

# IMAGE PROCESSING PROJECT REPORT

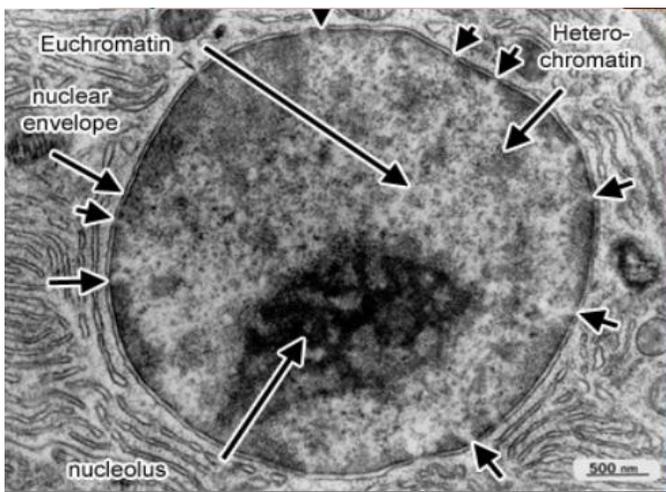
## NUCLEUS CLASIFICACION

### ABSTRACT :

The Main agenda of this project is to segment and analyze the a stack of image, where it contains nucleus, nucleolus and heterochromatin. Find the volume, Density, Area and circularity of the nucleus. There are some steps followed for segmenting the nucleus from the image, that can be explained in later part of this paper.

### INTRODUCTION :

Given image contains nucleus and several parts of the nucleus are Heterochromatin, euchromatin, Nuclear envelope and nucleolus as you can see these parts in the below image. This paper helps to segment the nucleus by layer by layer and finds the volume, density , circularity and area automatically. The following steps will give clear explanation of segmenting the nucleus from the image.



Steps Done for segmentation : segmentation process are classified in two steps.

- pre-processing of image.
- post processing of image.

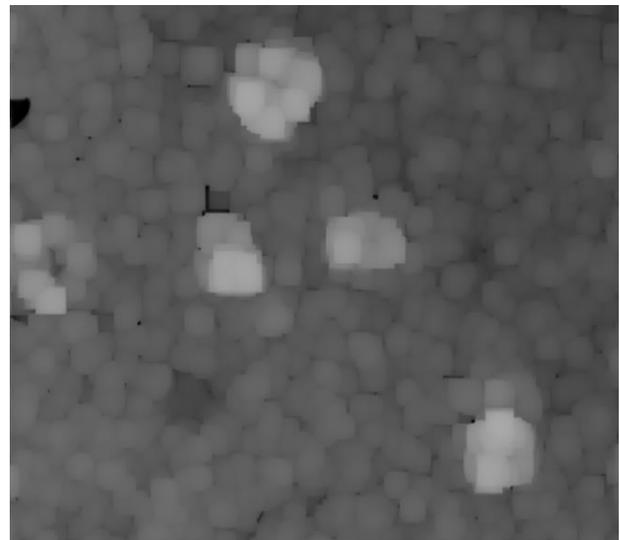
### Pre-processing of image :

It involves three steps

1. Background Subtraction
2. Enhance Contrast
3. Find Maxima

### Background Subtraction :

Background Subtraction is a technique which helps to recognize the objects in the image for further processing. When we do Background subtraction to an original image it shows like below.



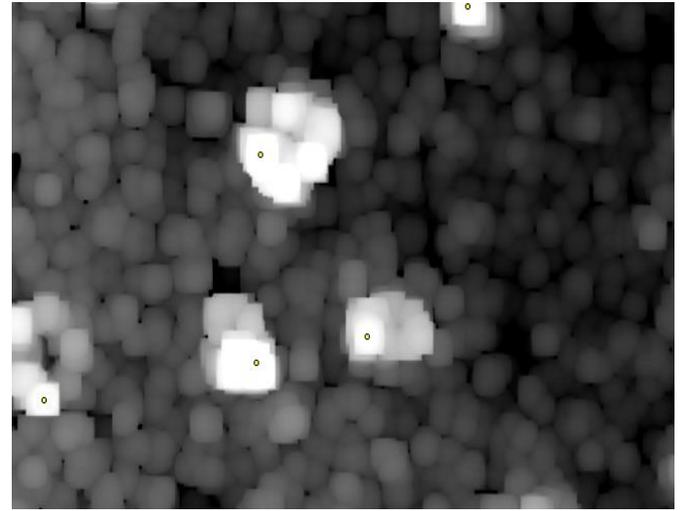
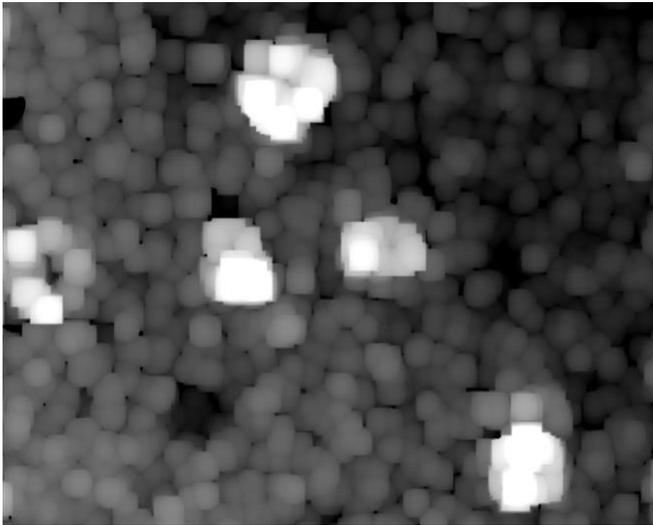
From above image it is clear that the objects are get identified. Here objects are identified in this image after background subtraction. Then this image is used for further processing of our project.

### Enhance Contrast :

Enhancing the contrast of a image increases the objects brightness in the image. When we do enhance contrast to the above background subtraction image it shows like below.

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The above image gives the clear picture of objects in image, which are more identified when compared to the background subtraction technique. Enhancing contrast helped to find the clear view of those objects. Then this image is now used to find the maxima.

### **Find Maxima :**

Determines the local maxima in an image and creates a binary image of the same size with the maxima, or one segmented particle per maximum. When this operation is done on above image the seed points are plotted in each objects as you can see in the image.

From the above image it is clear that the seed points are plotted in each image with the help of finding local maxima to each nucleus of image. As we have got the seed point we use the ResultsManger to store this seed points and then process the start the post processing.

### **Post Processing of a image :**

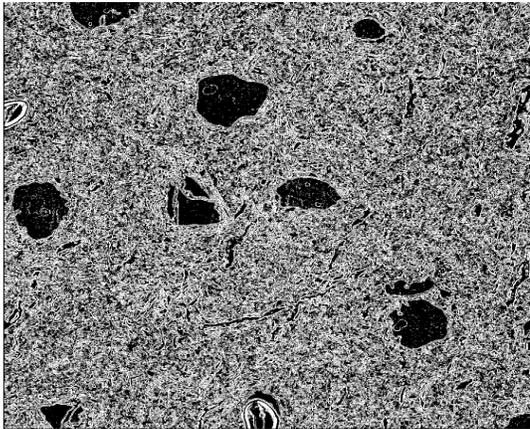
The following steps are done in post processing of an image

1. Finding the edges.
2. Make Binary.
3. Applying Level set algorithm.
4. Analyzing the results by calculating the volume, area and circularity and density.

**Finding the edges :** it uses a sobel edge detector to highlight sharp changes in intensity in the active image or selection. Two  $3 \times 3$  convolution kernels are used to generate vertical and horizontal derivatives. The final image is produced by combining the two derivatives using the square root of the sum of the squares. Finding edges to the above image represents below.

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The above image represents the edges of the nucleus. Now, this image is used to apply level set.

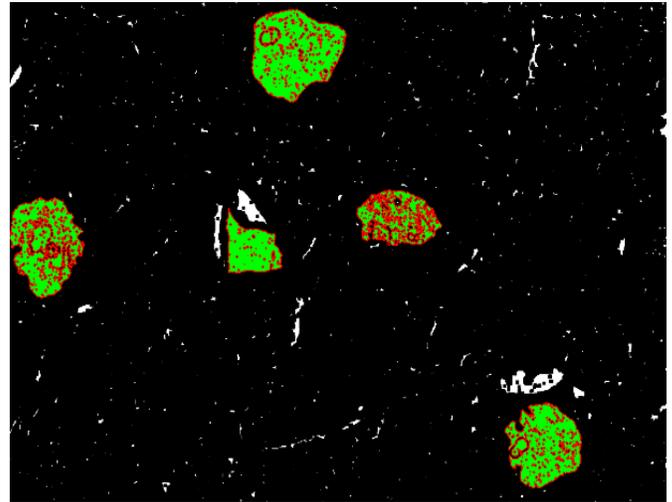
### **Make Binary :**

It analyze the histogram of the image and set an automatic threshold to create the binary image . It creates the threshold for each layer which is required for the application of level set.

### **Applying Level set algorithm :**

Level set plays an major category of image segmentation technique based on partial differential equations works on the differences among neighboring pixels to find object boundaries. Basically this algorithm will meet at the boundary of the objects where the difference between the objects are the highest level.

Applying level set to the image grows the regions and segment the nucleus into another stack of layers of nucleus .These regions are grown based on the seed point plotted after finding maxima to the image. The below image shows the growing regions of image.



Here, the image shows growing nucleus which are colored with green. These images are grown to their respective boundaries with the help of seed points selection that got after finding maxima. Finally these nucleus moves to a stack, layer by layer forming a stack of layers of the image. Then the final output of segmented images i,e the segmented stack of layers are shown below.



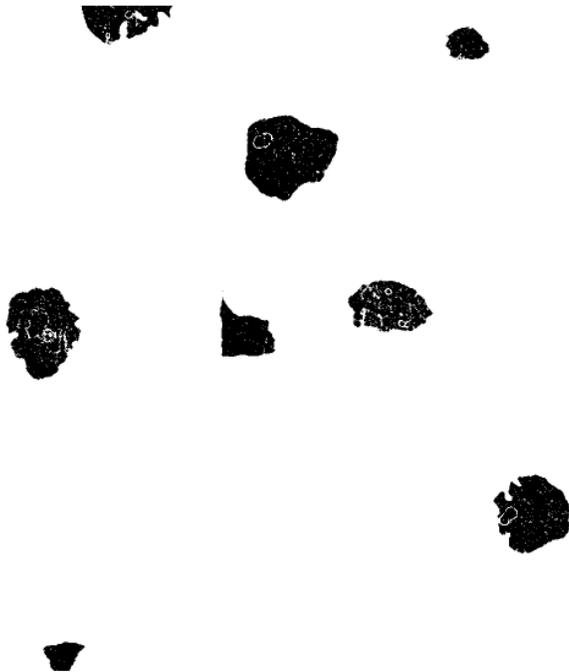
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These are the nucleus that are segmented from the original image which are then used to find the area, volume, circularity and density.

### Analyzing the results by calculating the volume, area and circularity and density :

This is the final step in our process of segmentation where segmented nucleus is used to find volume, area, density and circularity. The below diagram represents the segmented nucleus from the images.



Then these segmented nucleus are used to find the volume, density, area and circularity. The numbers on each nucleus represents the number of nucleus in the image and then finally all those results are displayed as shown below.

File	Edit	Font	Results				
	Area	X	Y	XM	YM	Perim.	Slice
1	7283	206.593	28.819	206.593	28.819	584.482	1
2	2677	771.394	74.928	771.394	74.928	243.463	1
3	15169	476.496	256.448	476.496	256.448	522.056	1
4	8155	643.923	504.186	643.923	504.186	582.365	1
5	12495	74.410	542.720	74.410	542.720	639.235	1
6	5483	406.601	550.245	406.601	550.245	360.635	1
7	11083	879.875	843.322	879.875	843.322	601.009	1
8	2420	108.821	1078.986	108.821	1078.986	225.279	1
9	7318	206.339	30.150	206.339	30.150	510.115	2
10	2963	770.679	74.940	770.679	74.940	273.706	2
11	15125	476.769	256.470	476.769	256.470	522.399	2
12	8365	644.241	504.525	644.241	504.525	548.867	2
13	12506	74.715	542.573	74.715	542.573	552.423	2
14	5453	406.421	549.930	406.421	549.930	348.735	2
15	10914	880.233	843.852	880.233	843.852	604.909	2
16	2300	109.500	1079.407	109.500	1079.407	228.693	2
17	7281	206.497	30.735	206.497	30.735	493.345	3
18	3206	770.330	74.768	770.330	74.768	279.605	3
19	15078	476.971	256.479	476.971	256.479	516.399	3
20	8523	644.380	504.576	644.380	504.576	573.252	3
21	12447	74.749	542.363	74.749	542.363	528.139	3
22	5437	406.101	549.702	406.101	549.702	343.421	3

As there are segmented nucleus in the image, the volume, circularity and area of the nucleus are shown in the above image. Where the slice represents the number of layers of image.

**Technology Used : JAVA**

**Tools Used : IMAGEJ**

**Conclusion :** Hence, The nucleus in the image are segmented and the results like volume, density, area and circularity of the nucleus are displayed. As we have tried iterating this slice by slice the output will be much better without even losing the intermediate values.

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### References

<http://rsbweb.nih.gov/ij/docs/examples/index.html>

<http://imagej.nih.gov/ij/developer/api/>

<http://rsbweb.nih.gov/ij/developer/api/ij/ImageJ.htm>

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<http://rsbweb.nih.gov/ij/developer/api/ij/IJ.html>

<http://rsbweb.nih.gov/ij/developer/api/ij/package-summary.html>

<http://rsbweb.nih.gov/ij/developer/api/ij/io/package-summary.html>

<http://rsbweb.nih.gov/ij/developer/api/ij/plugin/filter/Binary.html>

<http://rsbweb.nih.gov/ij/developer/api/ij/plugin/package-summary.html>