

# Edge Detection of the microscope images using AND Binary Operation

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## Abstract

large change in image brightness over a short spatial distance indicates the presence of an edge. The goal of edge detection of image is to mark the points in a digital image at which the luminous intensity changes sharply which refer changes in images properties .There are a number of techniques that might be used to edge detection of microscope image one of them is using AND binary operation.

In this paper two techniques are used to edge detection of microscope images one of them is use Threshold with AND binary operation and the other is use Sobel operator with AND binary operation .The result show that the two techniques give a good result for edge detection of microscope image.

Key words : edge detention ,Binary operation , ,Image Analysis

## 1-Introduction

The goal of edge detection is to mark the points in a digital image at which the luminous intensity changes sharply .Sharply changes in images properties usually reflect important events and changes in properties of the world. These include

- (i) discontinuities in depth .
- (ii) discontinuities in surface orientation
- (iii) changes in material properties
- (iv) variations in scene illumination.

Edge detection is a research field within the image processing and computer vision, in particular within the area of feature extraction. Edge detection of an image reduces significantly the amount of the data and filters out information that may be regarded as less relevant ,preserving the important structural properties of an image[1].

The edge detectors are used to mark points of rapid change thus indicating the possibility of an edge. These edge points represent local discontinuities in

specific features .For boundary representation the analysis is partially complete since the boundary already represents a closed path around a feature[2].The image processing operations operate on one image and produce a modified result that can be stored in the same image memory .Another class of operations uses two images to produce a new image (which may replace one of the originals) .These operations are usually described as image arithmetic since operation such as addition, subtraction, division and multiplication are included .They are performed pixel by pixel,. There are also additional operators that for example, compare two image to keep the brighter (or darker) pixel obtain the absolute difference and keeping the pixel with the greater local variance as a means of combining images. Other two image operations such as Boolean OR/AND logic, are general applied to binary images. [1,3]

### 2-Edge Detection

large change in image brightness over a short spatial distance indicates the presence of an edge. Same edge detection operators return orientation information (information about the direction of the edge)where as others only return information about the existence of an edge at each point. Edge detection methods are used as a first step in the line detection is also used to find complex object boundaries by marking potential edge points corresponding to places in an image where rapid changes in brightness occur . After these edge points have been marked, they can be merged to form lines and object outline [4].

### 3- Thresholding

This technique is based upon a simple concept. A parameter  $\theta$  called the brightness threshold is chosen and applied to the image  $a[m,n]$  as follows[5]:

$$\begin{aligned} \text{If } a[m,n] \geq \theta & \quad a[m,n] = \text{object} = 1 \\ \text{Else} & \quad a[m,n] = \text{background} = 0 \end{aligned} \quad \text{-----(1)}$$

This version of the algorithm assumes that we are interested in light objects on a dark background. For dark objects on a light background we would use [5]:

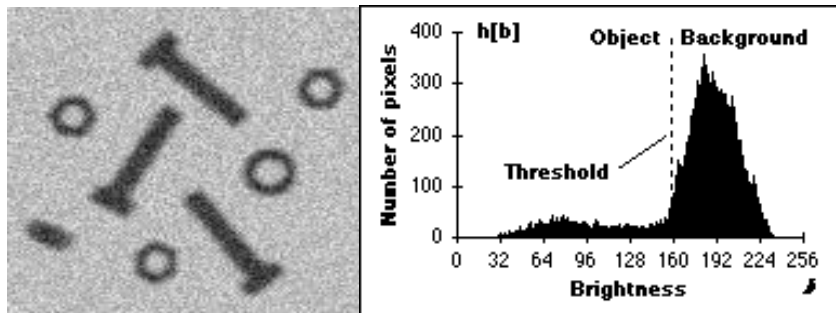
$$\begin{aligned} \text{If } a[m,n] < \theta & \quad a[m,n] = \text{object} = 1 \\ \text{Else} & \quad a[m,n] = \text{background} = 0 \end{aligned} \quad \text{-----(2)}$$

The output is the label "object" or "background" which, due to its dichotomous nature, can be represented as a Boolean variable "1" or "0". In principle, the test condition could be based upon some other property than simple brightness .

The central question in thresholding then becomes: who do we choose the threshold  $\theta$ ? While there is no universal procedure for threshold selection that is guaranteed to work on all images, there are a variety of lternatives.Istogram-

derived thresholds - In most cases the threshold is chosen from the brightness histogram of the region or image that we wish to segment. An image and its associated brightness histogram are shown in Figure(1)[5,6].

$$h_{smooth}[b] = \frac{1}{W} \sum_{w=-(W-1)/2}^{(W-1)/2} h_{raw}[b-w] \quad W \text{ odd}$$



(a) Image to be thresholded (b) Brightness histogram of the image

Figure 1: Pixels below the threshold ( $a[m,n] < \theta$ ) will be labeled as object pixels; those above the threshold will be labeled as background pixels [6]

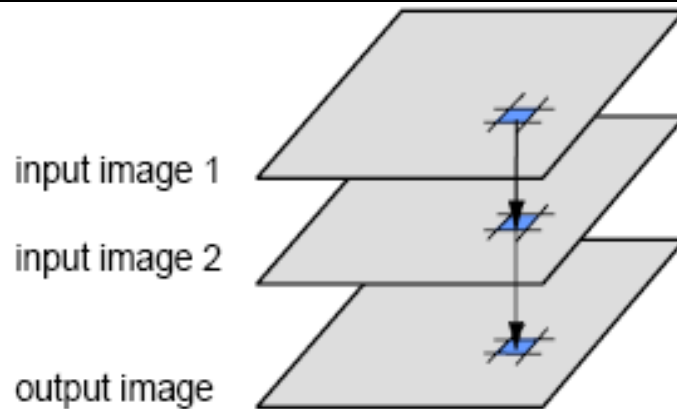
Threshold selecting feature within a scene or image is an important Prerequisite for most kinds of measurement or analysis of the seen one simple way this selection has been accomplished is to define arrange of brightness values in the original image select the pixels within range as belonging to the foreground and reject all of the other pixels to the background Such an image is then usually displayed as a binary or two-level image using black and white (or sometime other colors) to distinguish the regions [7].

#### 4- Binary Operations

Binary operation is the operation based on binary (Boolean) arithmetic form. The binary operations are point operation and thus admit a variety of efficient implementations included simple[2]. Table (1) show the type of operation on image and fig (1) show pixel operation[4].And fig.(2)show Binary images operations

Table (1) the type of operation on image[2].

| Operation type   | Monadic<br>(one input image) | Dyadic<br>(two input images) |
|------------------|------------------------------|------------------------------|
| Pixel operation  | Identity ,inversion          | Boolean arithmetic           |
| Neighborhood     | Cellular logic operations    | Hit-or-miss transforms       |
| Object operation | Skeleton Exo-skeleton        | Propagation Anchor-skeleton  |



|                         | Boolean operations   | Set operations  |
|-------------------------|--|---|
| Monadic (1 input image) | <ul style="list-style-type: none"> <li>• Identity</li> <li>• Invert</li> </ul>       | <ul style="list-style-type: none"> <li>• =</li> <li>• Complement: <math>\bar{C}</math></li> </ul> |
| Dyadic (2 input images) | <ul style="list-style-type: none"> <li>• AND</li> <li>• OR</li> <li>• XOR</li> </ul> | <ul style="list-style-type: none"> <li>• Intersection</li> <li>• Union</li> </ul>                 |

Fig (1) pixel operations[ 4]

Binary images have 1 bit per pixel:

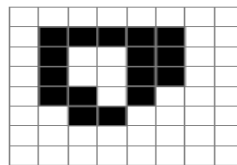
1 = object pixel

0 = non-object pixel (background pixel)

```

0 0 0 0 0 0 0 0
0 1 1 1 1 1 0 0
0 1 0 0 1 1 0 0
0 1 0 0 1 1 0 0
0 1 1 0 1 0 0 0
0 0 1 1 0 0 0 0
0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
    
```

Data



Image

Fig (2) Binary images operations[2].

The major tools for working with binary images to correct these threshold errors fit broadly into two groups'. Binary operations for combining images, and morphological operation that modify individual pixels within an image [3] what is Binary Operation?

The standard notations for the basic set of binary operation are .

1- The AND requires that pixels be ON in both of the original images to be ON in the result. Pixels that are ON in only one or the other original images the result off.[3,4]

*AND*                       $c = a \cdot b$

|     |   |   |
|-----|---|---|
| AND | b |   |
| a   | 0 | 1 |
| 0   | 0 | 0 |
| 1   | 1 | 1 |

2-The OR operator turns a pixel ON in the result if it is ON in either of the original images.

*OR*                               $c = a + b$

|    |   |   |
|----|---|---|
| OR | b |   |
| a  | 0 | 1 |
| 0  | 0 | 1 |
| 1  | 1 | 1 |

3-EX-OR turns a pixel ON in the result if it is ON in either of the original images but not if it is ON in both .That means that combining (with an OR)the results of AND ing together two images with those form EX-ORing them produces the same result as an OR in the first place.

There are infact, many ways to arrange different combinations of the four operations to produce identical results.

*XOR*                               $c = a \oplus b = a \cdot \bar{b} + \bar{a} \cdot b$

|     |   |   |
|-----|---|---|
| XOR | b |   |
| a   | 0 | 1 |
| 0   | 0 | 1 |
| 1   | 1 | 1 |

AND, OR, and EX-OR require two original images and produce a single image as a result. They are also commutative, meaning that the order of the images is unimportant A AND B produces the same result as B AND A.

4-The NOT operation requires only a single image .It simply reverses each pixel ,turing pixels that were ON to OFF and vice versa.

*NOT*  $c = \bar{a}$

|     |   |
|-----|---|
| NOT |   |
| a   |   |
| 0   | 1 |
| 1   | 0 |

Some system implement NOT by swapping black and white value for each pixel .As long as we are dealing with pixel detail, this works correctly[5].

*SUB*  $c = a \setminus b = a - b = a \cdot \bar{b}$

|     |   |   |
|-----|---|---|
| SUB | b |   |
| a   | 0 | 1 |
| 0   | 0 | 0 |
| 1   | 1 | 0 |

Other Boolean logical rules can be employed to combine binary images. The four possibilities are AND, OR, EX\_OR(exclusive OR)and NOT illustrates each of these basic operation .Fig (4 ) simple Boolean (binary )operations

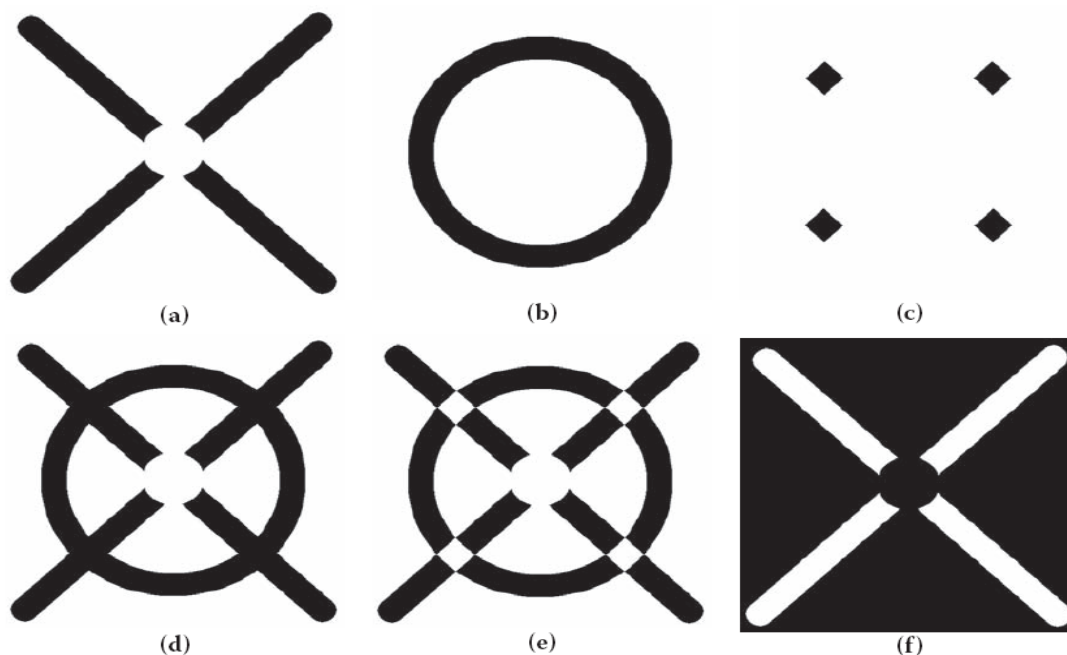


Fig (3 ) simple Boolean operations (a,b) tow binary images ( c)A OR B (d)A AND B (e) A EX –OR B (f ) NOT A[1]

**Sobel operator**

The Sobel operator have tow masks look for edges in both the horizontal and vertical directions and then combine into a single metric the masks are as follows

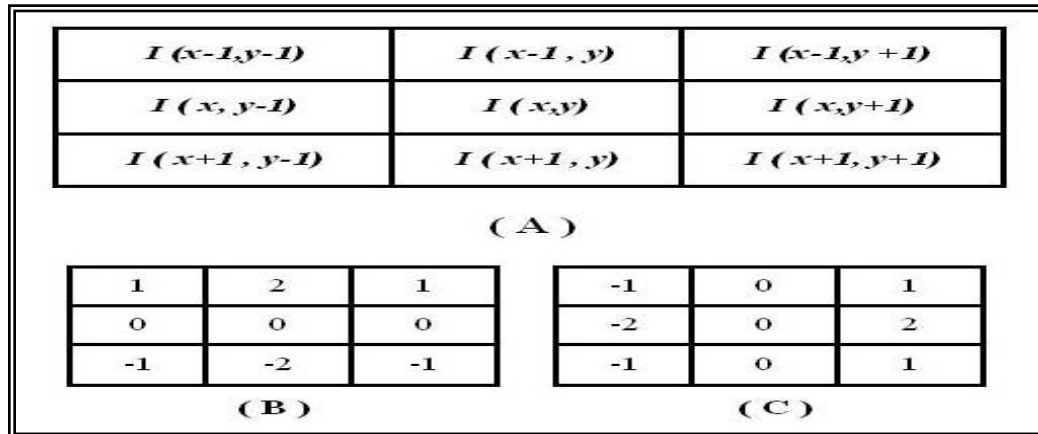


Fig (4)

A-Points Arrangement in the image [8]

B-Row Mask

C-Coolum Mask

These masks (row and Coolum) are each convolved with the image At each pixel now have two number corresponding to the result from the row mask and from the column mask we use these numbers to compute two metrics: the edge magnitude and the edge direction [8,9] .

**The Experimental Results**

This section is devoted to illustrate the experimental results of applying (Threshold and Sobel operator) with Binary AND operation on metal and microscope images The results of applying Threshold and AND binary operation are illustrated in the following figures Fig (5,6 )show the metal image and the result of applying threshold and AND binary operations.



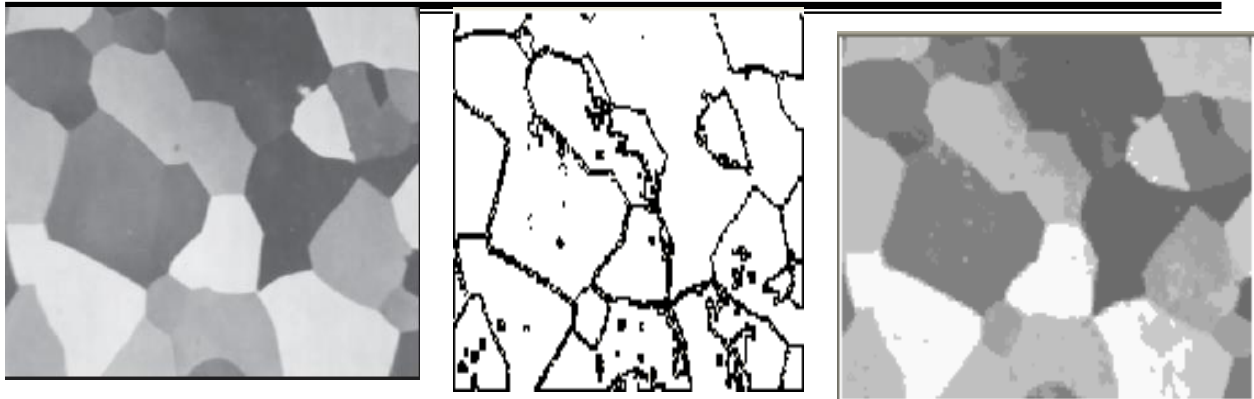
Fig(5) (a) microscope image (b) Threshold image (c) AND operation





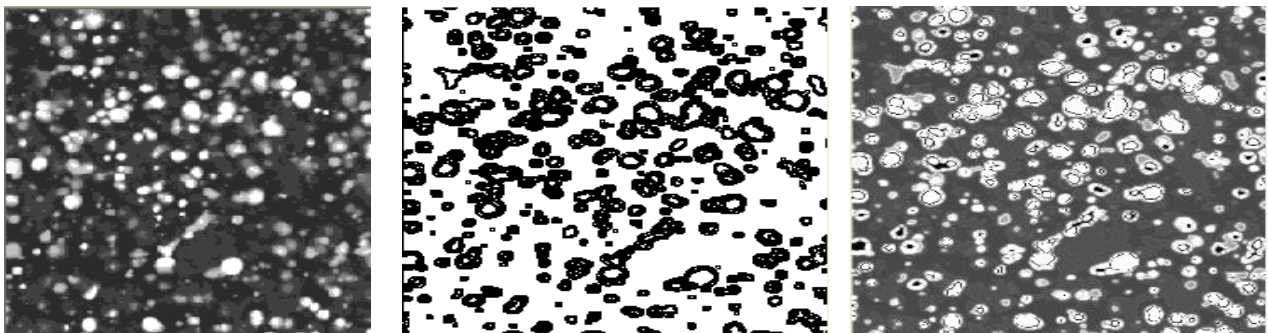
## Edge Detection of the microscope images using AND Binary Operation.....

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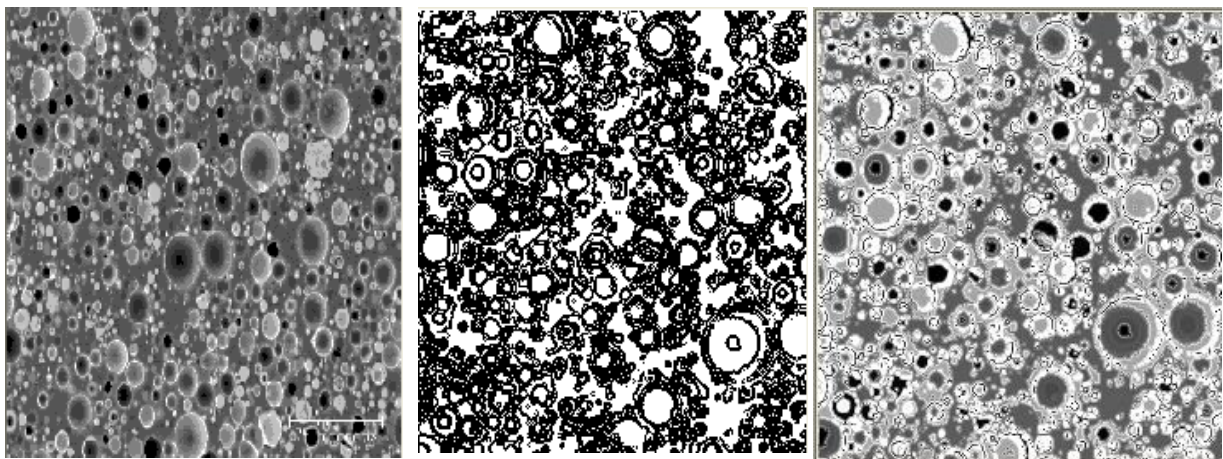


Fig(6 ) (a) microscope image (b) Threshold image (c) AND operation

2- The results of applying Sobel operator and AND binary operations to improve imperfect edges detection for images .Fig (7,8 ) show the original image and the result of applying Sobel operator and AND binary operation.



Fig(7 ) (a) microscope image (b) sobel operator image (c) AND operation image



Fig(8 ) (a) microscope image (b) Sobal operator image (c) AND operation

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## **7- Conclusions**

From the results obtained

- 1-In fig.(5,6) show that the AND binary operation is the major tools working with binary images to correct these threshold errors .
- 2- In fig.(7,8) show that the AND binary operation is the major tools working to correct or improve the imperfect edges of images.

## **8- Future work**

- 1- Apply the Binary image operation to region analysis.
- 2- Apply the binary image operation to object selection using geometric features.

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## كشف حواف صور المايكرو سكوب باستعمال عملية

### AND الثنائية

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#### الخلاصة

التغير الكبير في إضاءة الصورة لمنطقة قصيرة تدل على وجود حافة. الهدف من كشف حواف الصورة هو لتأشير نقاط في الصورة الرقمية التي شدة الإضاءة لها تتغير بصورة حادة مشيراً إلى تغير في خصائص الصورة هنالك عدد من التقنيات التي يمكن تستخدم في كشف حواف صورة المايكرو سكوب واحدة منها باستخدام عملية AND الثنائية.

في هذا البحث تقنيتان استعملت لكشف حواف صور المايكرو سكوب واحدة منها باستعمال (العتبة مع عملية AND الثنائية والأخرى باستعمال مؤثر سوبل مع عملية AND الثنائية). النتائج بينت بان كلا التقنيتان أعطت نتائج جيدة لكشف حواف صور المايكرو سكوب.