An Artificial Intelligence Based Speckle Noise Reduction for Medical Images

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Abstract— Digital signal processing (DSP) describes the science that tries to analyze, generate and manipulate measured real world signals with the help of a digital computer. These signals can be anything that is a collection of numbers, or measurements and the most commonly used signals include images, audio (such as digitally recorded speech and music) and medical and seismic data. In most digital signal processing applications, the frequency content of the signal is very important. The Fourier transform (FT) is probably the most popular transform used to obtain the frequency spectrum of a signal. Noise removal or de-noising is an important task in image processing.In image processing; medical images are corrupted by various sorts of noises. It is vital to acquire exact pictures to encourage precise perceptions for the given application. Noise is exceptionally hard to expel it from the medical images without the prior knowledge of noise sort. That is the reason noise models are essential in the study of image denoising procedures. These noise models can be selected by analysis of their cause. In this way, exhibit a complete and quantitative analysis of noise models available in medical images. In general, the results of the noise removal have a strong influence on the quality of the image processing techniques. So in this work, to introduce Pollination Based Optimization (PBO) based speckle noise reduction from medical images.

Index Terms— Minimum Medical Images (X-Ray, Ultrasound, MRI), Speckle Noise, Filters, Pollination Based Optimization (PBO).

1 INTRODUCTION

Before advent of medical imaging, the examination of some disease like lung and breast cancer was hard. Nowadays X-ray, Ultra sound, MRI, CT and other medical imaging systems are commonly used and important part of daily practice. Medical imaging and image processing is a big area in imaging and image processing. It is used in the daily remedy. From the electron microscopy to MRI, there is a wide variety of them. Medical imaging defined as techniques and processes used to create images of the human body for clinical purposes or medical science. In a wider sense it is part of biological imaging and it is used with radiology techniques. In soft intellect, medical imaging is a way to create visual information about the target body or body parts without physically intruders into it. In hard intellect it is an inverse mathematic problem which means reproduce the inside structure of the given object from observations. Image processing techniques plays important role in medical image to diagnostic and detection the sicknesses and monitor the patient from this sicknesses. The image processing technique using in many application in the medical image like Magnetic Resonance Imaging (MRI), Computerized Topography (CT), Ultrasound imaging is widely used in the field of medicine. It is use for imaging soft tissues in organs like liver, kidney, spleen, uterus, heart, brain and X-ray images etc, this applications is very cost to the patient when it don't clear the re-imaging is more cost for that, then the image operation is one of image processing techniques to solve this problem by less cost and fast.. They are present a simple and efficient technique to remove noise from the medical images, which combines both median filtering, and mean filtering to determine the pixel value in the noise less image [1].Ultrasound imaging is widely used in the field of medicine. It is use for imaging soft tissues in organs like liver, kidney, spleen, uterus, heart, brain etc. The common problem in ultrasound image is speckle noise which is caused by the imaging technique used that may be based on coherent waves such as acoustic to laser imaging [2, 3].

Noise removal or de-noising is an important task in image processing.In image processing; medical images are corrupted by various sorts of noises. It is vital to acquire exact pictures to encourage precise perceptions for the given application. Noise is exceptionally hard to expel it from the medical images without the prior knowledge of noise sort. That is the reason noise models are essential in the study of image denoising procedures. These noise models can be selected by analysis of their cause. In this way, exhibit a complete and quantitative analysis of noise models available in medical images. In general, the results of the noise removal have a strong influence on the quality of the image processing techniques. So in this work, to introduce Pollination Based Optimization (PBO) based speckle noise reduction from medical images.

2 MEDICAL IMAGES

Image processing techniques plays important role in medical image to diagnostic and detection the sicknesses and monitor the patient from this sicknesses.

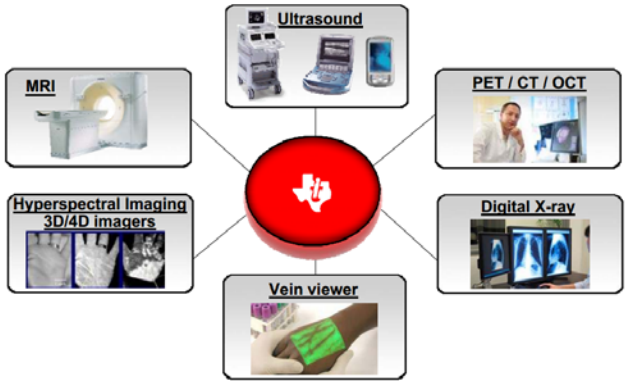

Figure 1: Medical Imaging Modalities.

The image processing technique using in many application in the medical image like Magnetic Resonance Imaging (MRI), Computerized Topography (CT), ultrasound imaging and X-ray images ect., this applications is very cost to the patient when it don't clear the re-imaging is more cost for that, then the image operation is one of image processing techniques to solve this problem by less cost and fast. Figure 1 show the modalities of different medical images.

3 Medical Image Noise

Medical images are often contaminated by impulsive, additive or multiplicative noise due to a number of non idealities in the imaging process. The noise usually corrupts medical images by replacing a portion of the pixels of the first picture with new pixels having luminance values close or equivalent to the base or most extreme of the reasonable element luminance range. The recognizable proof of kind of noise in the medical image is done in two phases in the first stage; a criterion is utilized to identify the presence of the impulsive noise. In the event that the consequence of this rule is negative, the image or picture is then submitted to second phase of another foundation with a specific end goal to distinguish either the additive or the multiplicative way of the noise. There are distinctive sorts of noise which are impulse noise, adaptive noise and multiplicative noise.

3.1 Impulsive Noise (Salt & Pepper)

The salt-and-pepper type noise is typically caused by errors in the data or information transmission failing pixel elements in camera sensors, defective memory areas, or timing mistakes in the digitization procedure.

3.2 Adaptive Noise (Gaussian)

The gaussian noise is regularly used to model natural noise processes, for example those happening from electronic noise in the image acquisition system or framework.

3.3 Multiplicative Noise (Speckle)

Speckle noise is multiple noises in the image an omnipresent antiquity that confines the interpretation of optical coherence of medical image. This kind of noise is extremely basis and ruined the medical image.

4 Filters

There are various types of filter which are use to remove noise from medical images. These filters which are helpful for noise reduction discussed below.

4.1 Mean Filter (MF)

Mean Filter (MF) is a simple linear filter, instinctive and simple to execute technique for smoothing images, i.e. decreasing the measure of intensity variation between one pixel and the next. It is frequently used to reduce noise in images. The idea of mean filtering is basically to replace each pixel value in an image with the mean (average) estimation of its neighbors, including itself. This has the effect of taking out pixel values, which are unrepresentative of their environment.

4.2 Standard Median Filter (SMF)

Standard Median Filter is the non-linear filter, which changes the image intensity mean value if the spatial noise distribution in the image is not symmetrical inside the window. Median filter decrease the fluctuation of the intensities in the image. Median filter is a spatial filtering operation, so it utilizes a 2D mask that is connected to every pixel in the input image.

4.3 Adaptive Median Filter (AMF)

This filter is combined of the mean filter and median filter and work in the two stages: The first is started when the mean filter is end and the second stage after median filter is starting to remove noise from the edge of image when the median filter unable to remove noise from edge of image.

5 Pollination Based Optimization (PBO)

The Pollination is a critical phase of the production cycle for most specialty crops, and in Michigan alone the total annual value of fruit and vegetable crops dependent on bee pollination is about $300 million. Bees are the most important delivery vehicle for pollen, and their activity ensures that the flower stigma receives sufficient pollen for fertilization to occur. Well pollinated crops ripen earlier, produce larger and more even fruit, and improve grower profit. Investment in pollinators is essential for reaching the potential of many fruit crops. To reach this potential, growers need to know how to optimize pollination of their particular crop(s) and varieties being grown. Optimization is a natural process embedded in the living beings [12].Pollination is a process of transfer of pollen from male parts of flower called anther to the female part called stigma of a flower. Some flowers will develop seeds as a result of self-pollination, when pollen and pistil are from the same plant, often (but not always) from the same flower. Other plants require cross-pollination: pollen and pistil must be from different plants. Plants benefit from pollinators because the movement of pollen allows them to reproduce by setting seeds. However, pollinators don't know or care that the plant benefits. They pollinate to get nectar and/or pollen from flowers to meet their energy requirements and to produce offspring. In the economy of nature, the pollinators provide an important service to flowering plants, while the plants pay with food for the pollinators and their offspring. The floral display, fragrance and nectar lure pollinators and leads to pollination. Some species of plants optimize their nectar, display and fragrance producing resources. If pollination process is proceeding smoothly the plants spend average resources. If pollination process is above normal the plants reduce expenditure on resources for producing nectar, floral display and fragrance in the flowers. If the pollination success goes below normal, plants increase the resource expenditure such that more floral display, fragrance and nectar to attract pollinator. As more pollinators and their number of visits increase the pollination success rate increases [12].

5.1 PBO Algorithm

Initialize a=1.2, A=0.9, D=1.2, N41.9, P=2,
Number of plants = 6;

Number of weeks =6;
Number of seasons =20 (number of iterations)
Pollination weekly goal = [0.10 0.25 0.50 0.75 0.90 1.00]
Randomly generate Investment Vector (IV)*
For season = 1 to number of seasons (iterations)
For week = 1: number of weeks
For k = 1: number of plants
Evaluate R using equation 1
Based upon R, update IV
Evaluate Error = Goal - R
Based upon error update N, D, A
End
Exit, if Error acceptable
End
End

6 Simulated Results

In this section, the proposed algorithm is evaluated via computer simulation using MATLAB simulator. In general, the results of the noise removal have a strong influence on the quality of the image processing techniques. So in this work, to introduce Pollination Based Optimization (PBO) based speckle noise reduction from medical images.All simulation results are obtained on the basis of proposed approach Pollination Based Optimization (PBO) as selection algorithm for speckle noise reduction from medical images.

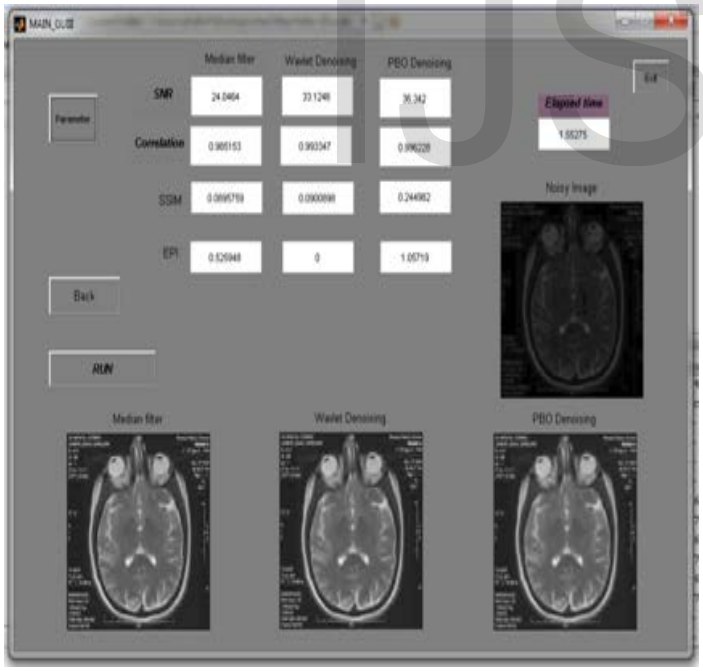

Figure 2: Comparative Analysis on the Basis of Parameters.

Figure 2 show the comparative analysis of different denoising techniques removes speckle noise from magnetic resonance imaging (MRI) on the basis of parameters and also calculate elasped time using Matlab. Figure 3 show the comparative analysis of different denoising techniques removes speckle noise from ultrasound imaging on the basis of parameters and also calculate elasped time using Matlab.

Figure 3: Comparative Analysis on the Basis of Parameters.

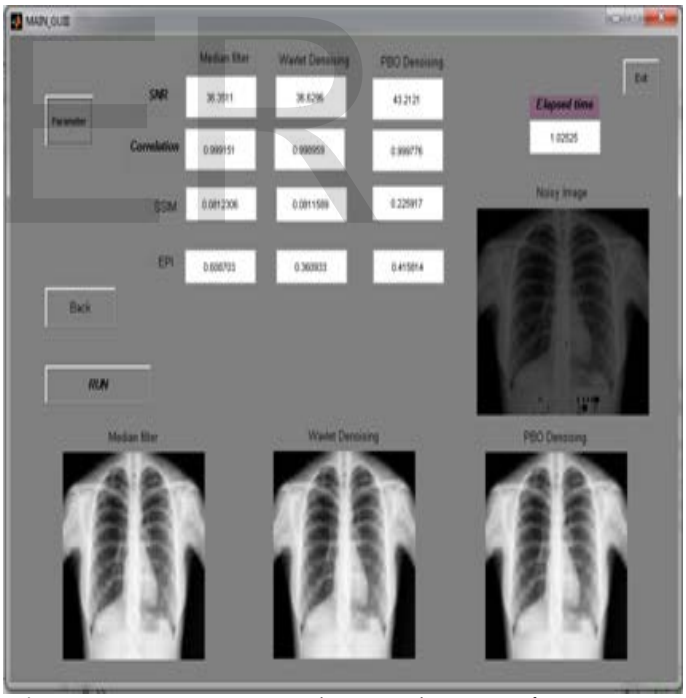

Figure 4: Comparative Analysis on the Basis of Parameters.

Figure 4 show the comparative analysis of different denoising techniques removes speckle noise from X-Ray imaging on the basis of parameters and also calculate elasped time using Matlab.

Table 1 shows the values of different parameters for different denoising techniques, which remove speckle noise from MRI Image and elasped time also.

Table 1: Comparative Analysis of Parameters for Denoising

Techniques.

Parameter	Denoising Technique		
	Median Filter	Wavelet	PBO
SNR	24.0464	33.1246	36.342
SSIM	0.0895	0.0900	0.2449
EPI	0.5259	0.0000	1.0571
Correlation	0.9851	0.9933	0.9962
Elasped Time	1.55275		

Table 2 shows the values of different parameters for different denoising techniques, which remove speckle noise from Ultrasound Image and elasped time also.

Table 2: Comparative Analysis of Parameters for Denoising Techniques.

Parameter	Denoising Technique		
	Median Filter	Wavelet	PBO
SNR	36.3209	39.0418	47.1033
SSIM	0.0240	0.0206	0.2978
EPI	0.4361	0.6469	0.7215
Correlation	0.9975	0.9993	0.9995
Elasped Time	1.0612		

Table 3 shows the values of different parameters for different denoising techniques, which remove speckle noise from X-Ray Image and elasped time also.

Table 3: Comparative Analysis of Parameters for Denoising Techniques.

Parameter	Denoising Technique		
	Median Filter	Wavelet	PBO
SNR	36.3511	36.6296	43.2121
SSIM	0.0812	0.0811	0.2259
EPI	0.6087	0.3609	0.4158
Correlation	0.9991	0.9989	0.9997
Elasped Time	1.02525		

7 Conclusion

The selection of the denoising technique is application dependent. So, it is necessary to learn and compare denoising techniques to select the technique that is used for speckle noise reduction from medical images. Noise is undesired information that spoil image. In digital image noise arise during acquisition and/or transmission process. The performance of image sensor is affected by variety of factors such as environmental conditions during image acquisition and by quality of the sensing elements themselves. So to detect that noise & to remove noise used a PBO based technique which gives efficient results. In medical images or in the medical field, there is a need of noise free images as to detect any type health problem. This PBO based technique can accurately tell where noise is; only the noise-corrupted pixels are replaced & helps to improve the quality of image. According to simulated results the proposed PBO based denoising technique which gives better results as compare to median filter & wavelet denoising.

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