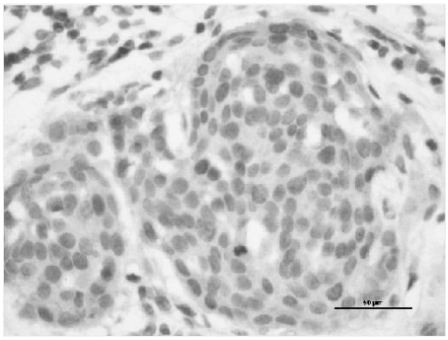
In the data set, images can be divided into three categories: poorly differentiated, moderately differentiated and highly differentiated. I did image processing so that it was available to extract features such as shape or texture feature. After extracting features, a classifier can be utilized and distinguish three different cells.



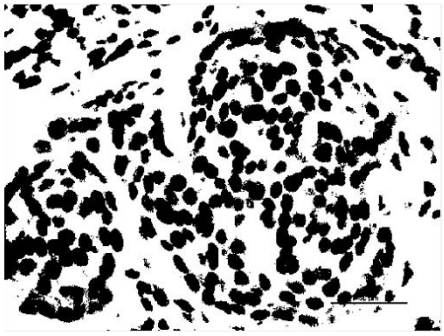
Original image



Brightness adjustment



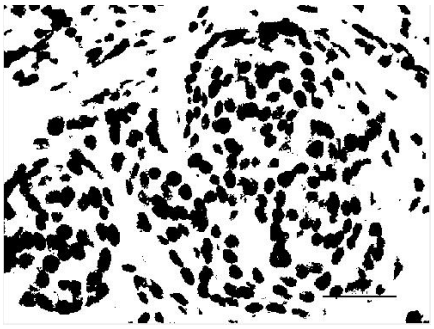
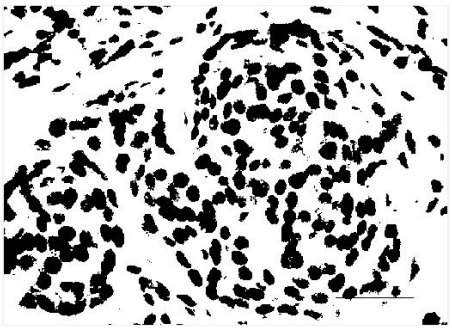
Grayscale



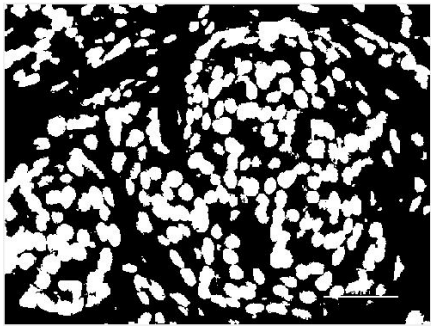
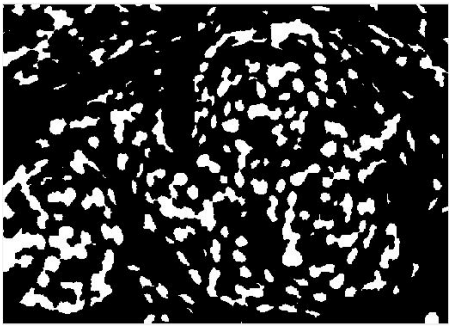
Otsu threshold

As shown in the figure above, the procedure of processing was brightness adjustment,

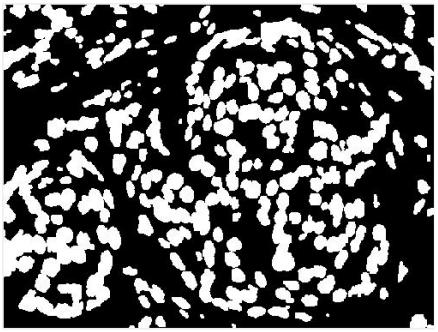
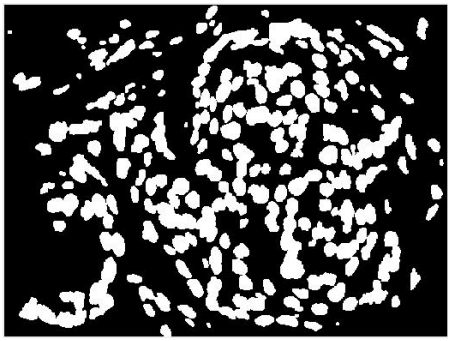
grayscale and Otsu threshold.Only the cells were segmented, the background (tissue fluid, broken cells) was eliminated.

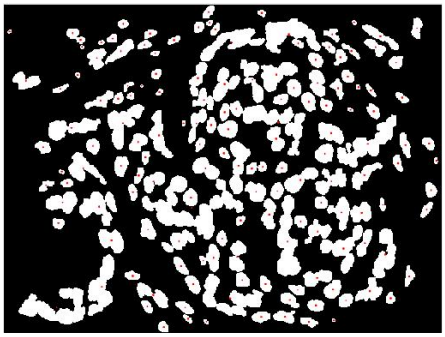
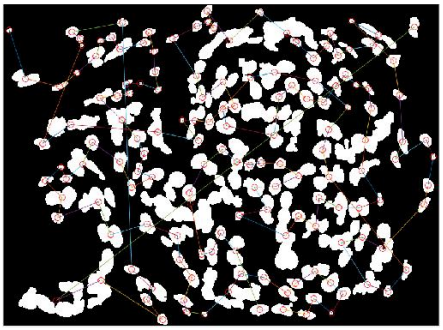
Morphological processing

After image processing, the picture became a binary image. Subsequently, it was reversed, the distant view changed to black, and the subject cells were white. In a binary image, white is 1 and black is 0. The inversion of the image was convenient for subsequent feature extraction.Through morphological processing, some of the adhered cells were separated.The treatment methods here were mainly erosion and expansion operations.

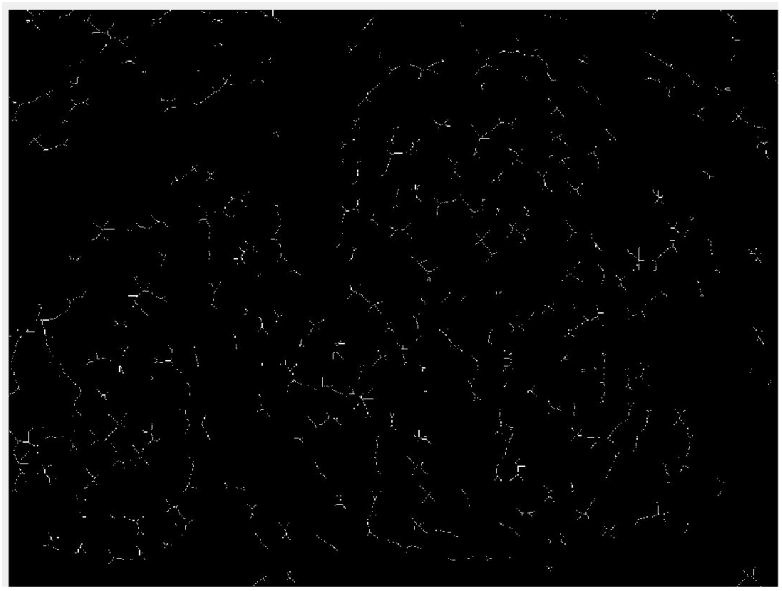
Edge removal

Marker Center

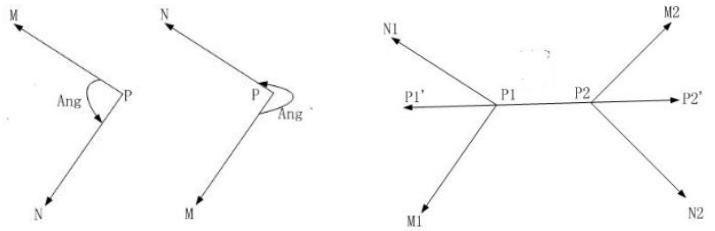
lining

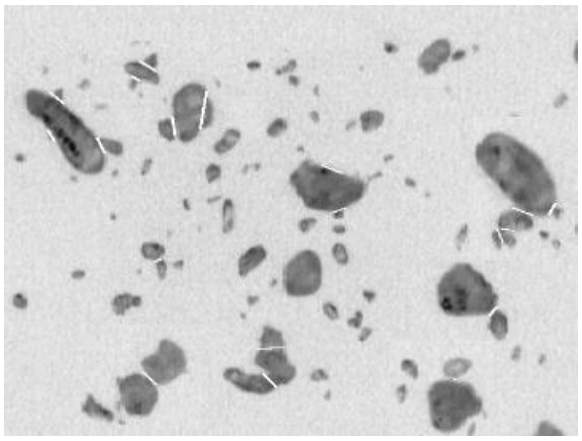
Some marginal cells may affect the results of the processing, so they were also removed. Subsequently, center of each cell was marked so that we can count the number of cells later. Meanwhile, connect all the red dots to study the topological structure. Skeletonizing was also an approach to study topological structure.



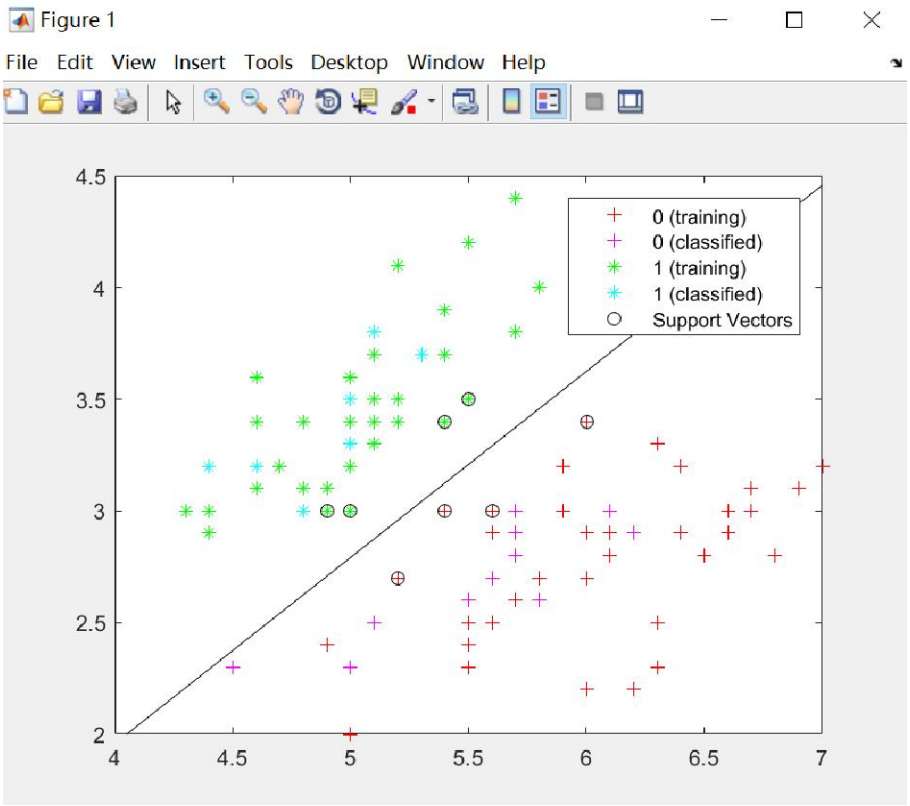
skeletonizing

By observing the skeletonized picture, the structure of the adherent cells often appeared as shown in the figure below. Therefore, the skeleton tends to have multiple intersections (P1,P2).In this way, we can separate the adherent cells.





Subsequently, by using the extracted feature vectors, we can distinguish between highly-differentiated and poorly-differentiated cells using the SVM(support vector machines) classifier.



svm classifier

The above processing was all done in MATLAB. After running the code, we got the following result.

```
Command Window
  > In images.internal.initS
    In imshow (line 309)
    In t1 (line 69)
  获得个数：0.287729
  获得个数：4259.777108
fx >>
使用svmclassify，正确率：0.700000
使用矩阵形式，正确率：0.700000
一个一个计算，正确率：0.700000
>>
```