

# Automatic ROI Selection in Centrosome Analysis for Very Earlier Cancer Diagnosis

## Introduction of centrosome

1) What is a centrosome?

A centrosome is a small organelle located near the nucleus that plays a critical role in cell division. If a centrosome appears abnormal then cell division will also be abnormal – resulting in a cancer cell.

2) Why centrosome analysis can be used for cancer diagnosis?

Centrosome amplification presents in most of the common human cancers, such as lung cancer, breast cancer, prostate cancer, pancreatic cancer .... Cancer can be detected through detection of centrosome abnormality.

3) How early can centrosome analysis diagnose a cancer?

Centrosomal defects have been found to occur at a very early premalignant stage of tumor formation, prior to the appearance of detectable lesions. Therefore, cancer can be detected at very earlier stage via detection of centrosome defects. For some suspicious very early stage cancers, centrosome analysis can help to diagnose.

4) How a cancer is diagnosed via centrosome analysis?

Stain centrosomes in a tissue or cells, scan them with a high resolution microscope to get high quality images, process images, extract features from centrosomes, and analyze features to arrive at a diagnosis. ROI selection is an important part of image processing in centrosome analysis.

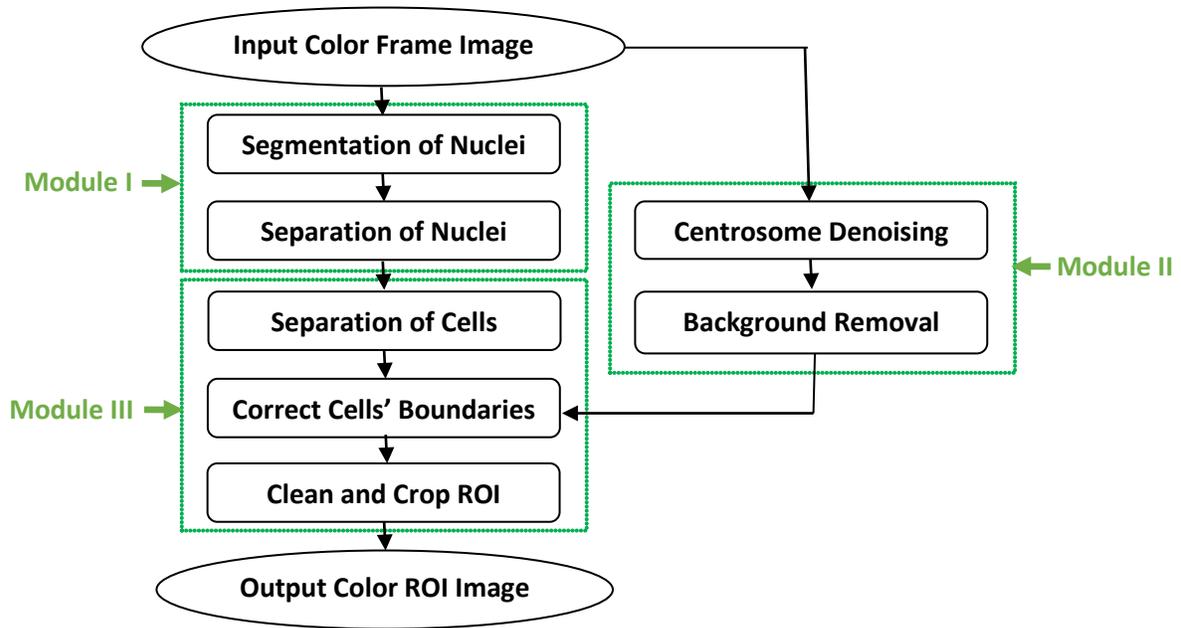
## Automatic ROI Selection

Region of interest (ROI) selection is commonly used in medical image processing. ROI selection has been carried out manually at many hospitals for many years and this method is still used. Manual ROI selection is time inefficient, therefore economically inefficient. Manual ROI selection is also subjective and lack of consistency. Because of these reasons, people started to work on semi-automatic ROI selection and fully-automatic ROI selection. As databases become increasingly larger, fully-automatic ROI selection will be the only viable choice.

Our team started from using manual ROI selection while developing a semi-automatic ROI selection process. It worked well but not as efficient as fully-automatic ROI selection, especially for a large database. We have recently developed a fully-automatic ROI selection software with an accuracy rate of about 97% in our database.

With selected ROI, our image processing work will be easier and the performance will be better. That is obvious as it is much easier to work on a smaller and simpler ROI image that only includes one cell and its centrosomes than working on a huge, complicated frame image with many cells and other tissues.

The objective of our ROI selection is to divide a frame image into some smaller images. Every resulting image features only one cell and the centrosomes belonging to this cell. The first step is segmentation of the nuclei and then the separation of some connected nuclei. Boundaries are then drawn between cells where some of these boundaries may need to be corrected to avoid centrosome bisection which inhibits centrosome analysis. After the correction, all the cells and centrosomes are separated appropriately. The final step is cleaning and cropping of individual ROI and outputting it. The following is the flow chart of this system.



Flow Chart of Automatic ROI selection

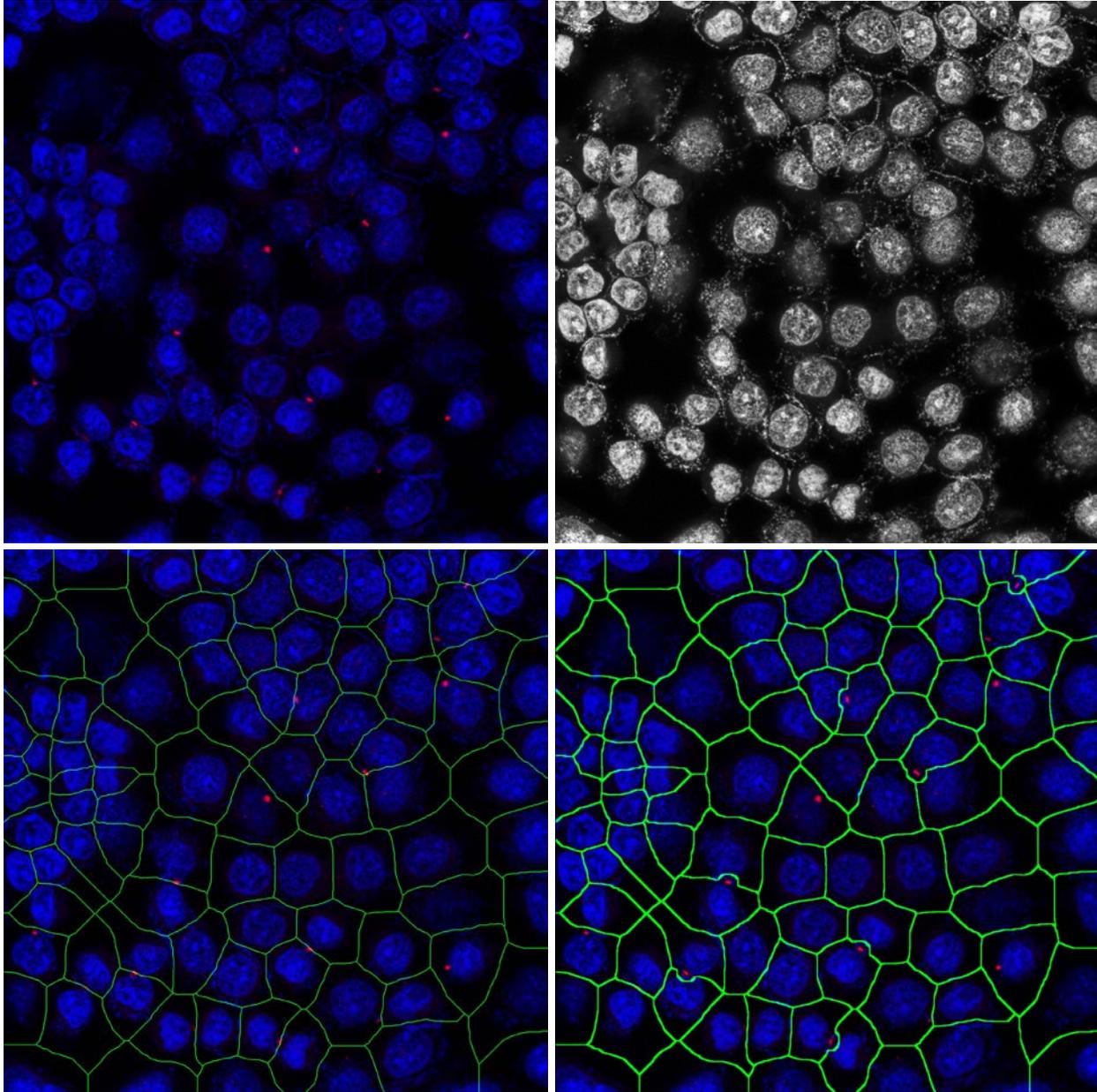
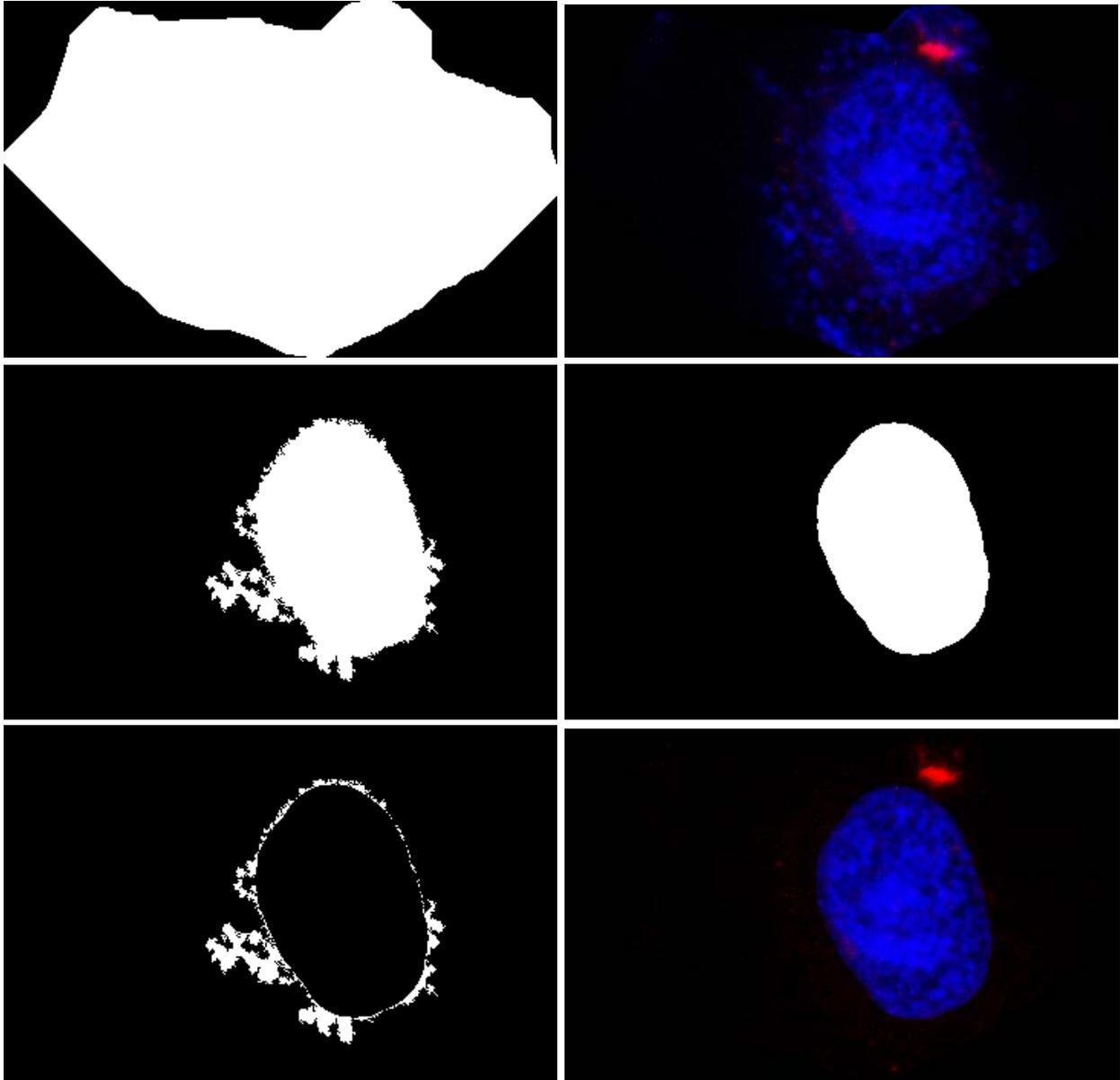


Fig. 1. **Top-left:** Original color frame image includes nuclei, centrosomes, and noises. **Top-right:** Gray image taking from a channel of original frame image. It only includes cell nuclei without centrosome. **Bottom-left:** Full color image with cells' boundaries. Cells have been separated. However some centrosomes were cut, which is not acceptable since it will affect the following centrosome analysis. **Bottom-right:** The full color image with corrected boundaries, no centrosome is cut by new boundaries.



**Fig. 5. Top-left:** A mask of a separated cell area. **Top-right:** A separated cell obtained by the mask. **Middle-left:** A segmented nucleus mask with noise. **Middle-right:** A cleaned nucleus mask. **Bottom-left:** The difference between the masks of before and after cleaning. **Bottom-right:** The full color image of nucleus and centrosome of the cell after the cleaning.