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Ultrasound-Image De-noising Technique's best mix selection using Genetic Algorithm Approach

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Abstract:

Medical Images are regularly of low contrast and boisterous/Noisy (absence of clarity) because of the circumstances they are being taken. De-noising these pictures is a troublesome undertaking as they ought to exclude any antiquities or obscuring of edges in the pictures. The Bayesian shrinkage strategy has been chosen for thresholding in light of its sub band reliance property. The spatial space and Wavelet based de-noising systems utilizing delicate thresholding strategy are contrasted and the proposed technique utilizing GA (Genetic Algorithm) is used. The GA procedure is proposed in view of PSNR and results are contrasted and existing spatial space and wavelet based de-noising separating strategies. The proposed calculation gives improved visual clarity to diagnosing the restorative pictures. The proposed strategy in view of GA surveys the better execution on the premise of the quantitative metric i.e PSNR (Peak Signal to Noise-Ratio) and visual impacts. Reenactment results demonstrate that the GA based proposed technique beats the current de-noising separating strategies.

Keywords — **Speckle-noise, Medical-Imaging, Filtering-techniques, Bayesian-shrink, PSNR.**

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I. INTRODUCTION

In medical-imaging noise concealment alongside the ease and cost effectiveness make ultrasound pictures another attractive apparatus for analysis. In the medicinal writing, speckle has been dealt with as a diverting ancient rarity as it has a tendency to corrupt the determination and the article perceptibility. Ultrasound pictures are influenced by the nearness of multiplicative noise i.e. speckle noise that reduce the visual quality which is acquainted due to participation of several variables [3].

Image-Noise makes aggravation in clear visual results. This builds the need of pre-handling the picture by an appropriate computerized denoising method. Speckle-Noise debases the fine points of interest, edge location and differentiation determination is corrupted.

Denoising of picture is a sort of picture upgrade approach. It empowers to have a superior picture quality.

A few condition of-workmanship denoising separating procedures are being concentrated on by the scientists to enhance the execution of these channels as far as quality, decrease of run time and numerous more elements are concerned.

II. FILTERING TECHNIQUES

The different denoising procedures are:

Lee-Filter

The Lee filter is based on the approach that is the variance over an area is low or constant, and then the smoothing will be performed. Otherwise, if the variance is high (E.g. near edges), smoothing will not performed. The main disadvantage is that it tends to ignore speckle in the areas closest to edges and lines [1].

Kuan-Filter

It does not make approximation on the noise variance within the filter window. The main limitation of kuan filter is that the ENL parameter is needed for computation. The Kuan-filter is considered to be superior to Lee filter. [1].

Wiener-Filter

Wiener is a low pass filters for handling an intensity image which is degraded by constant power additive noise. Wiener uses a pixel-wise adaptive Wiener method based on statistics estimation from a local neighborhood of each pixel.

Median-Filter

Median filter is a non-linear technique that works best with impulse noise (salt & pepper noise) while retaining sharp edges in the image [1].

Wavelet-Based Denoising

Donoho and Johnstone in (1994) developed a theoretical framework for denoising signals using Discrete Wavelet Transform (DWT). The method consists of applying the DWT to the original data, thresholding the detailed wavelet coefficients and inverse transforming the set of thresholded coefficients to obtain the denoised signal [1].

Zong et al. proposed a homomorphic wavelet shrinkage system to partitioned the dot clamor from the first picture [5].All the homomorphic separating approaches by and large experience the ill effects of two noteworthy downsides: The log change being a nonlinear operation, prompts the one-sided estimation of reflectivity by changing the mean of the homogeneous regions and computationally extremely costly because of the extra log and exponential operations [5].

BayesShrink is a versatile information driven edge for picture denoising by means of wavelet delicate thresholding. Limit is driven in a Bayesian structure, and we expect Generalized Gaussian Distribution (GGD) for the wavelet coefficients in every point of interest subband and attempt to discover the edge T which minimizes the Bayesian danger.

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III. LITERATURE REVIEW

David and Kalyanmoy (1991), [2] considers a number of selection schemes commonly used in modern genetic algorithms and analysed for more detailed analytical investigation of selection techniques.

Hong Sern (2001), in [11] presented a new adaptive contourlet transform-based technique for SAR image speckles removal. The discussuion consider the comparison of performance of Lee filter, Forster filter, Gamma filter, wavelet-based despeckling and contourlet transform-based despeckling is provided for both simulated and actual SAR images.

Lakhwinder et al. (2002), in [7] proposes an adaptive threshold estimation method for image denoising in the wavelet domain based on the generalized Guassian distribution (GGD) modeling of subband coefficients. Experimental results show that the proposed threshold removes noise significantly and remains within 4% of OracleShrink and outperforms SureShrink, BayesShrink and Wiener filtering most of the time.

Savita Gupta et al. (2003) have specified in [4] that a novel speckle-reduction method is introduced, based on soft thresholding of the wavelet coefficients of a logarithmically transformed medical ultrasound image. Experimental results showed that the proposed method outperformed the median filter and the homomorphic Wiener filter by 29% in terms of the coefficient of correlation and 4% in terms of the edge preservation parameter.

S. Gupta et al. (2005) in [3] have discussed a versatile wavelet domain despeckling technique which visually enhances the ultrasound images for diagnosis purpose. The different qualitative

measures are visually being compared and show the best result.

Qi-ming, et al. (2006), [10], shows the effectiveness of the methods which validates the results by analysing the simulated and real signals.

Paulinas and Usinskas (2007) in [9], explains that genetic algorithms are most powerful unbiased optimization techniques for sampling a large solution space.

Gupta, et al. (2007), [5] presents a versatile wavelet domain despeckling technique to visually enhance the medical ultrasound (US) images for improving the clinical diagnosis. The visual comparison of despeckled US images and the higher values of quality metrics (coefficient of correlation, edge preservation index, quality index, and structural similarity index) indicate that the new method suppresses the speckle noise well while preserving the texture and organ surfaces.

Hashemi and Kiani (2009) in [6] demonstrated the genetic method which was stronger than counterpart methods in terms of contrast and detail enhancement and producing natural looking images.

Krishna and Reddy (2010) , developed the approach in [8] which is based on functional level evolution whose architecture includes nonlinear functions and uses genetic algorithm for finding the best filter configuration.

Abassi et.al (2014) in [11] discussed blind, still image, Genetic Programming (GP) based robust watermark scheme for copyright protection.

IV. G.A. Based Image Enhancement Approach

Genetic Algorithm (GA) accomplishes the answers for enhancement issues regulated after the procedure of characteristic development. Among the evolutionary strategies, Genetic algorithms (GAs) are the most developed gathering of techniques that speak to the use of developmental devices. GAs depends on the rule of "Survival of Fittest".

GA utilizes the wonders which comprises of a choice, hybrid and transformation administrators. GA takes after the progressive eras to pick a chromosome structure. An underlying populace is produced haphazardly. Further genetic-operators, for example, cross-over and mutation are connected to accomplish craved advanced results [6].

Fundamentally, straightforward GA comprises of taking after steps:

1) Initial Population produced.
2) Fitness estimation of each chromosome taking into account some issue particular measurements is assessed.
3) Select a couple of chromosomes on premise of some determination system
   a. Apply genetic operators i.e. cross-over and mutation transformation
   b. Selected chromosomes supplanted by new chromosomes that are determined after utilization of genetic operators/administrators
4) Finally result acquired by picking the chromosome with most noteworthy wellness esteem.

Fundamentally, this paper dissects a picture improvement issue which is contrasted and the diverse denoising sifting procedures.

The proposed picture upgraded GA comprises of chromosome structure as appeared in figure 1 & 2. Chromosome is represented as a cluster comprising of 6 components.

The components contain the accompanying variables:

Element 1: Original Image (Collection of data set of Ultrasound image)
Element 2: Image format, which can be .jpg, .tif, .gif
Element 3: Noise variance, whose range varies from 0 to 1 i.e. 0.1,0.2 ……so on till 1.
Element 4: De-noising Enhancement Method, which may be Lee, Kuan, Weiner, Median, BayesShrink.
Element 5: Multiscale Decomposition Level, which can LL, LH, HL or HH.
Element 6: For each level, scale parameter K calculated which can 2, 4, 6.

Fig. 1 Chromosome Structure

Original Image	Format of file (.jpg/.tif/. gif)	Noise Variance (0 to 1)	Denoising Enhancement Method (Lee, Kuan, Weiner, Median, BayesShrink)	Multiscale Decomposition (LL, LH, HL or HH)	Scale Parameter (2,4,6)

Fitness function

PSNR metric is used as fitness value for each chromosome. This fitness function has been shown in equation below:

$$Fitness\ Function\ =\ PSNR$$

where PSNR is defined as follows: Peak Signal-to-Noise Ratio(PSNR) :

$$\text{PSNR}= 10 \log 10 \left(\frac{\sigma_g^2}{\sigma_e^2}\right)$$

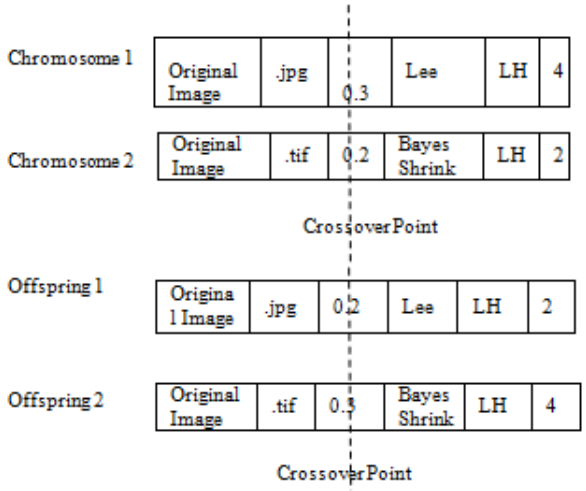
Genetic-Operators

Genetic-Operators are connected in the wake of selecting a couple of chromosomes taking into account Roulette Wheel Selection technique. This technique considers the chromosomes to be a piece of roulette wheel where every chromosome possesses part in view of their wellness values. Guardian chromosomes are chosen by turning the wheel. Further crossover and mutation operators are connected to create the best arrangement haphazardly [10].

Crossover

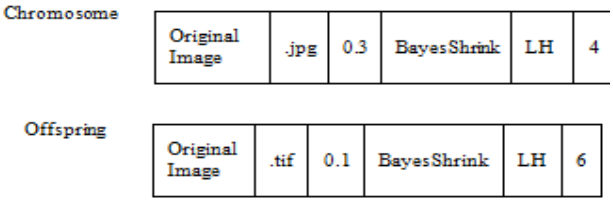
Crossover operator is connected by applying hybrid on certain arbitrary component of chose pair of chromosomes. Any arbitrary number is chosen from the reach 2 to 6. The chosen component number is traded among the chosen chromosomes as appeared underneath in figure:

Fig. 2 Crossover operation n progress



Mutation operator when applied to a selected element of chromosome, changes its value. Mutation point is chosen randomly between the range 2 to 6. Mutation operator changes the values based on element chosen:

Fig. 3 Selection of chromosome with highest fitness



Proposed Image Enhancement GA results randomly in following image which gives highest fitness function:

Original Image	.tif	0.1	BayesShrink	LH	6

Analysis Result

Experiments are conducted to assess the better performance from all denoising filtering methods.

The result in table shows that GA produce better result than Homomorphic Filtering Methods. Wavelet based denoising algorithms uses soft thresholding to provide smoothness and better edge preservation but proposed GA based method outperforms these results. The value of PSNR should be greater than zero. Greater the value of PSNR , better is the quality of the image. The value of EPI and CoC should lie between 0 and 1. Value near to 1 gives the better result. The comparison of different filtering methods with Proposed GA is shown in the table below

Filters	PSNR	SNR	EPI	CoC
Median Filter	32.2767	5.0444	0.1487	0.9793
Lee Filter	33.8362	6.6003	0.2098	0.9853
Kuan Filter	33.2187	5.9864	0.2764	0.9846
Wiener Filter	33.0478	5.8154	0.2277	**0.9924**
Bayes Shrink	34.8585	10.7931	0.84361	0.977565
GA	**34.9763**	**10.9109**	**0.84558**	0.978223

V. CONCLUSIONS

The Trial results demonstrates that the proposed strategy accomplish preferred results over the other homomorphic picture denoising techniques and that too in less time (constant time multifaceted nature). The proposed strategies chromosome contains six parameters specifically unique picture, picture design, clamor fluctuation, accessible denoising techniques, wavelet deterioration sorts and disintegration levels. Proposed GA discovers the best mix of offered parameters to get the ideal and close ideal results as far as time complexity is considered. In addition when we are managing the huge information set of boisterous pictures the proposed procedure ensures better results with substantially less time intricacy. This strategy can be connected on more non specific fields of study where numerous parameters impact a figuring for finding ideal and close ideal results in steady time multifaceted nature.

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