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Reconstructing the Biological Images Using Morphological Processes and Evaluating Using Statistical Features

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Abstract

In this paper morphological operation using to reconstruction biological images Reconstruction is keeping the biggest structures completely sound while removed small structures. Algorithm has been proposed include per processing of biological images using contrast adjustment and then applying different morphological operation has been using to reconstruction biological images include (erosion, dilation, opening , top-hat and closing) and In order to compare results, quality assessments were adopted Included(msr,psnr,l2rat,maxerr). The colored biological used in the research were taken from the Microbiology Laboratory at the college of Science, Department of Life Sciences Al-Mustansiriyah University. Ten different biological images applied to the algorithm proposed in this research were shown only two images The programming tool used is MATLAB software

version R2010a and the results showed that morphological operations which include (erosion, closing, dilation, and opening) are given good result for reconstruction for biological image. Top-hat transformation morphological operation is given bad result for reconstruction for biological image.

Keyword: Morphological operation, Morphological reconstruction, Contrast Adjustment, image Quality

المستخلص

في هذه البحث عمليات التشكيل استخدام إعادة إعمار الصور البيولوجية. إعادة إعمار الصور يقوم بإزالة الهياكل الصغيرة، مع الحفاظ على هياكل أكبر سليمة تماما. وقد تم اقتراح خوارزمية تشمل في معالجة الصور البيولوجية باستخدام تعديل التباين ومن ثم تطبيق العملية المورفولوجية المختلفة وقد تم استخدامها لإعادة الصور البيولوجية تشمل (تآكل، وتمدد، وفتح، أعلى قبعة وإغلاق). مقارنة الصور الناتج باستخدام معايير تقييم الجودة تشمل (msr, psnr, l2rat, maxerr). وقد استخدمت الصور البيولوجية الملونة المأخوذة من مختبر الاحياء المجهرية في قسم علوم الحياة في كلية العلوم بالجامعة المستنصرية. وقد طبقت الخوارزميات على عشرة صور ملونة بيولوجية مختلفة؛ في هذا العمل تم عرض صورتين فقط. أداة البرنامج التي تم استخدامها هي ماتلاب R2010a. وأظهرت النتائج العمليات المورفولوجية (تآكل، وتمدد، وفتح وإغلاق) تعطى نتيجة جيدة لإعادة الإعمار للصورة البيولوجية. أعلى -تحويل عملية المورفولوجية تعطى نتيجة سيئة لإعادة الإعمار للصورة البيولوجية

1-INTRODUCTION

A growing important function in a lot of fields of science and its countless which requests from pictures .the best examples of this fields which accreditation strongly upon pictures

for making progress is Biology .effective of microscopic picture, obsession treading devices As a consequence of the start growing the ability to discriminate , telecommunication media. And the fast decreasing cost of mass storage, more and more information was carried by biological picture. Hence there is increasing need for computerized image which under treatment and analytics, not only to reach a higher level of accuracy, objectivity and sensitivity but because extracting this information by visual inspection its results weakly reusable are potentially inaccurate than can be the be realized by human observers not only to adaptation with the height rate at which picture are obtained [1,2].Deep learning enables improved image analysis for high through put microscopy as compared to traditional machine learning methods [3, 4]. This is mainly due to three general advantages of deep learning over traditional machine learning: there is no need for cumbersome preprocessing and manual feature definition, prediction accuracy is improved, and learned features can be visualized to uncover their biological meaning. In particular, we demonstrate that this enables reconstructing continuous biological processes, which has stimulated much research effort in the past years [5–8].

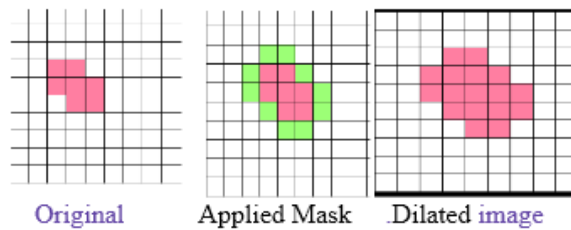
2-Morphology

The term morphology refers to the shape, structure of the object, arrangements, mutual relationships between its parts, and digital morphology means to describe and decomposition the form of a

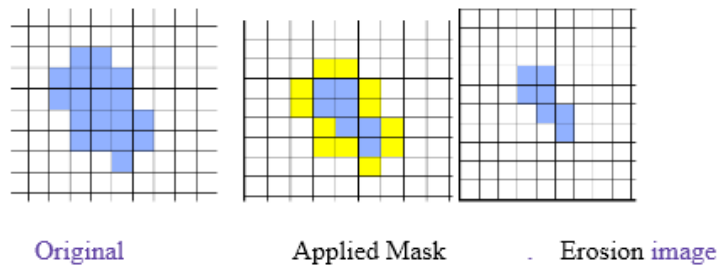
digital element in biology is a morphology directly correlated to the organism like bacteria [9].

2.1. Morphological operations

Morphological operations can be applied to images of all types. Dilation and erosion represent ones relatively simple operation of morphological operations .it is indeed as possible to display and many more complex morphological measures may be drop to series of dilations and erosions .In picture erosion removes picture an item on object boundaries while Dilation adds picture an item to the boundaries of objects. Number of picture elements added or removed from the objects in picture depends on the size and content of the structuring an item used to treat the picture. In the morphological dilation and erosion operations, the state of any through picture an items in the output picture is specify by progress a base to the interview picture an item and its neighbors in the enter picture [10]. Figure 1 (a and b) The dilation and erosion of picture.



A-Dilation change a background pixel to foreground if it has a foreground pixel as a 4-neighbor [10].



b- Erosion change a foreground pixel to background if it has background pixel as a 4-neighbor [10].

Figure. (1): a-Dilation Morphological operations .b-Erosion Morphological operations

2-2 Opening and Closing

The erosion of the expanded dilator is the opening which is used to removes all picture anitemin very small areas to fit an item structural. In this status the an item structural is usually which is called investigation in order to investigate the picture you ought to search for small objects which work purification of the image Opening process is:

$$A \circ B = (A \ominus B) \oplus B \text{ --- (1)}$$

Where A is image and B is the structuring element. The opening of the image A by structuring element B is defined as the erosion of A by B followed by a dilation of the result with B.

Nomination the internal picture is done by erosion and dilation which purification the external picture whiles the opening process

which break the narrow gaps and soften the picture contour. Closing is a morphological process used in revealing of the edge of the image because it work to remove the small gaps and tight links and fills the gaps in the advantages and at the same time reduces the noise of picture it is opposite of the opening .The closing Process is as below:

$$A \cdot B = (A \oplus B) \ominus B \text{-----} (2)$$

The closing of the image A by structuring element B is defined as the dilation of A by B followed by a of the result with B [11].

2-3 Morphological reconstruction

Morphological reconstruction is a morphological transform which include 2 pictures and a structuring an item. One picture is marker sign; it contains the beginning points of conversion and the other picture, the mask, constrains the conversion. The structuring an item is used to locate contact [12].

2-4 Opening by reconstruction of erosion

Frequent implementation of the dilation or erosion of the picture leads to stability result. Frequent operations of dilation and erosion even stability which is called reconstruction through erosion and reconstruction by dilation respectively. It can be shown that iterated application of geodesic dilation or erosion to picture .Will converge to a stable result. If we iterate the operations until stability occurs, this is called reconstruction by dilation and reconstruction by erosion respectively. The opening is the convening of erosion and dilation. The special formation of

erosion and reconstruction by dilation is called opening by reconstruction of erosion or just an opening by reconstruction. The influential means of removing small facilities structures from the image is opening by reconstruction. The erosion step works to cancellation the small facilities from the original picture. It also corrosion the border of large facilities, yet some of these facilities stayed in the picture reconstruction by geodesic dilation with original picture for a organize picture If this does small parts are completely removed by erosion and will not grow again as reconstruction leads to the removal of small facilities while maintaining facilities that are completely safer [13].

2-5 the Top-Hat Transformation

The difference benny the picture and the picture after the treat of opening with the building an item is top-hat Transformation(conversion) and it is useful to ignore the details that produce was hidden through illumination or shading the difference of the whole picture [4]. And to identify local parameters for the size of an item of structuring that indicate the local patterns of picture item. It represents an alternative to matching a template in the sense of finding groups of picture items with particular shape characteristics (such as border points or corners) [14].

3- Contrast Enhancement

Analysis of a biological image involves examining every particle of the image and removes any of the problems such as non-uniform illumination, less brightness etc. contrast enhancement

techniques (contrast adjustment) is used to enhance the contrast of the biological image, it spreads the intensity values over full range. The enhancement techniques are used to improve biological image, where

3-1 Contrast Adjustment

For drawing new mapping of Image density values on a new scale In addition to increasing or decreasing contrast, using the intensity modulation technique is changing the general lightness or darkness of the image and a wide range is changed of image enhancements can get from contrast adjustment [15].

4-image Quality

Table (1): methods quality of biological images

	method	representation
1	MSR (Mean Square error)	$\text{MSR} = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N (x(i,j) - y(i,j))^2$
2	PSNR (Peak Signal to Noise Ratio)[16]	$\text{PSNR} = 10 \log_{10} \left(\frac{2^n - 1}{\sqrt{\text{MSE}}} \right)^2$
3	L2RAT	Representation ratio of the squared norm of the image approximation to the input image.[17]
4	MAXERR	Representation maximum absolute squared deviation of input image from the approximation output image

Note – Where $x(i, j)$ represents the original (reference) image and $y(i, j)$ represents the distorted (modified) image and i and j are the pixel position of the $M \times N$ image.

to evaluate the quality of the images used methods explain in table (1) were this method calculated in this work for each biological reconstruction image obtained after applying morphological operation(erosion, dilation, opening and top-hat and closing)

5- Proposed Methodology

The Proposed Methodology can be divided in six steps as shown below (input color biological image and the output is the reconstructed biological image)

step1: Read color biological image.

step2: Convert color image to grayscale.

step3: Adjust the contrast of the biological image to create the mask image using contract adjustment

step4: Applying the Morphological Operations (erosion, dilation, opening and top-hat & closing) using a diamond structuring element of radius 7.

step5: Perform morphological reconstruct on the biological image obtained from step 4

step6: Quality assessment depend on calculated the methods based on the biological images which are (MSR, PSNR, L2RAT and MAXERR)

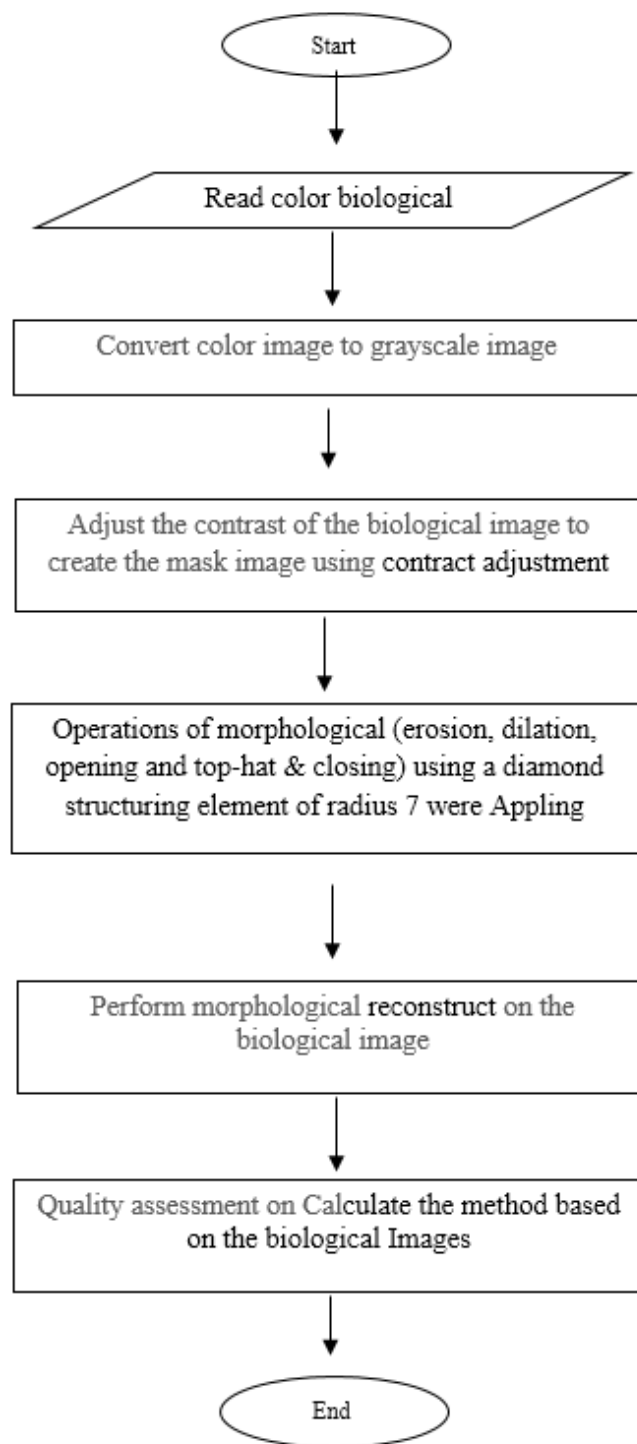


Figure 2–Block diagram of implemented system

6- Results

We ran tow real biological images through our proposed algorithm and the results are:

Figure 3:- Effects of morphological operations (erosion, dilation, opening, top-hat & closing) applying on tow biological images. From top to down (original color image, grayscale & its contract adjustment, erosion & its reconstruction, dilation& its reconstruction, opening& its reconstruction, top-hat & its reconstruction, closing & its reconstruction to identifies high-intensity objects in the biological image

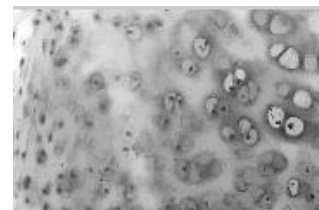
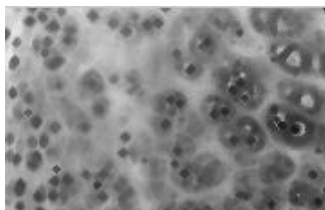
Figure 2: Shows charts of approximation quality metrics include (PSNR, MSE, L2RAT and MAXERR) for tow biological images for different morphological operations and its reconstruction.



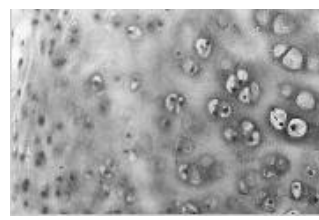
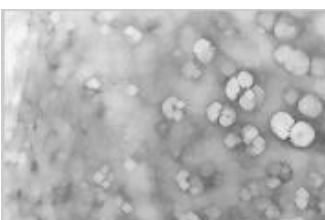
RGB biological Image1



Grayscale & Adjust mask biological image1



Erosion & its reconstruction biological image1



Dilation & its reconstruction biological image1



Opening & its reconstruction biological image1



Top-hat & its reconstruction biological image1



Closing & its reconstruction biological image1



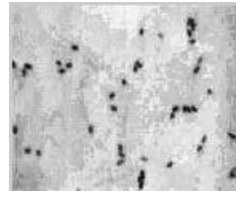
RGB biological Image2



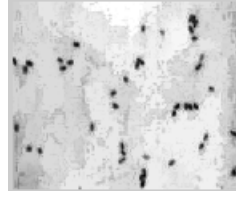
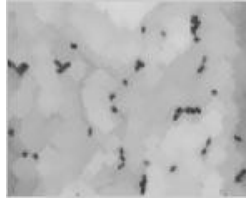
Grayscale & Adjust mask biological image2



Erosion & its reconstruction biological image2



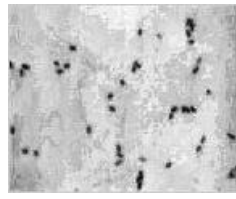
Dilation & its reconstruction biological image2



Opening & its reconstruction biological image2



Top-hat & its reconstruction biological image2



Closing & its reconstruction biological image2

Figure 3:–.From top to down (original biological color image, grayscale & its contract adjustment, erosion & its reconstruction, dilation& its reconstruction, opening& its reconstruction, top-hat & its reconstruction, closing & its reconstruction).

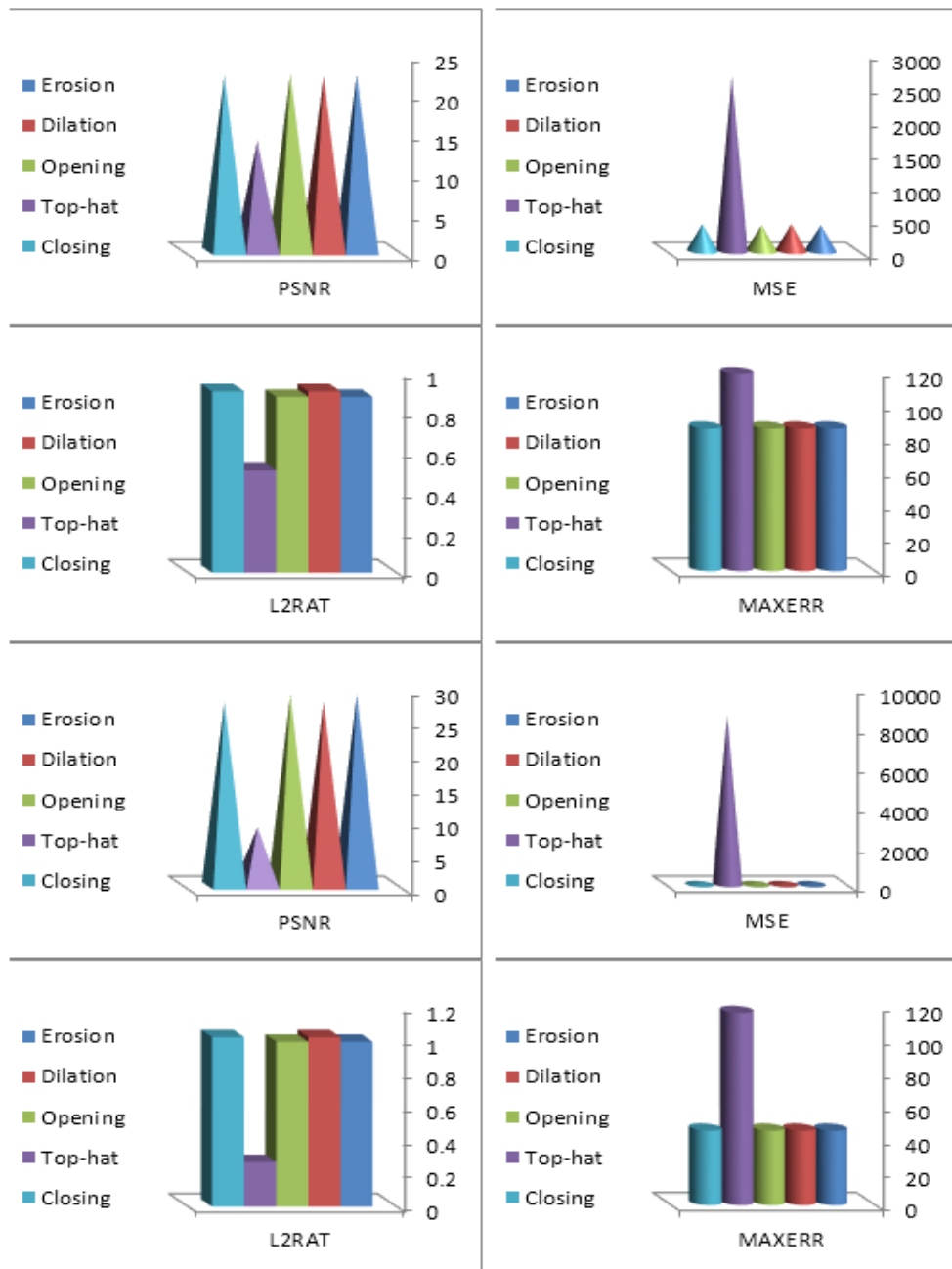


Figure4: Shows charts of approximation quality metrics for tow biological images for different morphological operations.

7- Conclusion

Mathematical morphological processes are a powerful tool in checkup of forms in the pictures of the biological because they work to transform the building with simple shapes of object that enhance their explanations and extraction their features.

The analysis of results showed:

1. Operations of Morphological which include (erosion, opening, dilation and closing) are given good result for reconstruction for biological image because (higher value of PSNR&L2RAT and lower value of MSE & MAXERR) represents better quality of the compressed or reconstructed image.
2. Top -hat transformation morphological operation is given bad result for reconstruction for biological image because (lower value of PSNR & L2RAT and higher value of MSE & MAXERR represents bad quality of the compressed or reconstructed image. .

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