Magnetic Resonance Images Edge Detection Based on three-scales Mathematical Morphology

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***Abstract*- In medical image the details are very important. Edge is considered one of these important details. For that it must be detected. Edge detection is not an easy task specially when image is contaminated with noise.**

In this paper multi scale morphing is used so that the segment of the image is classified into three classes by two thresholds The part greater than the second threshold uses large-scale structure element to detect the edge while part less than second threshold and greater than first threshold uses mean-scale structure element and the part less than first threshold uses small-scale structure element. The large and mean-scales established from dilation of small-scale structuring element. The Image output proceed from multiply the weights to Edge detection of each part of Image.

Keywords*---** morphology**,** *two thresholds,** *sobel operator***.**

I.INTRODUCTION

The edge is very important component of image, because the edge clears the transform between levels of color in an image . Many methods are used to detect edge as LOG operator ,SOBLE operator,…etc. All these methods are used for detection of edges. The noise and edge are located in high frequency domain. Therefore, these mentioned methods are unsuitable to detect the noise corruption of image. Mathematical morphology is derived from set theory. It is used to detect noise and edge by developing structure element. Small-scale is sensitive to edge signals. It affects the detection of edge signal but large-scale affects detection of noise.

In [1] is used mathematical morphological edge detection algorithm. The algorithm is efficient for edge details extraction in place of shading while distinguish features.

In study[2] the researcher proposed a method based on edge detection operator depending on combination of fuzzy gradient other morphology. It has the capability to work with high accuracy. The work in [3] shows different threshold values for given input image by using algorithm. yielded results were better compared with other methods.

In method[4] used multi scale morphing. The image is classified into two classes by threshold. The part greater than the threshold uses large-scale structure element to detect the edge while part less than threshold uses small-scale structure element. In this paper, the image is divided into three parts by two thresholds by applying structure element with different scales .This method gives better results.

II. EDGE DETECTION MATHMATICAL MORPHOLOGY

Mathematical morphology consider non-linear tool for detecting the edges and noise [2].The mathematical morphology is used to detect the edges and noise defined as[4] :

$$MO = g - g \circ B \quad (1)$$

$$MC = g\bullet B - g \quad (2)$$

$$MOC = g\bullet B - g \circ B \quad (3)$$

Where:

g: oreginal image

B: sturucture element

The upper operations in terms of morphology tools as opening and closing operations work together in the same time to detect the edge and noise[4].

The mathematical morphology operation detects noise which can be defined as:

$$OE = g \circ B - g\theta \quad (4)$$

$$DC = g \oplus B - g\bullet B \quad (5)$$

$$ODC = (g \circ B) \oplus B - (g\bullet B)\theta \quad (6)$$

We can rewrite the last operation as :

$$OEP = (f\bullet B) \circ B - (f\bullet B)\theta \mathrm{B} \quad (7)$$

$$\mathrm{ODP} = (g \circ B) \oplus B - (g \circ B)\bullet B \quad (8)$$

$$\mathrm{E_{min}} = \min\{OEP, ODP\}$$

$$\mathrm{E_{max}} = \max\{OEP, ODP\}$$

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$$\mathrm{E_{min}} = \min\{OEP, ODP\}$$

$$\mathrm{E_{max}} = \max\{OEP, ODP\}$$

The equations (7),(8) reduce and detect the noise and edge ,respectively[4]. To gain better image edge details and more reduce the effect of noise we can use [4]:

$$E_d = E_{\max} - \mathrm{E_{min}} \quad (9)$$

Where E_d is modified morphological edge detection operation.

Improved modified morphological edge detection operation is defined as[4]:

$$ED = ODP + E_d \quad (10)$$

The equations (7),(8),(9),(10) increase the ability to detect the edge and noise in the image, and the results are effected with the selected structure element.

III. PROPOSED WORK

In this paper the original image is segmented into three parts , g_1 , g_2. g_3 by two thresholds, T_1, T_2. The larger part than T_2uses large-scale structure element established by dilation of small structure element. The median part witch greater than T_1 and less than T_2uses median-scale structure element by dilation of small. structure element. The small part which less than T_1uses small structure element.

A. Algorithm Description

The proposed algorithm as follows.

1-Read original image, and adding noise to it.

2-Select the initial thresholds by using iterations to gain new thresholds

3-Making structure elements which is suitable with the size of each part in image by dilation structure element B.

$$B_i = B \oplus B \oplus \ldots \oplus B, (i = 2,3,..,n)$$

$$B_j = B \oplus B \oplus \ldots \oplus B, (j = 2,3,..,n), j > i$$

for median part and large part ,respectively.

4- Applying the equations from(7) to (10) on each part of the image

5- Computing the output image which is defined from the Following equation.

$$f = w_1 * ED_1 + w_2 * ED_2 + w_3 * ED_3 \quad (11)$$

6- Computing the Mean-Squared Error (MSE) and Peak Signal –to- Noise Ratio (PSNR) by [5].

$$MSE = \frac{1}{M*N}\sum_{i=1}^{M}\sum_{j=1}^{N}[g(i,j) - f(i,j)]^2 \quad (12)$$

$$PSNR = 10.\log_{10}\frac{(255)^2}{MSE} \quad (13)$$

B. Computing The Weights

In this paper, the weights are computed by the following steps:

1- compute the mean of each part of image

$$e_1 = \frac{g_1\bullet B \circ B + g_1 \circ B \bullet B}{3}$$

$$e_2 = \frac{g_2\bullet B_i \circ B_i + g_2 \circ B_i \bullet B_i}{3}$$

$$e_3 = \frac{g_3\bullet B_j \circ B_j + g_3 \circ B_j \bullet B_j}{3}$$

The mean of each part is calculated by using mathematical morphology, opening and closing.

2- computing the standard deviations of each part of image.

$$\sigma_1 = |g_1 - e_1|$$

$$\sigma_2 = |g_2 - e_2|$$

$$\sigma_3 = |g_3 - e_3|$$

3- the weight of each part is

$$w_1 = \frac{\sigma_2 * \sigma_3}{(\sigma_1 + \sigma_2 + \sigma_3)^2}$$

$$w_2 = \frac{\sigma_1 * \sigma_3}{(\sigma_1 + \sigma_2 + \sigma_3)^2}$$

$$w_3 = \frac{\sigma_1 * \sigma_2}{(\sigma_1 + \sigma_2 + \sigma_3)^2}$$

IV. EXPERIMENT

In this section, the proposed algorithm is compared with the existing SOBLE operator. Fig.1 is the original image. Fig. 2 is the result of processed image after applying SOBLE operator with Gaussian noise, .

Fig. 3 is the result of processed image after applying SOBLE operator with salt & pepper noise. Fig. 4 shows the image which was processed by proposed algorithm with Gaussian noise. The image in fig. 5 was processed by proposed algorithm with salt & pepper noise.

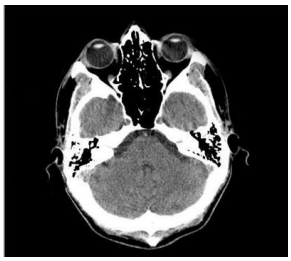

Figure 1: Original Image

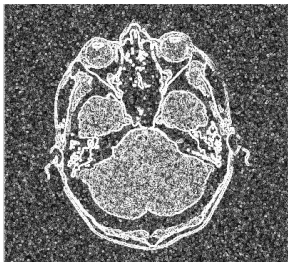

Figure 2:SOBLE Operation With Gaussian noise

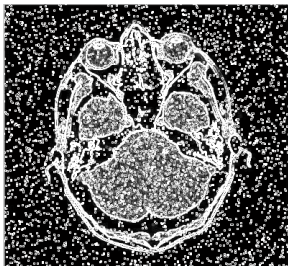

Figure :3 SOBLE Operation With Salt &pepper noise

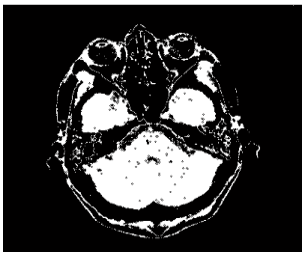

Figure 4:Proposed Method With Gaussian noise

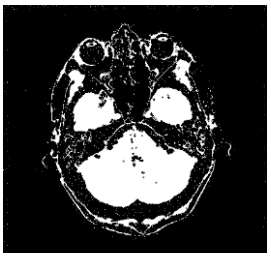

Figure 5: Proposed Method With Salt &pepper noise

TABLE.I

Various techniques of Comparing Parameters MSE and PSNR(dB)

Technique	Type of Noise	EMS	PSNR
SOBLE Operator	Gaussian	86.25	28.77
SOBLE Operator	Salt &pepper	86.20	28.77
Proposed Method	Gaussian	56.58	30.60
Proposed Method	Salt &pepper	56.06	30.70

The preceding results showed that the proposed method was better than SOBLE operator

V. CONCLOION

The edge is very important in medical image. In this paper, the results showed the proposed method had the values of MES and PSNR better than other methods.
The structure element has important act in processing and effecting on the results.

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