CENTRALE NANTES

Biomedical Image Processing Labwork Report

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Objectives

The main goal of this laboratory work is to work using several methods that are used in the biomedical field in the image treatment part of the process.

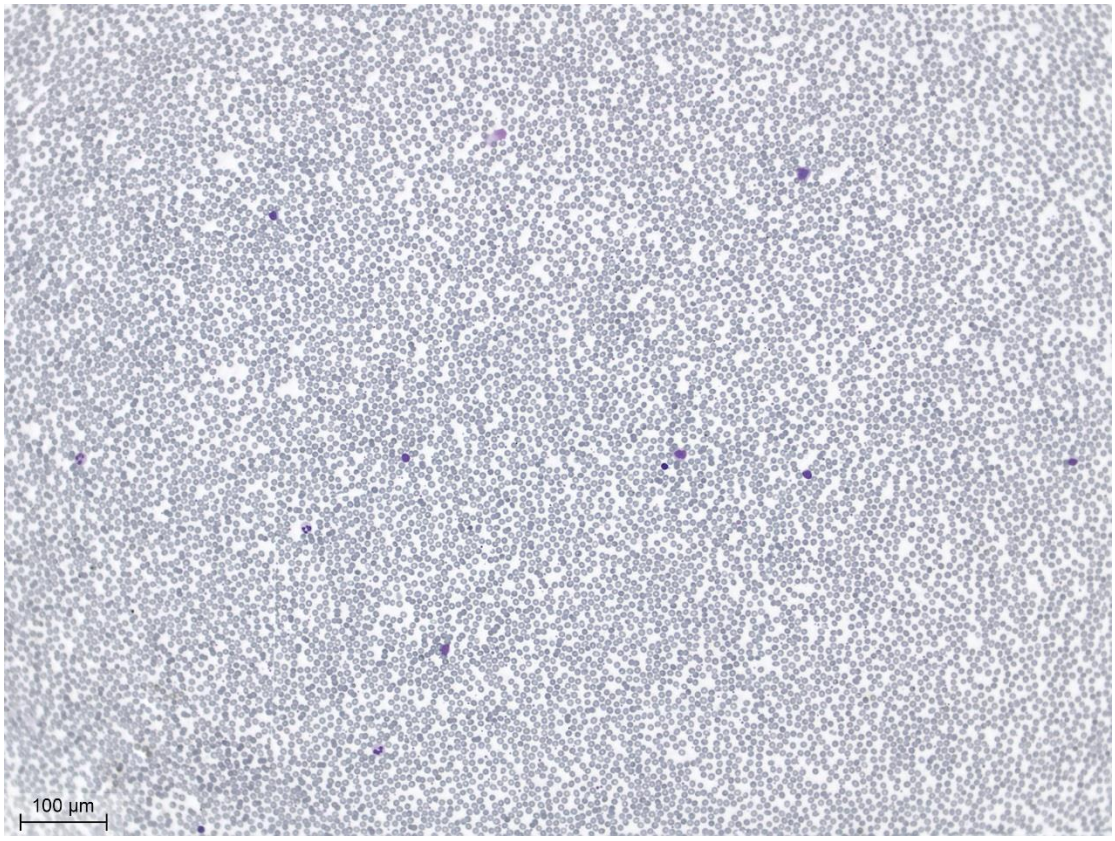
We will discuss two problems that are:

1- Cells counting in an image
2- Cells segmentation based on type of cell

We will introduce the problematic, and defend each problem and the methods that have been used in order to resolve our problems.

Problem 1 : Cells counting in an image.

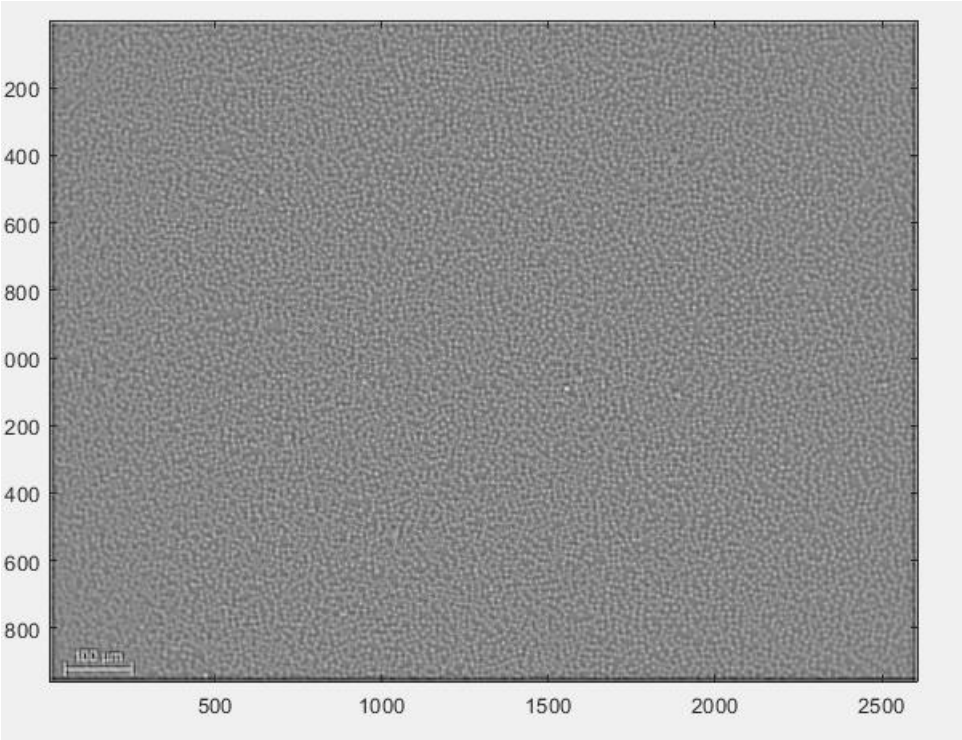
Our image to be treated is here below:



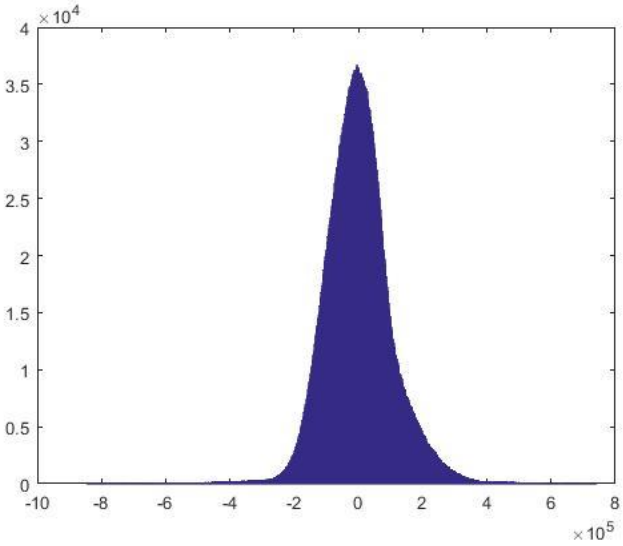
As we can see there are thousands of cells that should be counted in our problem.

The main method that has been used for this problem was to take as a kernel the image of one cell, and then to calculate the convolution of this cell with the original image.

After calculating the convolution , we show the resulting image:

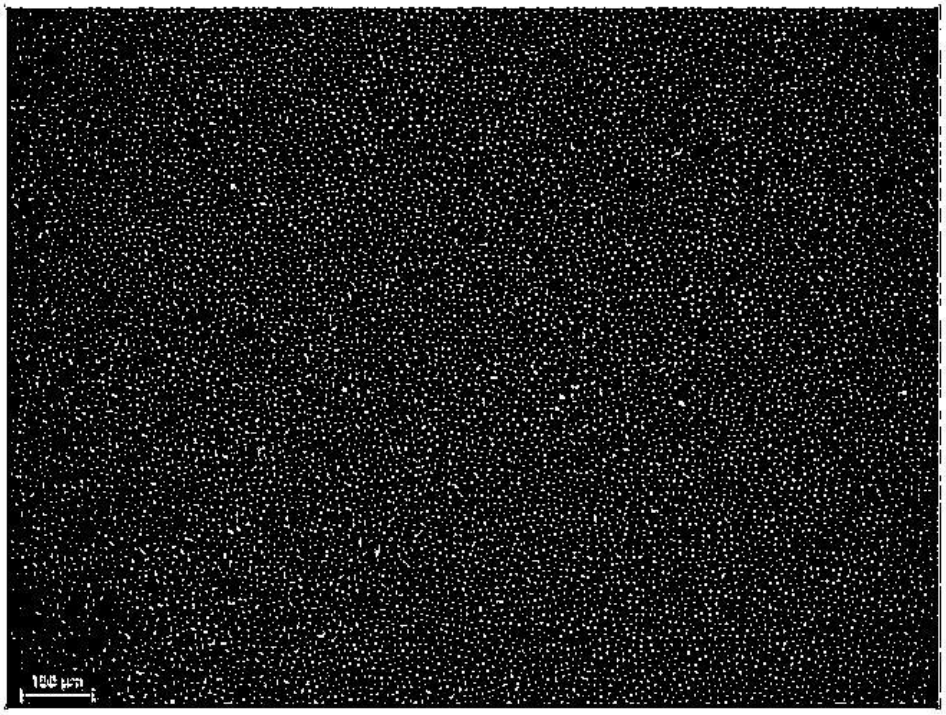


If we plot its histogram to know where to apply our threshold , we get:



Since in the resulting image, we get peaks in each convoluted area, those peaks lay in the end of the histogram,

After several trials to choose the best threshold to be applied , we choose (`0.13*10^6`) as a threshold, and we get that image as a result:



We have chosen the threshold in a way we minimized the fusion of two cells in case it was lot, or the loss of cells in case it was high

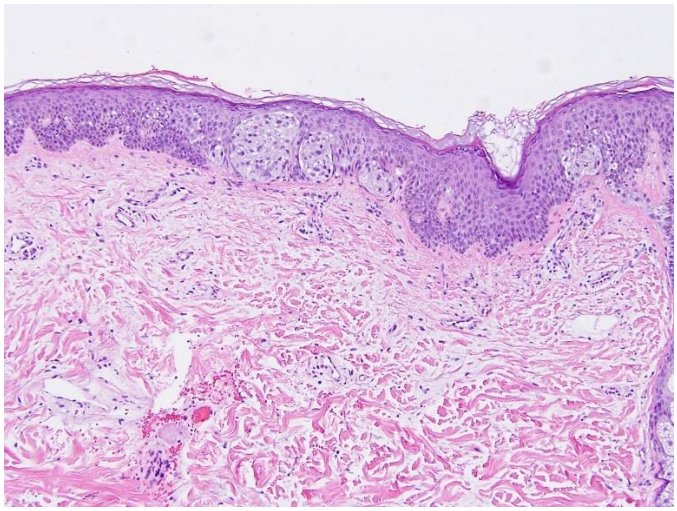
And finally, as a result we have gotten: **13356 Cells** in the picture !

Matlab code for this problem :

```
clear all
close all
image_rgb=imread('hematies.jpg');
image=rgb2gray(image_rgb);
image=double(image);
kernel=imread('kernel.jpg');
kernel=rgb2gray(kernel);
%14800
kernel=double(kernel);
test=conv2(image,kernel-mean(mean(kernel)));
% test=test/max(max(test));
imagesc(test)
colormap('gray')
hist(test(:),1000)
B=imsharpen(test);
C=bwlabel(B>0.13*10^6);
imshow(C)
max(max(C))
```

Problem 2: Human cell segmentation

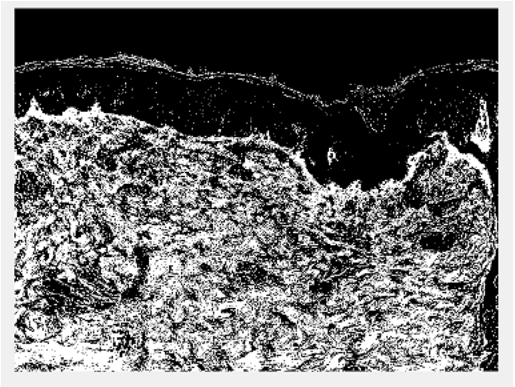
Our first image to be treated is :



As we can see in this image, the bluish cells and the rose cell and the “white/void/air” cell” are all separated based on color, so our method was color based .

Using the Color Thresholder app in matlab, we have chosen our thresholds in a visual-interactive way, till we have separated the cells .

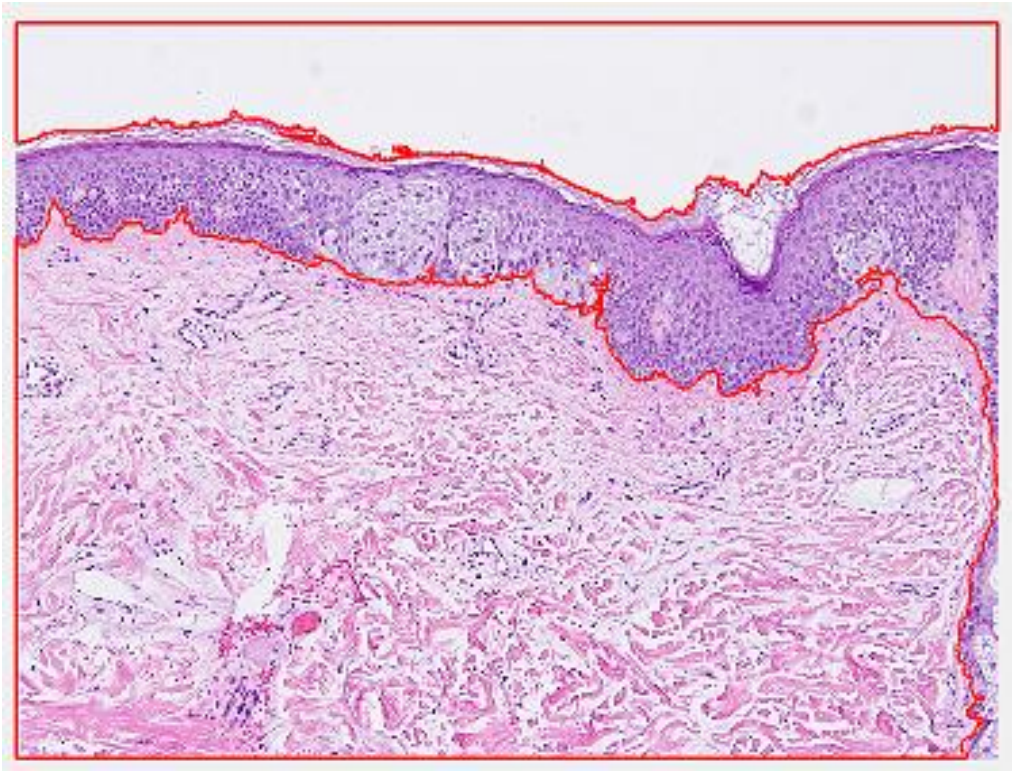
We have decided to make two main thresholding to separate the regions, the thresholding results were :



Then by using matlab functions “imfill” and “bwareopen”, we have refined our images to get the following:

As we can see, we have now two masks, that were generated for sure with a lot of trial and error, (It might be automated using more sophisticated techniques like Kmeans and also Mask RCNN methods)

As a final result, we plotted the boundaries using matlab function “visboundaries” , to get the following :



Results are satisfying !

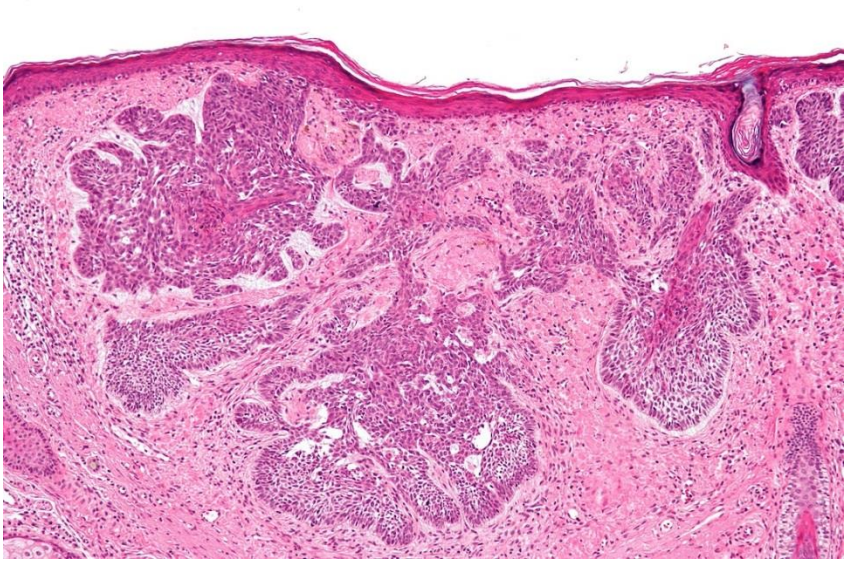
Matlab code for this picture :

P.S : functions createMaskSkin and createMaskShallowSkin are autogenerated by Matlab after choosing visually our thresholds)

```
%% read image
```

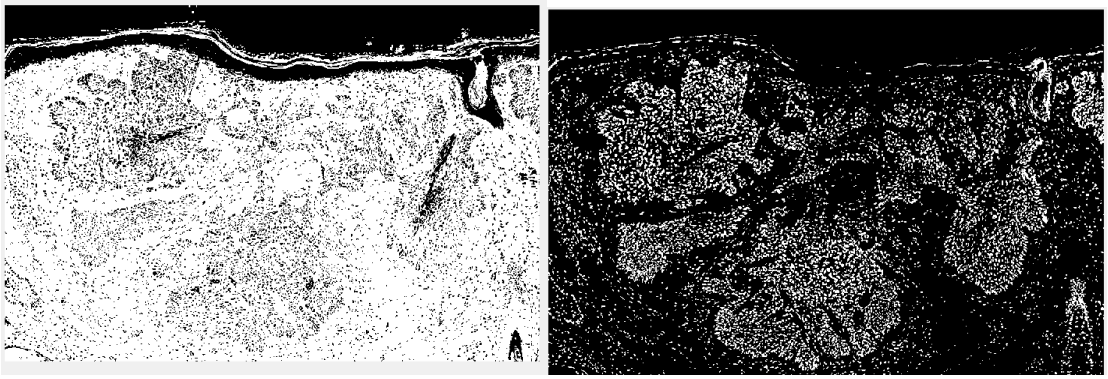
```
img = imread('skin1.jpg');
%% mask generation
[BWAir,~] = createMaskSkin(img);
[BWDeepSkin,~] = createMaskShallowSkin(img);
%% Air-mask refinement
figure, imshow(BWAir);
BWAir_fill = imfill(BWAir, 'hole');
BWAir2 = bwareaopen(BWAir_fill, 100000);
figure, imshow(BWAir2);
%% Deepskin-mask refinement
figure, imshow(BWDeepSkin);
BWDeepSkinClose = imclose(BWDeepSkin, strel('disk',3));
BWDeepSkin_fill = imfill(BWDeepSkinClose, 'hole');
BWDeepSkin_fill = bwareaopen(BWDeepSkin_fill, 10000);
BWDeepSkin2 = imcomplement(bwareaopen(imcomplement(BWDeepSkin_fill),
2000));
figure, imshow(BWDeepSkin2)
%% boundaries visualization
figure(99)
imshow(img)
hold on;
visboundaries(BWAir2)
visboundaries(BWDeepSkin2)
```

Second Picture to be treated :

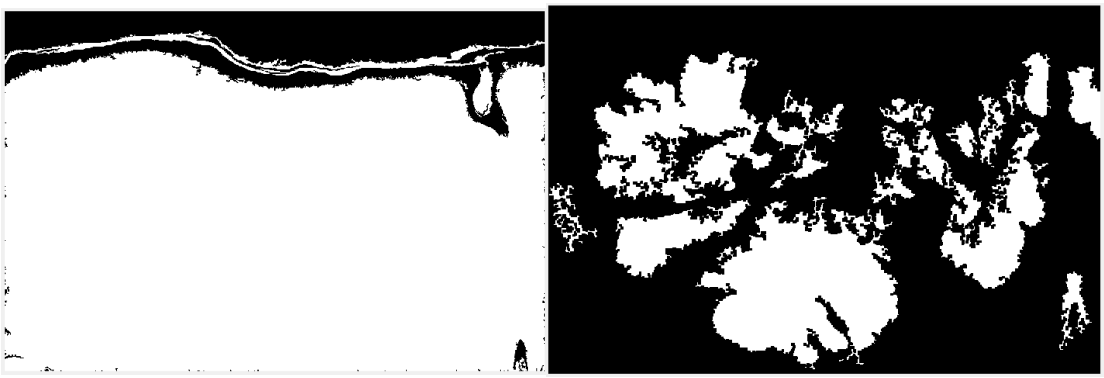


We will use the same method here in our problem and we will show with each step the evolution of our mask that were created :

After the first thresholding :



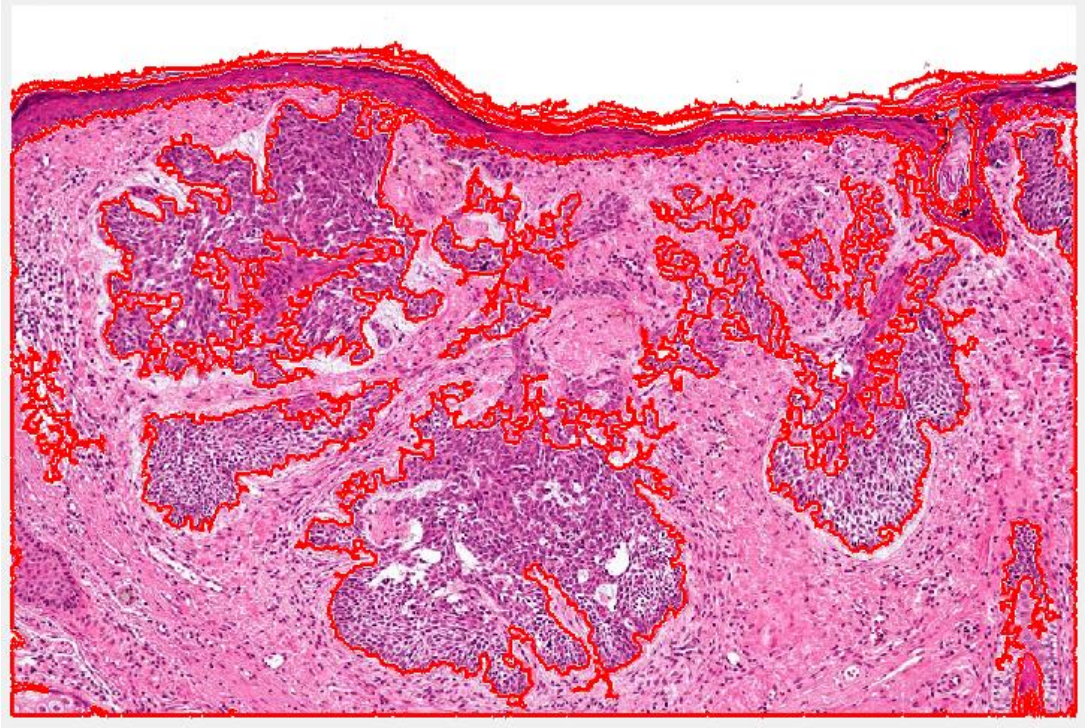
Now applying morphological operations on these masks that would give us :



Results were great for the masks !!

In the left image, the upper thick line was segmented, and all the other cells below were clear in the mask.

In the right image, we have gotten a great segmentation for the inner cells.



Matlab code :

P.S: (functions of the thresholds createMaskForUp and createMaskFor Up2 are autogenerated by matlab after choosing visually our thresholds)

```
%% read image
img = imread('skin2.jpg');
%% mask generation
[BWAir,~] = createMaskForUP(img);
[BWDeepSkin,~] = createMaskForUp2(img);
%% Air-mask refinement
figure, imshow(BWAir);
BWAir_fill = imfill(BWAir, 'hole');
BWAir2 = bwareaopen(BWAir_fill, 12000);
figure, imshow(BWAir2);
%% Deepskin-mask refinement
figure, imshow(BWDeepSkin);
BWDeepSkinClose = imclose(BWDeepSkin, strel('disk',3));
BWDeepSkin_fill = imfill(BWDeepSkinClose, 'hole');
BWDeepSkin_fill = bwareaopen(BWDeepSkin_fill, 1000);
BWDeepSkin2 = imcomplement(bwareaopen(imcomplement(BWDeepSkin_fill),
2000));
figure, imshow(BWDeepSkin2)
%% boundaries visualization
figure(99)
imshow(img)
hold on;
visboundaries(BWAir2)
visboundaries(BWDeepSkin2)
```

Little Conclusion :

It’s all a matter of thresholds at first, then it is the role for other operations to continue the work.