

3D Visualization For Blood Cells Analysis Versus Edge Detection

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Abstract

3D microscopy imaging is important for understanding complex biological assemblies. Computers and digital image acquisition systems have made possible the 3D visualization of images obtained from optical microscopes.

This paper discussed a morphological approach for 3D blood cell visualization. The 3D plotted image is obtained from 2D image by combining 2D image space with the intensity value presented as third axis. 2D image detection techniques are commonly apply for blood cell analysis on image taken from microscopy or scanner sample which normally could be affected by noise. In order to enhance the detection of blood cell for 2D image and to obtain the clearest view of the blood cell, 3D image detection, which is more flexible and accurate, is proposed. This approach helps to obtain a clear image for disease analysis.

A color image taken from microscopy or scanner has to gone through such image analysis using intensity, and edge operator to detect the blood cell disease, before 3D visualization can be done.

INTRODUCTION

In blood analysis component of the blood are distinguished by their dimensions and color. Blood cell classification and analysis is an important diagnostic technique in the detection of many illnesses [1]. The importance of traceability in the medical diagnostics is a technique that can be determined from a microscope slide or from a set of images.

An accurate diagnosis could aid in diagnoses treatment disease, therefore the accurate details of the cells has to be analytical.

In malarial blood, the red corpuscles of vertebrates are infected by malarial parasites [2]. The morphological blood cell image analysis includes calculation of geometrical features for recognition of pathology [3].

The goal of this paper is to enhance the detection by using or viewing blood cells visualization to provide a clear view to pathologies in order to reduce noise of the image for more accuracy diagnoses.

BLOOD IMAGE DETECTION TECHNIQUES

There are automated technologies for cell analysis, such as

impedence analysis and flow cytometry, these method lack the ability to visualize each of the cell used in there determinations, and visually inspect them to ensure that they were classified appropriately [4]. In edge image detection acquired from stained blood, smears are suitable for measuring and characterizing properties of individual cells [5].

Edge detection is essentially the operation of detection significantly local changes in image. In one dimension, a step edge is associated with local peak in the first derivative. The gradient is a measure of change in function, and an image can be considered to be an array of sample of some continues function of image intensity. The gradient is the two-dimensional equivalent of the first derivative and is defined as the vector.

Figure 1

$$G[f(x,y)] = \begin{bmatrix} G_x \\ G_y \end{bmatrix} = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix} \quad (1)$$

There are two important properties associated with gradient, a vector $G[f(x,y)]$ point in the direction of the maximum rate of increase of the function $f(x,y)$, and magnitude of gradient.

Figure 2

$$G[f(x,y)] = \sqrt{G_x^2 + G_y^2} \quad (2)$$

$$G[f(x,y)] \approx |G_x| + |G_y| \quad (3)$$

To achieve a better edge object detection; edge detection algorithm consist of two steps which is filtering and enhancement.

In filtering since gradient computation based on intensity values of only two point are susceptible to noise and other verities in discrete computation, filtering is commonly used to improve the performance of an edge detection with respect to noise. There is a process between edge strength and noise reduction, more filtering reduced noise results in a loss of edge strength.

For enhancement: in order to facilitate the detection of edge, it is essential to determine changes in intensity in the neighborhood of a point. Enhancement emphasize pixels where there is a significant change in local intensity value and is usually performed by computing the gradient magnitude

Clearly clarify that it is important to not that detection merely indicates that an edge is present near a pixel in an image, but does not necessarily provide an accurate estimate of edge location or orientation. In conclusion it is impotent to note that detection indicates that an edge is present a clear pixel in an image, but does not provides an accurate estimation of edge location or orientation.

The errors in edge detection are errors of misclassification like false edges and missing edges.

SYSTEM PREVIEW

In blood cell image detection, the task is usually split into two stages one is image enhancement, with the purpose of reducing noise and clear view and the other is detection of blood cell data. In our proposed stage image filtering and enhancement is one part of stage and the detection on the later stage. 3D plotting surface algorithm achieves a better result for decision making, This is illustrated in diagram 1-a which shows the edge detection and diagram 1-b the proposed image visualization process.

During the visualization development, we realized that most of blood cells were aggregated. To recognize the cells, we must visualize and sharpen the image edge to drive more details and location [6].

To enhance the color image quality, from darkness to brightness image equalization is applied. Other image enhancement steps and techniques are also applied to increase the preparation of the visualization of the cells.

Figure 3

Diagram 1-a: image preparation process

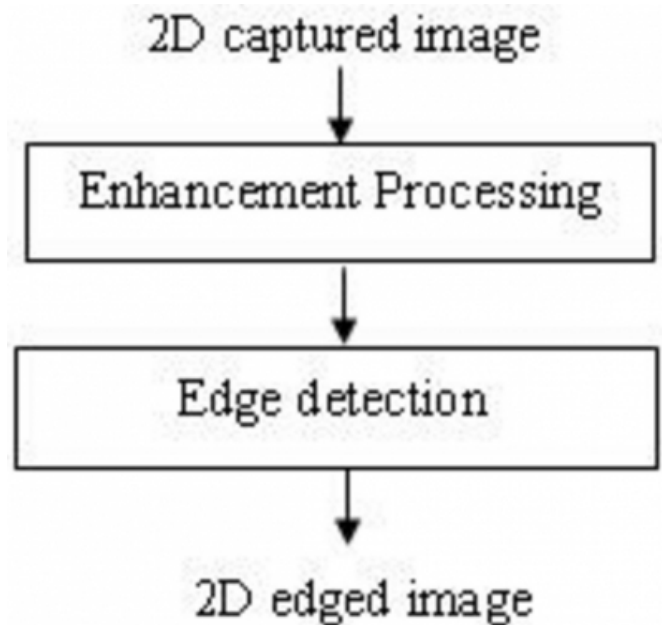
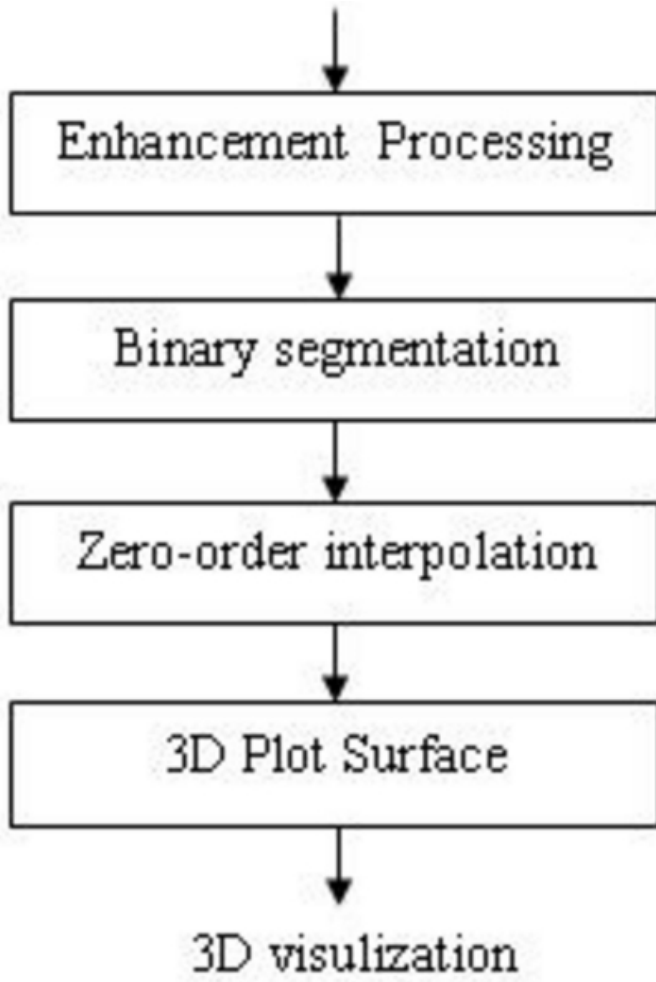


Figure 4

Diagram 1-b: purposed image visualization process



VISUALIZATION USING SURFACE REPRESENTATION ALGORITHM

Surface representation refers to the discrete three-dimensional data points derived elsewhere (reconstructed data points) and interpretation of the data to be displayed.

These data's can be used to form the polygon mesh model of visualized complete object. A polygon mesh model consists of collection of three or more points (x, y, z).

In well arranged data, it may be adequate to assume that the surface is a series of planner polygons (quadrilateral or triangles) interpolation between adjacent data points [7].

To smoothen the surface, smooth technique or some times called an approximation method is used [8]. The surface passes near to or approximate to the given data. In interpolation method, the surface passes through the measured data points.

A parametric B-spline technique is widely used for both smoothing and interpolation surface coordinates. B-spline uses control points to define the shape of the surface smoothing and continuity [9].

B-spline cure is a parametric representation characterized by

Figure 5

$$P(\mu) = \sum_{i=0}^N P_i B_i(\mu) \tag{4}$$

Where P_i is the vertices of B-spline curve while $B_i(\cdot)$ is the cubic B-spline basic function.

3D PLOT SURFACE APPROACH FOR BLOOD CELL IMAGE

Blood cell image enhancement. Surface plotting will show a 3D visualization approach and 3D data is considered as a function z of two variables x and y, that is z (x, y).

Every pixel in 2D image shown as a row and column (x, y) are drawn as a 2D image. Each pixel in any image have n row and m column, the number of row and column will change according to image size. Pixel carries the coefficient value of intensity. From the Figure 1-a and 2-b, rows and columns of 2D image can produce pixel intensity values verses pixel row and column in (x, y) space.

Figure 6

Figure 1a:

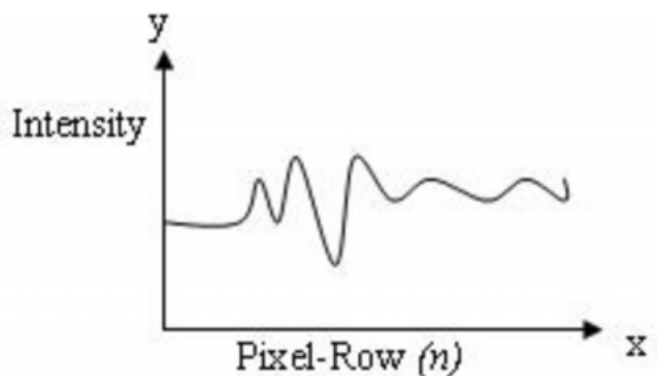
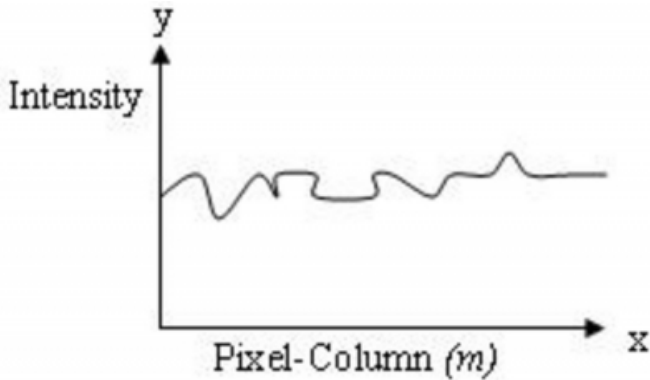


Figure 7
Figure 1b:



The intensity is the depth of each pixels for the image. Figure 2-a; show the row and column pixel value against intensity. In Figure 2-b show the row and column, pixel connection in (x, y, z) space.

The depth value of each pixel is stored in a depth of a 2D array. To obtain the 3D array, (x, y, z) from 2D array carried (x, y) pixels values although combine the intensity array z as intensity pixel value. The intensity, which is the depth of the pixel will be represented by z-axis. The z value is the value stored in the depth map and hence gives 3D array (x, y, z) to draw a 3D diagram from the 3D array with x-axis represents column, y-axis represents rows and z-axis represents intensity of every pixel in the image.

Figure 8
Figure 2a:

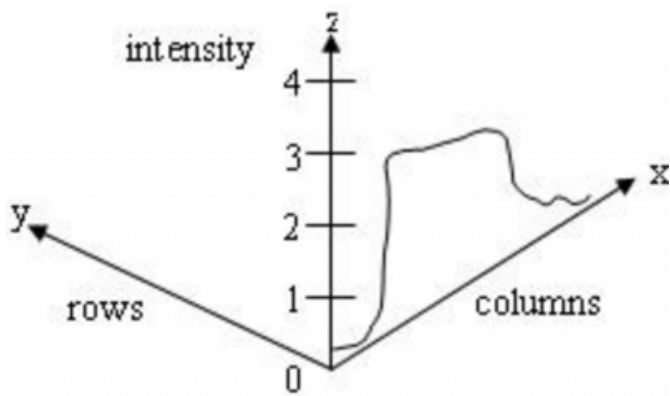
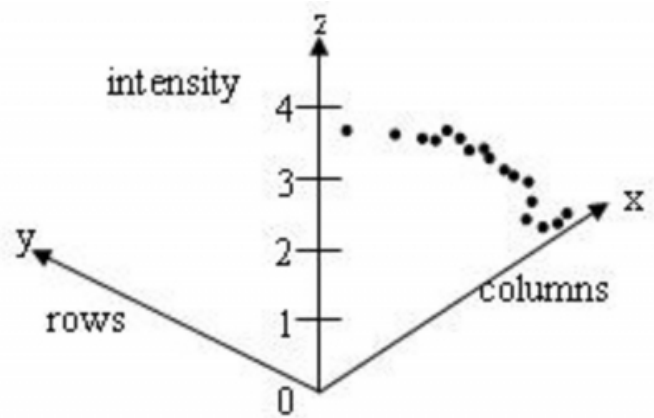


Figure 9
Figure 2b:

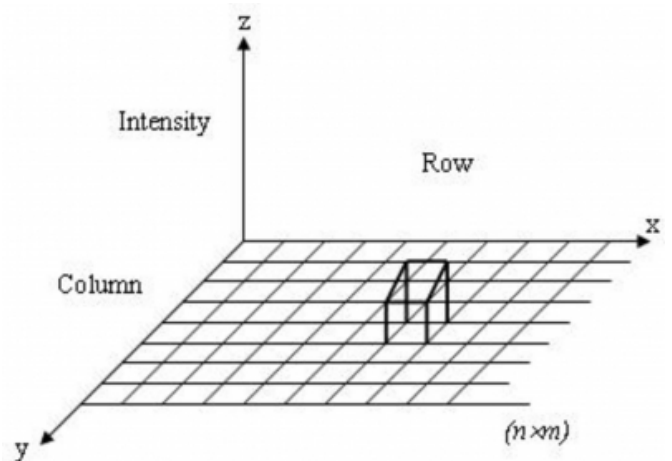


The intensity information for blood cell image in z-axis, shown the high intensity pixel as a high point, and the low intensity pixel will appear as a deep point in (x, y, z) space.

To obtain visualization for 2D blood cell images, pixel value are presented as volumes for each pixel elements in 3D array (x, y, z). Data set can be regarded as a 3D array of vectors, where each vector in general has several values. The values in general are transformed to three vectors x, y and intensity to represent the data in 3D surface model, illustrated in Figure 3. Where the number of pixel in n numbers of row will represent as x-axis, the number of pixel in m numbers of column will represent as y-axis and the value of pixel intensity will represent as z-axis.

By combining the 3 values of pixels in the same graph, illustrated in Figure 3 the n number of row crosses the m number of column, as a 2D image space and the z-axis shows the 3D image space by the pixel intensity values.

Figure 10
Figure 3:



The surface can be defined by applying a binary segmentation function $B(v)$ to the volumetric data. $B(v)$ evaluates to 1 if the value v is considered part of the object, and evaluates to 0 if the value v is part of the background.

The surface is then the region where $B(v)$ changes from 0 to 1.

If a zero-order interpolation function is being used, then the surface is simply the set of faces which are shaded by voxels with differing values of $B(v)$.

The zero-order interpolation functions, is the natural choice for a geometric primitive in the 3D rectangular cuboids, since the surfaces are set of faces and each face is a rectangle.

By presenting the pixel intensity value in image space, 3D points per visible surface cell are achieved.

EXPERIMENTAL RESULT

Mathematic morphology is well suited to biological and medical image analysis.

Proposed system is based on morphological techniques, using 3D visualization to plot 3D surface for the blood cells with nucleus and without nucleus.

Before image visualization is carried out, the first step in the whole analysis procedure is the enhancement of the image quality by applying histogram equalization to reduce unclarity, contained in the real image that come from microscopy or scanner sample.

Second step is to detect the high intensity area from the blood cell image.

Third step is to detect the board and the edge of blood cells. Figure 4 illustrate original image. In the application the outline area will appear clearly so that the edge detection approach can be done. However the result will be of 2D image as illustrated in Figure 5.

Figure 11

Figure 4: Blood cell image original

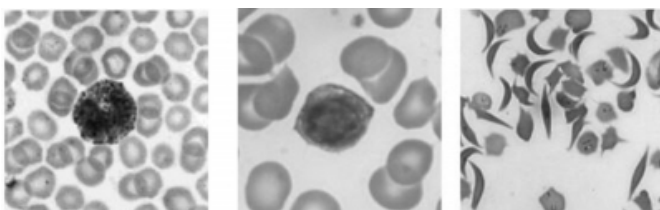


Figure 12

Figure 5: Blood cell image edge detection



Figure 13

Figure 6: 3D blood cells image

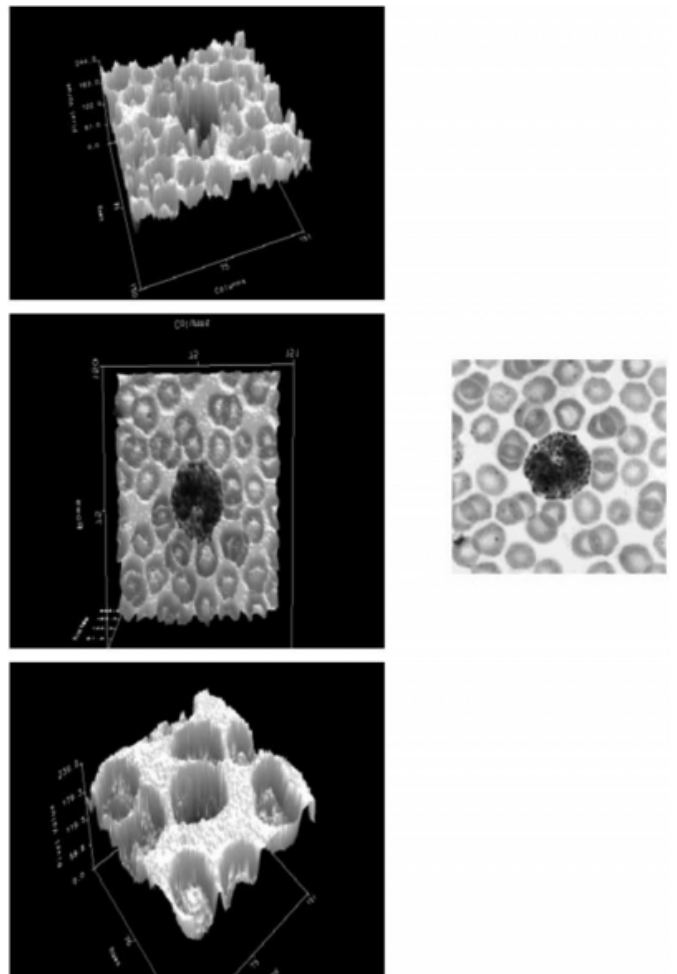
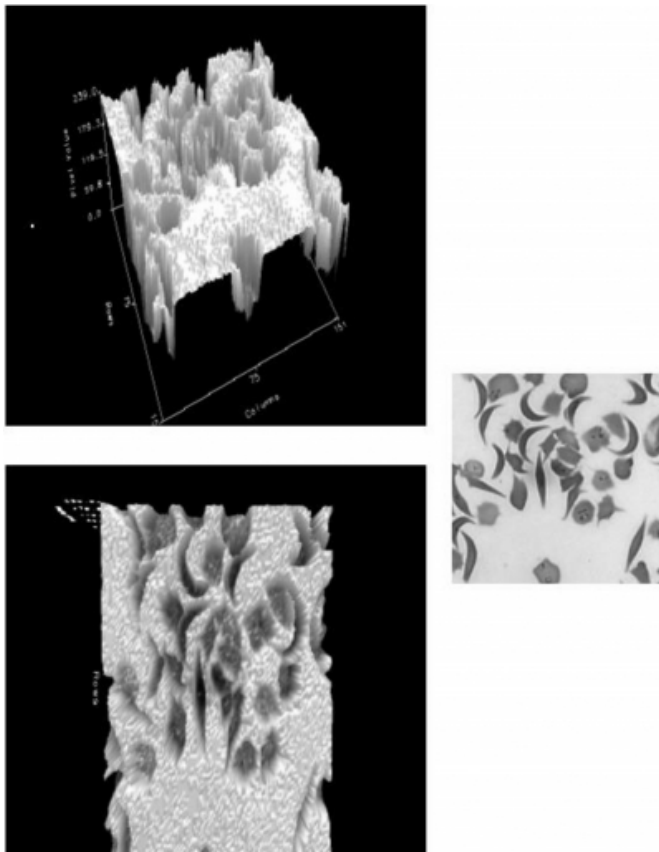


Figure 14



We have applied 3D plotting surface method on 2D blood cells images. The 3D image obtained from 2D image in different views are illustrated in Figure 6.

From the result clearly shown that the effect and blood cells overlapping problem, where the noise and edge in 2D image actively covered. Visualization providing the 3D space surface to obtained clear view on the edges and cells image detail more accurate for further pathologies analysis.

CONCLUSION

Edge detection is often used as a basic method for diagnosis of blood disorder.

The initial analysis for any blood sample starts from size, shape, nucleons, etc.

To make the right decision for diagnosis we need a clear view to help the pathologist to get further information from the sample for early and accurate detection of abnormalities.

To provide a better image view, edge detection and contrast enhancement is needed.

In this paper we have presented a morphological system to visualize blood cells images. We have applied 3D plotting surface on blood cells, which exist as partial difference between 2D blood and 3D blood images.

The 3D image is obtained from the 2D image by combining 2D image space (x, y) axis with intensity value as z-axis.

From the results shown, we can realized that the resolution of blood cells is affected by the pixel intensity as high value and hence give us a brighter area rather than low intensity pixel which remarks in dark colored area. This result depends on the pixel depth in the array element.

2D image detection techniques cannot give as a clear view of the detected image.

In conclusion, the proposed method helps to further provides information for the pathologies to obtain clear image for decision analysis rather than the edge detection method.

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