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Using Digital Filters and Fractal Filter To Segmentation the Medical Image

Dr .Maha Abdul Amir Kahdim

1Foundation of Technical Education, Technical Instructors Training Institute, Lecturer

Abstract: - Fractal geometry used to describe the local grey level change in digital image . This research aims at using number of filters to get a butter image than the original one by blurred image edge detection and blurred image sharpening for using local fractal filter and Discrete Cosine Transform digital filter to segmentation the medical images that uses, this beside is important for purpose the diagnosis and the medicament in medical applications . The concept is evaluated by comparing of the performance fractal filter with operators such as, Gaussian and Laplace operator. Results show a similar performance in a low-noise environment and superiority of the fractal operators in a high noise environment, by designing program using MATLAB. The inclusion of the operators into an edge based segmentation scheme revealed the same results for an application in image segmentation.

Index Terms: Reduction colors, gray scale, level images, Katz's Method, Edge-Based Segmentation

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1 INTRODUCTION

The fractal dimension can be used to classify two dimensional digital images, if interpreted as a three-dimensional terrain whose height is given by the pixel value [1]. At a large scale segment membership constitutes a counteracting deterministic component, and at small scales the image resolution poses a limitation to the computation of a fractal dimension. On medium scales, however, the surface roughness may show a segment-dependent self-similarity. A Local Fractal Dimension (LFK), solely based on the evaluation of this scale range, should yield a parameter for every pixel whose value is related to local surface roughness. The LFK depends on noise and internal segment texture [2]. Image segmentation is the identification and isolation of an image into regions that correspond to structural units. It is an especially important operation in biomedical image processing since it is used to isolate physiological and biological structures of interest. The problems associated with segmentation have been well studied and a large number of approaches have been developed, many specific to a particular image [3]. The extraction of invariants patterns in varying positions, orientations and dimensions, would be lead to the development of more robust and flexible systems [4].

- *Dr. Maha Abdul Amir Kahdum receive his BSc from university of Baghdad , MSc and PhD from university of technology –Baghdad at 1998,2002 and 2005 respectively .Currently he is full time lecture in Electronic Engineering department –Technical Instructors Training Institute– foundation of technical education, Iraq, PH-07802566511. E-mail: author_maha. kahdum@ yahoo.com*

2- THE DISCRETE COSINE TRANSFORM (DCT)

The key to the compression process is a mathematical transformation known as the Discrete Cosine Transform (DCT). The DCT is a class of mathematical operations takes a signal and transform it from one type of representation to another. It takes a set of points from the spatial domain and transforms them into an identical representation in the frequency domainhttp://www.ijser.org. The DCT can be used to convert spatial information into "frequency" or "spectral" information. And there is an inverse DCT (IDCT) that can convert the spectral representation of the signal back to a spatial one [5].

The actual formulas for the two-dimensional DCT are:

$$DCT(i,j)=\frac{1}{\sqrt{2N}}C(i)C(j)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1}I(x,y)\cos\left[\frac{(2x+1)i\pi}{2N}\right]\cos\left[\frac{(2y+1)j\pi}{2N}\right]$$

$$C(x)=\begin{cases}\frac{1}{\sqrt{2}} & if \quad x=0\\ 1 & if \quad x>0\end{cases} \qquad (1)$$

and its inverse (IDCT) are:

$$I(x,y)=\frac{1}{\sqrt{2N}}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}C(i)C(j)DCT(i,j)\cos\left[\frac{(2x+1)i\pi}{2N}\right]\cos\left[\frac{(2y+1)j\pi}{2N}\right] \quad (2)$$

$$C(x)=\begin{cases}\frac{1}{\sqrt{2}} & if \quad x=0\\ 1 & if \quad x>0\end{cases}$$

The DCT is performed on an N×N square matrix of pixel values, and an N×N square matrix of frequency coefficients is produced. In the DCT matrix all the elements in row 0 have a frequency component of zero in one direction of the signal. All the elements in column 0 have a frequency component of zero in the other direction. As the rows and columns move away from origin, the coefficients in the transformed DCT matrix begin to represent higher frequencies, with the highest frequencies found at position (N-1, N-1) of the matrix [6].

One of the first things noticed when examining the DCT algorithm is that the time required calculating each DCT coefficient is heavily dependent on the size of the matrix. Since a doubly nested loop is used, the number of calculations is O (N2): as N goes up, the amount of time required to process each element in the DCT output array will go up dramatically.

One of the consequences of this dependency is that it is virtually impossible to perform a DCT on an entire image. The amount of calculation needed to perform a DCT transformation on even a 256×256 grey-scale block is prohibitively large. To get around this, DCT implementations are typically break the image down into smaller and more manageable blocks.

While increasing the size of the DCT block would probably give better compression, it doesn't take long to reach a point of diminishing returns. Researches have showed that the connections between pixels tend to diminish quickly, such that pixels even fifteen or twenty positions away are of very little use as predictors. This means that a DCT block of 64×64 pixels might not compress much better than if it is broken down into four 16×16 blocks. And to make matters worse, the computation time would be much longer [7].

3-Local Fractal Katz's Method

Katz's approach solves this problem by creating a general unit or yardstick: the average step or average distance between successive points, a. Normalizing distances in Equation (2) by this average result in:

$$D=\frac{\text{Log10}(L/a)}{\text{Log10}(d/a)} \quad (3)$$

where (L) is the total length of the curve or sum of distances between successive points, and (d)is the diameter estimated as the distance between the first point of the sequence and the point of the sequence that provides the farthest distance. Mathematically speaking, (d) can be expressed as:

$$d=\max(\text{distance }(l,i) \quad \ldots\ldots(4)$$

Considering the distance between each point of the sequence and the first, point i is the one that maximizes the distance with respect to the first point[8].

4- Edge-Based Segmentation

General approaches to segmentation can be grouped into three classes: pixel-based methods, regional methods, and edge based methods. Pixel-based methods are the easiest to understand and to implement, but are also the least powerful and, since they operate on one element at time, are particularly susceptible to noise Historically, edge-based methods were the first set of tools developed for segmentation. To move from edges to segments, it is necessary to group edges into chains that correspond to the sides of structural units, i.e., the structural boundaries. Approaches vary in how much prior information they use, that is, how much is used of what is known about the possible shape. False edges and missed edges are two of the more obvious, and more common, problems associated with this approach. The first step in edge-based methods is to identify edges which then become candidates for boundaries spatial gray level co-occurrence estimates image properties related to second-order statistics

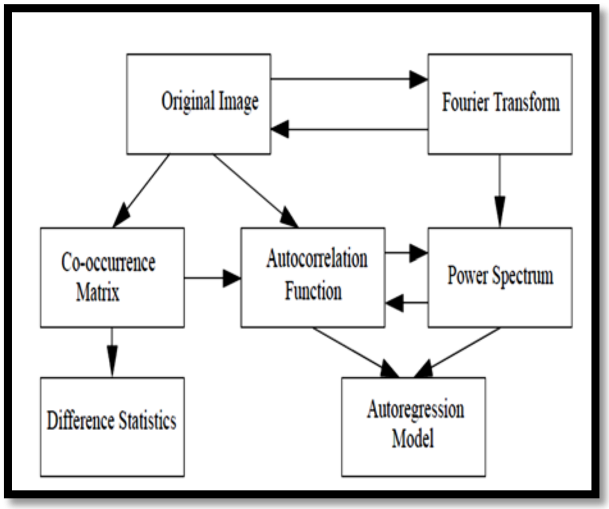

Fig. 1. The interrelation between the various second-order statistics and the input image [9]

5-General Image Formats

Irrespective of the image format or encoding scheme, an image is always represented in one, or more, two dimensional arrays, I(m,n). Each element of the variable, I, represents a single picture element, or pixel. (If the image is being treated as a volume, then the element, which now represents an elemental volume, is termed a voxel.) The most convenient indexing protocol follows the traditional matrix notation, with the horizontal pixel locations indexed left to right by the second integer, n, and the vertical locations indexed top to bottom by the first integer[10]. This indexing protocol is termed pixel coordinates by MATLAB. A possible source of confusion with this protocol is that the vertical axis positions increase from top to bottom and also that the second integer references the horizontal axis, the opposite of conventional graphs .MATLAB also offers another indexing protocol that accepts non-integer indexes. In this protocol, termed spatial coordinates, the pixel is considered to be a square patch, the center of which has an integer value. In the default coordinate system, the center of the upper left-hand pixel still has a reference of (1,1), but the upper left-hand corner of this pixel has coordinates of (0.5,0.5).. In this spatial coordinate system, the locations of image coordinates are positions on a (discrete) plane and are described by general variables x and y ,Fig.(2)shows a spatial coordinate system[11].

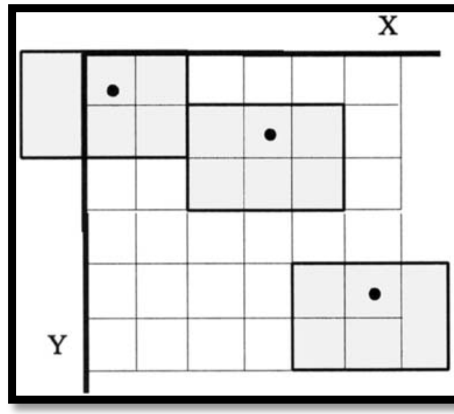

Fig. 2. Spatial coordinate system

6-Laplace Image Features

An approximation of the Laplace operator is used to transform the image. The distance r, in practice the size of the convolutions matrix, can be selected. The measuring field is eroded by an octagon of the size r to eliminate border effects. The Laplace transformation is often used for segmentation purposes. The so called zero-crossings [12] define borders of objects via zeros of the sum of the second partial derivatives. These are approximated by the here applied convolution. From this point of view the features or distributions of a Laplace transformed image deliver a certain description of changes in pixel neighborhoods defined by the size of the convolution matrix used. An in-depth examination of this topic can be found in the recent thesis from G. Smith [13]. The convolution can also be considered as a correlation. The feature seen in this way reflects measurements of the probability distribution of the existence of pixel on figurations described by the chosen convolutions matrix. In some cases this matrix is called an approximation of a Mexican hat. Mathematically spoken, the Laplace transformation is an approximation of

$$\partial^2 f(x,y)|\partial x^2 + \partial^2 f(x,y)|\partial y^2 \qquad (5)$$

the sum of the second partial derivatives. The resulting features L. . . may be roughly considered as quantification of the velocity of changes of the gradient[14].

7- RESEARCH Procedure

The performance for edge enhancement of attributes related to the LFK, computed on a 7×7-neighbourhood, was compared with other edge enhancement techniques (3×3 DCT operator, a 3×3 Laplacian, a 7×7 derivative of Gaussian). , Fig (3) shows a sample of the Magnetic resonance MR –brain images. Engineering procedures contained multiple and different techniques to disclose image edges used and also divides medicine image . one of these techniques is throughout smooth image from origin image that not clear after determine its dimensions during image filtering operation by applying equation (2) ,(4) and

(5) on all image elements then save resulted image from filtering and then do filtering operation for second and then save resulted image and doing throughout to origin image resulted from second filtering and using (matlab) program and compared it with (laplacion) filter where had used work square in size (3, 3) to apply display factors (mask) on origin image and move (mask) center on all image factors and substitute central value for work square in resulted value from applying (mask) this filter an so on doing this operation subsequently on each element in image . Image divided by using (LFK) technique

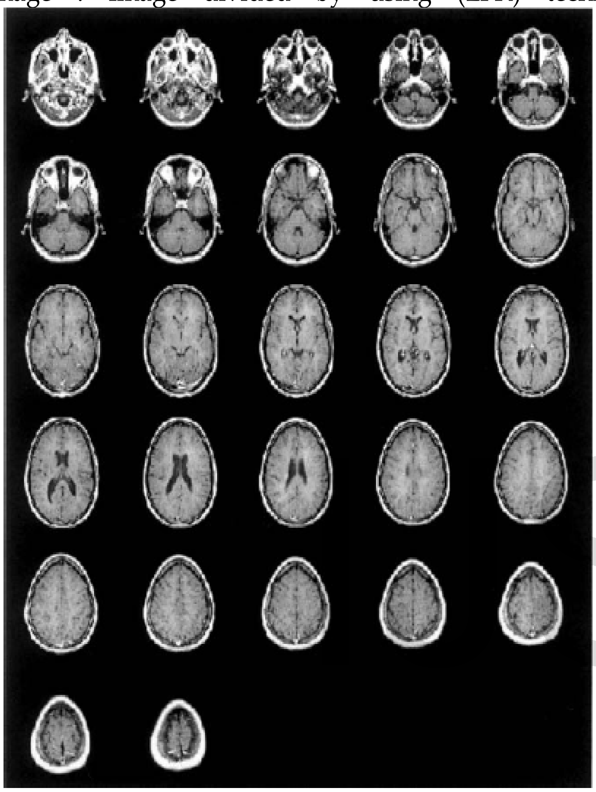

Fig.3 Sample of the Magnetic resonance MR –brain images

Program designed to assist in the analysis and segmentation images by using visual basic to estimate fractal dimension by solving equation (2), Fig. (4) Shows a research procedure for segmentation the MR images –brain images.

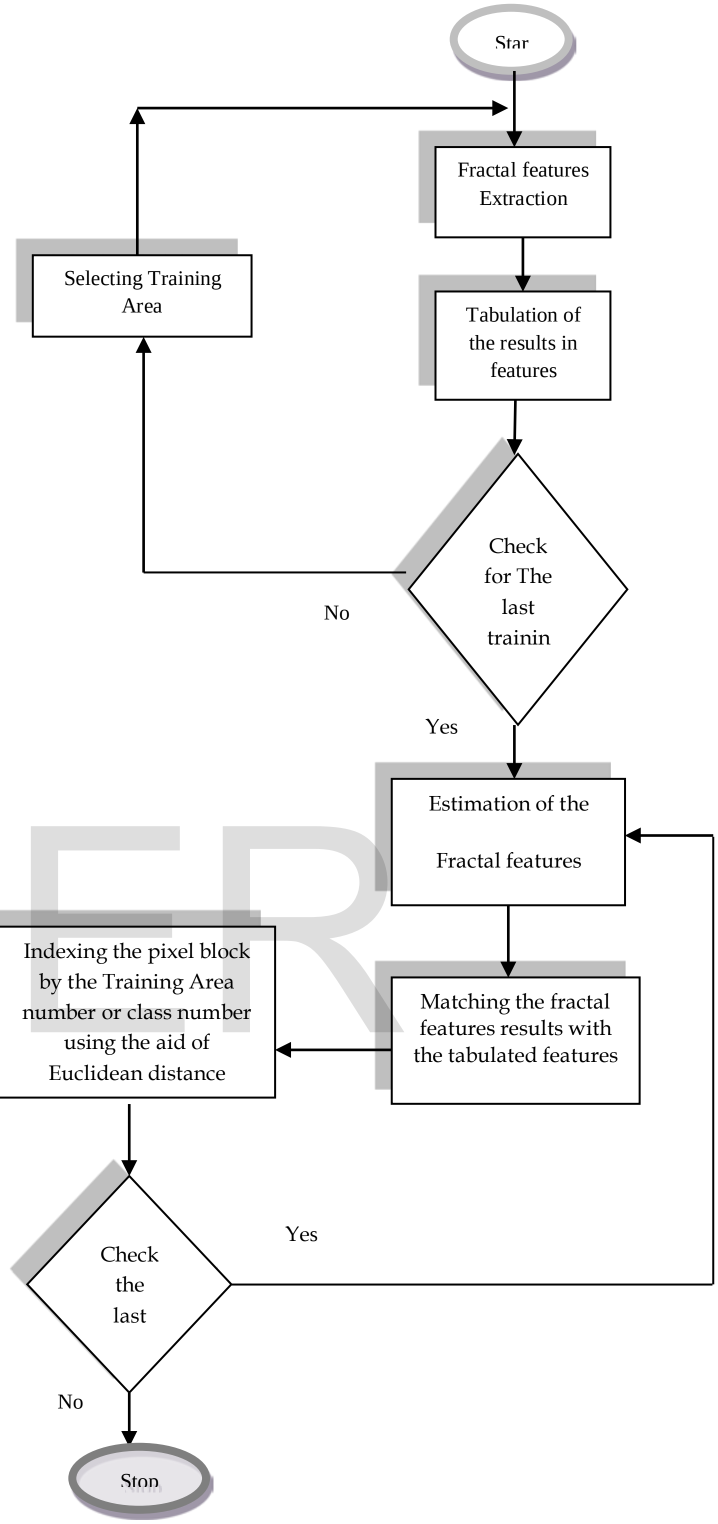

Fig. 4 Textural Images segmentation using the fractal geometry Techniques

8-Result and Discussion

LFK and DCT as well as the two first-derivative operators were applied as cost functions in a probability-driven graph-searching algorithm for edge linking This method attempts to find a boundary by maximizing the probability

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of belonging to an edge for all boundary elements. Fig.(5) Results of different edge operators at edges under varying amounts of added noise. A profile from a 2D image is shown to which 2D operators were applied. Operator responses are normalized. Cost function and the local shape of the boundary (boundaries with a high local curvature have a lower probability of being on the segment boundary)

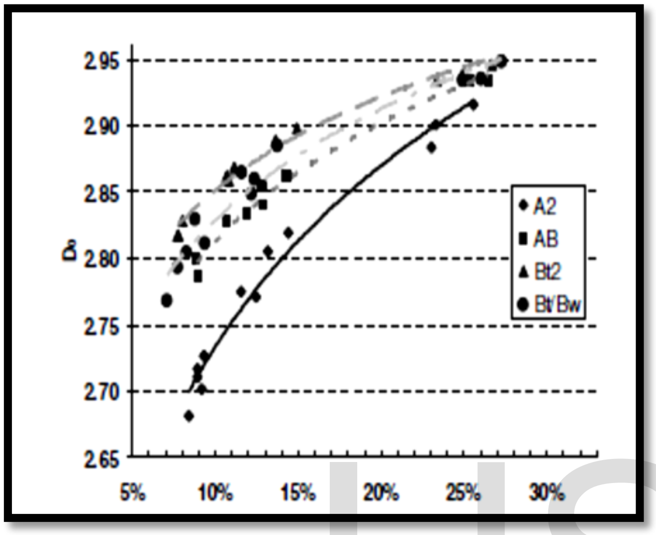

Fig. 5 Results of different edge

The Laplacian filter is good ability to disclose, develop lightening image and during result we observe appearing to all edges image clearly without take care about direction. This filter operation worked on get good image but it tends to noise. Either to (LFK) technique it had disclosed all lightening image edges accurately and clear without any noise. The Table (1) refers to error for segmentation of a medical image at different noise.

TABLE. 1 error for segmentation of an medical image at different noise

SNR	**Laplace**	**DCT**	**LFK**
1:0	0.3%	0.2%	0.1%
2:1	1.4%	0.8%	0.6%
4:1	2.2%	1.2%	0.7%
6:1	1.8%	1.1%	0.7%
10: 1	2.2%	0.8%	0.7%
30:1	2.2%	0.8%	0.7%

Table(1) shows the Error (in percent of falsely classified pixels) for segmentation of an medical image at different noise levels using different cost functions, also Katz's Algorithm uses to estimation the fractal dimension for 20-sample of MR images applied in 2 ,4,8,and16 Dimensions, fig.(6)shown the value of multiracial dimension

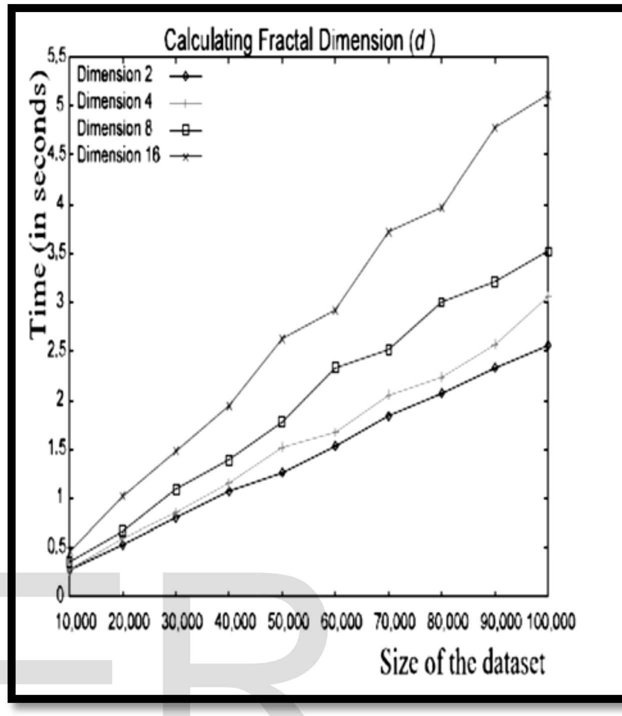

Fig. 6 value of FD in Katz method

Factors such as knowledge of possible FD range, noise level, and window length must be considered to achieve the best results. By using filter (LFK) we got clear edges and throughout (DCT) from origin image and giving it accurate edges.

9- CONCLUSIONS

Fractal models may be used for image segmentation, texture classification, shape from- texture, and the estimation of 3-D roughness from image data, also some important conclusions derived from the test results are presented:

1-The result show that the fractal transformation is efficient in high frequency information and DCT transformation for representing low frequency information.

2- The Local Fractal Dimension and parameters derived from it appear to be stable estimators to differentiate edges for a wide range of noise levels in medical images.

3- Getting special edges for unclear image by using (Laplacion) filter which is working on disclose image edges only while worked on appearing noise on edges. (LFK) filter worked on disclose and divide image for all variables in gray level and in each direction.

4- Filtering (DCT) is the best filter that used for its ability to appear image edges in each direction.

5- Transformation to (LFK) filters during using it to divide image and multiple dimensions to develop and treating medicine image.

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