KAUNAS UNIVERSITY OF TECHNOLOGY

Electrical and Electronics faculty
Electronics engineering dep.

Biomedical Image Processing and Analysis

Laboratory work report

Lab 2

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KAUNAS

REPORT FOR LABORATORY 2:

A) Introduction and Problem Statement

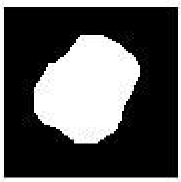
I am using Matlab and I will solve the below problems:

1. Preprocessing. Crop a given image ‘TumorMRT.png‘, as shown in an example Fig. 1. Do the same operation with an image ‘expert_lab.png‘, which later will be used as a reference for evaluation of segmentation quality (crop the images preserving the same coordinates of rectangle).
2. Histogram based threshold selection. Compute and display histogram of cropped image region. Select T value respective to histogram. Is it possible to identify two separate distributions representing foreground and background in the histogram?
3. Segmentation. Try to extract tumor in a cropped image region applying global threshold method using selected T value.
4. Evaluation. Compare obtained binary image to given reference image by computing overlap (O) estimate. Compute the area of extracted tumor if the area of single pixel 1 mm2.
5. Optimal threshold. Investigate the relationship between threshold value and overlap estimate and determine optimal T value.
6. Otsu method. Implement Otsu method for automated optimal threshold selection. Compare threshold obtained using Otsu technique to T value determined in 5.

B)Figures and Results - C) Comments and Conclusion

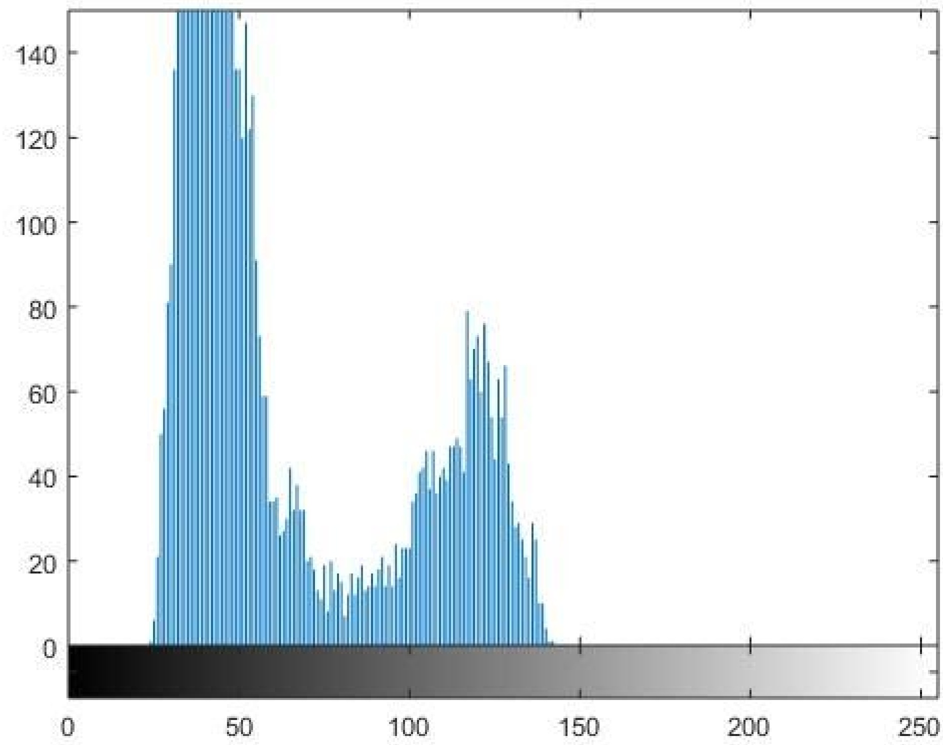
1)

Cropped rectangle of ‘TumorMRT.png‘

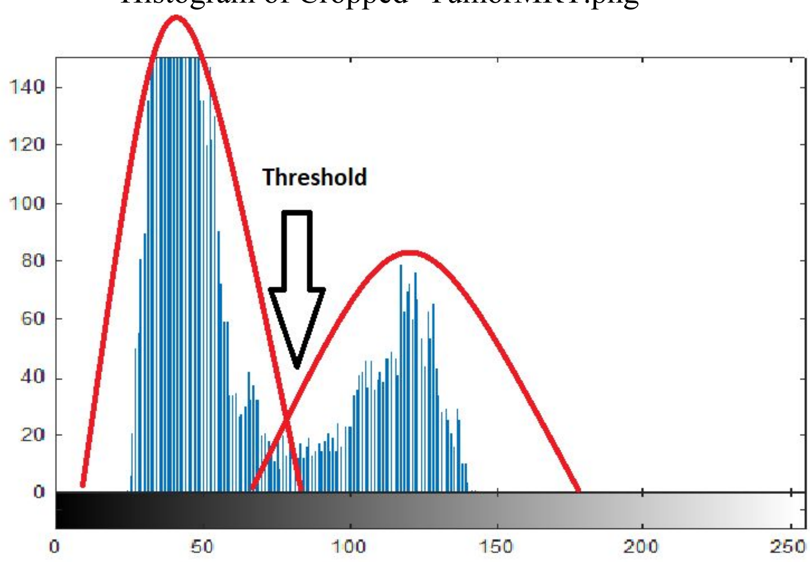


Cropped rectangle of ‘expert_lab.png‘

2) We can try and select T by naked eye. We can see it is around 75. So, we may say it is 77, because the threshold seems to be on the right of 75. Of course we can identify two different distributions and we have drawn them below.

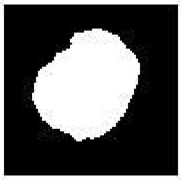


Histogram of Cropped ‘TumorMRT.png‘



Drawn Histogram of Cropped ‘TumorMRT.png‘

3)



Extracted Tumor in Cropped ‘TumorMRT.png‘
by using T=77 and applying global threshold method.

4) The overlap estimate (O) proves to be after our calculations : O = 0.9274.
Also, we found that the Tutor Area is 2096 mm^2 .
O is 0.9274, therefore we did a good job by choosing T to be 77. Because the two pictures are 92.74% similar and we manually extracted 92.74% of the tumor.
5) We realise that : the best T gives us a value of O that is the closest it can be to 1. We experiment with T by giving it different values. The best we get by this experiment is T to be 80, which gives us O = 0.9326.
6) By using the Otsu Method , we get T to be 78. In Task 5 we found optimal T to be 80. So, we made a very good approach by naked eye and ,also, by experimenting. Because the results we got about optimal T , are very close to each other. Furthermore, by experimenting with Otsu method T=78 , we get O to be 0.9285 ! Therefore, our experimental method proves to have better results, due to the fact that we discovered a bigger amount of the Tumor.

In conclusion, it is possible to identify two separate distributions representing foreground and background in the histogram ; it proved to be a strong connection between O and T which we analyzed above. And finally, the experimental method of Task 5 proved to be better than the Otsu method, because the overlap estimate it gave us was closer to 1.

D) Program Code

```
close all;
clear all;
clc;
%task 1
I = imread('TumorMRT.png');
J = imcrop(I,[63.5 251.5 86 84]); %cropped TumorMRT img
I = imread('expert_lab.png');
J23 = imcrop(I,[63.5 251.5 86 84]); %cropped expert img
imshow(J)
figure
imshow(J23)
%task 2
figure
imhist(J)
%we can select T by naked eye. we can see it is around 75.
%so, we may say it is 77,because the threshold is on the right of 75.
%yes of course we can identify 2 different distributions and we have drawn
%them.

%task 3
```

```
f = im2uint8(J);
T = 77;
g = im2bw(f, T/255);
figure,imshow(g)

%task 4
same=0;
union=0;
TumorArea=0;
for a=1:85
        for b=1:87
        if g(a,b)==1 && J23(a,b)==1
        same=same+1;
        end
        if g(a,b)==1
        union=union+1;
        TumorArea=TumorArea+1;
        elseif  J23(a,b)==1
        union=union+1;
        end
        end
end

overlap_estimate=same/union;

%Task 6 - Otsu method for T
T_Otsu_float = graythresh(J);
T_Otsu=T_Otsu_float * 255; %T_Otsu -->78
```