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Comparison from Accuracy Time between Artificial Neural Networks (ANN) of Matlab & Iterative Resolution with Gauss Seidal to Detect the Lesion

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Abstract

In this paper we propose an iterative method (Gauss seidal technique (GS)) to detect the lesion than compared with Matlab program for neuronal network (ANN technique), where we can see clearly the high level of detection for the both methods, but for accuracy time our propose with G S present an excellent time in front of ANN technique, The program used is Matlab.

Keywords: ANN; SOR; Relaxation; Iterative.

1. Introduction

In numerical linear algebra, the Gauss–Seidel method, known as the Liebmann method [1]. It is an iterative method used to solve a linear system of equations. It is named after the German mathematicians Carl Friedrich Gauss and Philipp Ludwig von Seidel [1]. Though it can be applied to any matrix with non-zero elements on the diagonals, convergence is only guaranteed if the matrix is either diagonally dominant, or symmetric and positive definite. It was only mentioned in a private letter from Gauss to his student Gerling in 1823[1]. A publication was not delivered before 1874 by Seidel [1].

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Mathematical models for information processing in computer vision could reviews all aspects of image processing, pattern recognition, geometric optics, and artificial intelligence that are important to solving computer vision problems. Also provides an introduction to digital image acquisition and display, hardware, and techniques. Discusses special computer architectures for computer vision, new neural network applications, edge detection strategies, and segmentation. For example the iterative methods used for solving large linear systems were based on relaxation of the coordinates. Beginning with a given approximate solution, these methods modify the components of the approximation, one or a few at a time and in a certain order, until convergence is reached [2].

From SPM logiciel come our idea to apply the numerical analysis in processing of image [3]. In this paper we use Gauss seidal technique to detect the position of disease medical images which obtained from hospital of Algiers-Algeria with format of "DICOM". We have problem of cost computation & accuracy of that we thought for another method which was iterative approach (Gauss Seidal (G.S)) for linear resolution . the results obtained excellent if compared with ANN technique .

This paper is organized as follow. Section II, presents the principle of Gauss seidal method than some principle of ANN method. Section III describes the proposed model. Experimental results are shown in section IV. Finally section V concludes the paper.

For more details of this paper by used neuronal networks, Gauss seidal & their mathematic capabilities to detect the lesion in processing of image, we pass to the following title of "back ground".

2. Background

The next subtitle We are going to present some theory of numerical analysis method with GS technique than the Networks method with ANN.

2.1 Gauss Seidal method

The description of Gauss Seidal method used for given a square system of n linear equations as the following [4][5][6][7][8][9][10][11]:

$$A * X = b \qquad (1)$$

Where $A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ .. & .. & .. & .. \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix}$; $X = \begin{bmatrix} x_1 \\ x_2 \\ . \\ . \\ x_n \end{bmatrix}$; $b = \begin{bmatrix} b_1 \\ b_2 \\ . \\ b_n \end{bmatrix}$

Then A can be decomposed into a diagonal component D, and the remainder R:

$$A = L + U \qquad (2)$$

Where

$$L = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ .. & .. & .. & .. \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} ;U = \begin{bmatrix} 0 & a_{12} & \dots & a_{1n} \\ 0 & 0 & .. & a_{2n} \\ 0 & 0 & \dots & 0 \end{bmatrix}$$

The solution is then obtained iteratively via

$$X^{(k+1)} = D^{-1}(b - RX^{(k)}) \qquad (3)$$

The element-based formula is thus:

$$x_i^{(k+1)} = \frac{1}{a_{ii}}(b_i - \sum_{j<i} a_{ij} x_j^{(k+1)}) - \sum_{j>i} a_{ij} x_{ij}^{(k)} \quad ;i, j = 1,2,...n \qquad (4)$$

Note that the computation of xi(k+1) requires each element in x(k) except itself. Unlike the Gauss–Seidel method, we can't overwrite xi(k) with xi(k+1), as that value will be needed by the rest of the computation. The minimum amount of storage is two vectors of size n.

a. Convergence

The convergence properties of the Gauss–Seidel method are dependent on the matrix A. Namely, the procedure is known to converge if either [2]:

- A is symmetric positive-definite
- A is strictly or irreducibly diagonally dominant.

The Gauss–Seidel method sometimes converges even if these conditions are not satisfied.

2.2 History of Neural Networks

In 1943 McCullough and Pitt [12][13], Modeling the Neuron for Parallel Distributed Processing. In 1969, Minsky and Papert [12], publish limits on the ability of a perceptron to generalize.1970’s and 1980’s are ANN renaissance. In 1986 Rumelhart, Hinton & Williams[12] present back propagation. In 1989, Tsividis[13] is a Neural Network on a chip.

2.2.1 What is a Neural Network?

An artificial neural network (ANN) is an information-processing system that has certain performance characteristics in common with biological neural networks.

A method of computing based on the interaction of multiple connected processing elements. Mathematical models for information processing, which based on the biological prototypes and mechanisms of human brain activities. Computational models inspired by the human brain:[12][14][15]

- Massively parallel, distributed system, made up of simple processing units (neurons)
- Synaptic connection strengths among neurons are used to store the acquired knowledge.
- Knowledge is acquired by the network from its environment through a learning process

2.2.2 Properties of Nervous Systems

- Parallel, distributed information processing
- High degree of connectivity among basic units
- Connections are modifiable based on experience
- Learning is a constant process, and usually unsupervised

2.2.3 Biological Neuron

The basic computational unit in the nervous system is the nerve cell, or neuron. A neuron has:See Fig(1) [12][13][16][17]

- Dendrites (inputs)
- Cell body dendrites
- Axon (output)

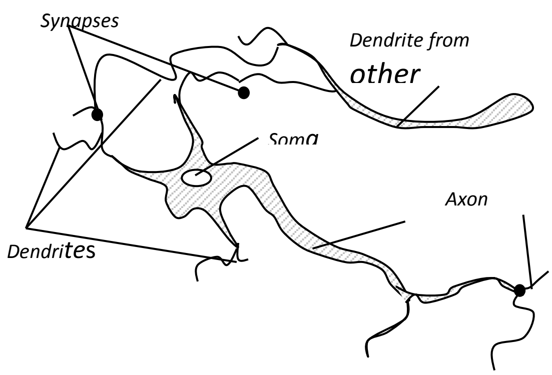


Figure 1: The schematic model of a biological neuron[2]

2.2.4 Model of an artificial neuron

Figure(2) present the inputs and out puts to the neurons

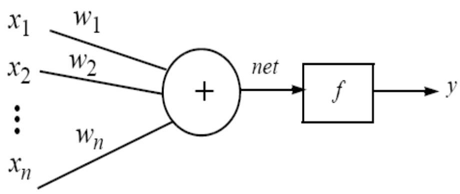


Figure 2: Model of artificial neuron [18]

Where

- x_1, x_2, ..., x_n are the inputs to the neuron
- w_1, w_2, ..., w_n are real-valued parameters called weights
- net = w_1 x_1 + w_2 x_2 +…+ w_n x_n is called the weighted sum
- f: is called the activation function?
- y = f(net) is the output of the neuron

2.2.5 Common Activation Functions

a. Identity Function

The identity function is given by :[2][19]

$$F(x)= x \quad (5)$$

- Binary step function
- Threshold activation function
- Step f(x)=1 if x >= Ø, else 0.see fig(3)

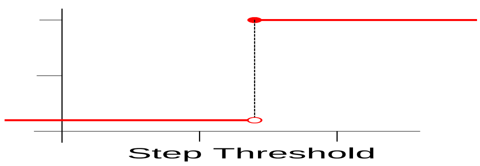


Figure 3: Identify function f[2][19]

b. Binary sigmoid function

The sigmoid function is:

$$F(net) = 1/(1+exp(-\lambda*net)) \quad (6)$$

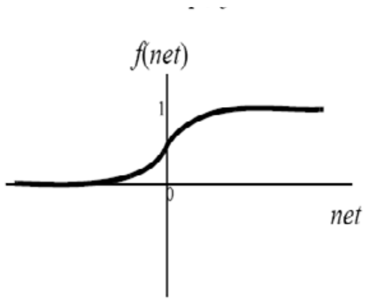


Figure 4: The schematic model of a biological neuron[12][20]

3. Describes The Proposed Mode

We have problem of resolution in accuracy time to detect the tumor, where we have applied many numerical analysis methods. In this paper we propose from (eq(4)) a solution of this problem by using Gauss seidal method & we have compare it with network method with ANN technique (eq(6)) in matlab. At the end of resolution we reach that the both methods have same power of presentation the kind of image but Gauss seidal is the best for reduce the time .

4. Experimental Result

4.1. Algorithm

- Read both image with "dicom "format
- Choose a sample of image
- Applied Gauss Seidal equation
- Choose precision "e" than compute the error
- If result less than the precision put the result on the pathological image for extract the place of lesion
- Compare between ANN & Gauss Seidal methods.

Examples:

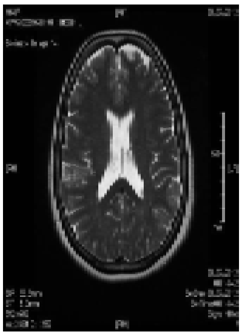
In the following examples we choose in Gauss seidal method the following data: -precision :e=10^-3

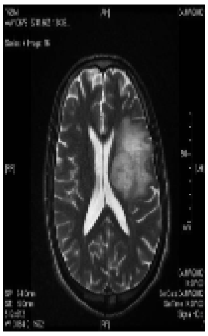
- Number of iteration max=200

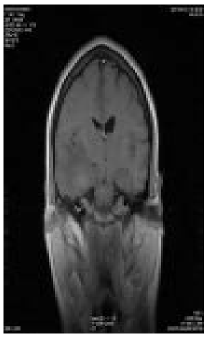
We propose three examples which we have them from kuba hospital of algiers-algeria in 2015

Example1

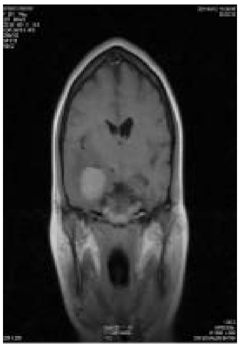
We have in fig(5(a,b,c,d,e,f)) normal images & pathological ones & we want to display with two method the place of disease, fig(6.b) present the iterative method with gauss seidal, the fig(6.c) present the network mehod with ANN where we could see here that ANN detect more better than GS but the time of execution is very level in front of GS(see fig(7-(a,b)).

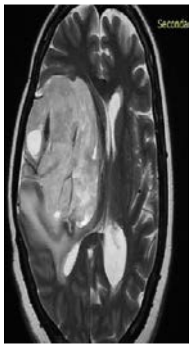






a b c





d e f

Figure 5: Reel (a,c,e) & pathological (b,d,f) images

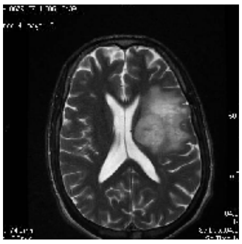


Fig.a Pathological image

Fig.b.Result with Gauss-seidel

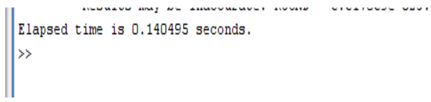
Fig.c.Result with Network ANN

Figure 6: presentation the disease with GS and ANN

a. pathological image, b. result with GS, c. result with ANN method

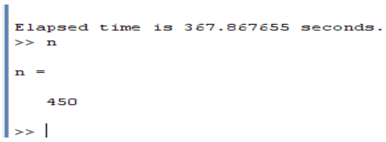
Elapsed time for GS &ANN

Elapsed time with Gauss seidal for number of repitition=200



a

Elapsed time with :ANN



b

Figure 7: elapsed time for GS(a) & ANN(b)

For the second & third example we applied the same analysis as the first one but the image s change. See fig(8(b,c)), where here GS detect the lesion better ANN & with accuracy time.see(Fig(9(a,b))

Example2

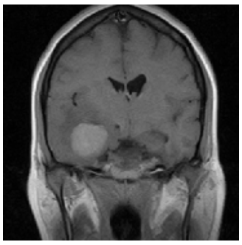


Fig.a Pathological image

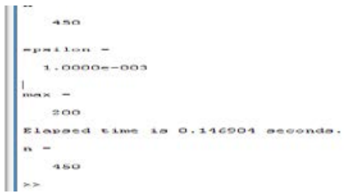
Fig.b.Result with Gauss-seidel

Fig.c.Result with ANN

Figure 8: Presentation of illness for GS & ANN

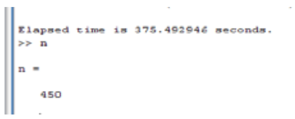
Elapsed time for GS &ANN

Gauss seidal



a

ANN



b

Figure 9: elapsed time for GS(a) & ANN(b)

Example3

For the third example where the both method detect with same level the lesion.(fi(10)), but always GS is better in accuracy .see(Fig(11(a,b))

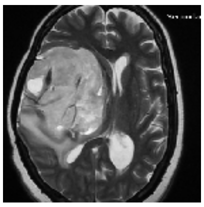


Fig.a Pathological image

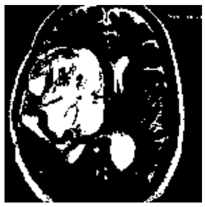


Fig.b.Result with Gauss-seidel

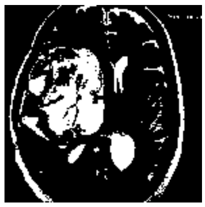
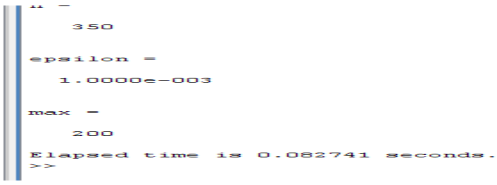


Fig.c.Result with ANN

Figure 10: Presentation the disease with GS and ANN

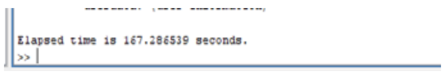
a.pathological image, b.result with GS ,c.result with ANN method

GS



a

ANN



b

Figure 11: Elapsed time for GS(a) & ANN(b)

Resume the three examples in table

Table 1: Two examples' resuts of many surfaces for Gauss & ANN

	Time of execution(s) ***Gauss***	***Time of execution(s)*** ***ANN***	***kind of detection*** ***Gauss***	***Kind of Detection*** ***ANN***
EX1 450X450	0.14s	367,9s	less	good
EX2 450X450	0.14s	375,5s	good	less
EX3 350X350	0.08s	167.28s	good	good

5. Conclusions

In this paper, we apply two linear resolution methods to extract the place of diseases in MR image. Our results indicate that the iterative Gauss Seidal converges to the solution I the same way for the both methods but GS detect in less time in comparison with Networks method with ANN. see table1

As Perspective we propose use Gauss Seidal & ANN network to detect the lesion for multi images.

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