NOISE REDUCTION BASED ON ARTIFICAL BEE COLONY (ABC) ALGORITHM

G.DURGA NANDHINI M.E_APPLIED ELECTRONICS
Final year student, Department of Electronics & Communication Engineering.
K.S.Rangasamy College of Technology, Tiruchengode - 637 215

Project Guide :S.MALARKHODI M.Tech.,Ph.D
Assistant Professor, Department of Electronics & Communication Engineering.
K.S.Rangasamy College of Technology, Tiruchengode - 637 215

***Abstract*- A 2D FIR filters is presented for denoising the digital images. Here the filter coefficients of 2D FIR filters were optimized using the Artificial Bee Colony (ABC) algorithm. To achieve the most tremendous filter design, the filter coefficients were experienced with different mask and connection types during optimization. Initially, the speckle noise with variances was added to the synthetic test image. Soon after, these noisy images were denoised with the proposed approach and other familiar filter types called noise adaptive switched median filter are used. For image quality determination metrics such as mean square error, peak signal-to-noise ratio and signal to noise ratio were used. Even if the noise having maximum variance, the proposed approach performed better than other filtering methods. This noisy image was denoised with high PSNR and SNR values. The performance of the planned approach was tested on several clinical ultrasound images such as kidney and liver tissues. As results, that the 2D FIR filters designed based on ABC optimization can eliminate speckle noise quite well on noise added test images and inherently noisy ultrasound images.**

***keywords*- denoising, 2D FIR filter, median filter, Noise adaptive switched median filter**.

I. INTRODUCTION

Ultrasound imaging is a accepted technique and is used for imaging soft tissues in organs. These system have great advantages such as being non invasive, low cost, safe, adaptable and a real time imaging device but the imaging system can cause speckle noise because of phase sensitive transducers. This can affect image quality negatively and degrade the diagnostic decisions in ultrasound systems. Speckle noise is random, granular and a form of local correlated noise. It is a kind of multiplicative noise and is defined as follows

$$m_{noisy}(x, y) = m_{nfree}(x, y)\dot{\eta}_m(x, y) \quad (1)$$

In this noise model m_{noisy} (x, y) shows the real noisy image, m_{nfree} (x, y) defines the noiseless image and $\dot{\eta}_m(x, y)$ is the multiplicative noise.

II. ULTRASOUND IMAGE

Medical ultrasound uses high frequency broadband sound waves in the mega hertz series that are reflected by tissue to altering degrees to produce images. This is normally associated with imaging the fetus in pregnant women. Other main uses hold imaging the abdominal organs, heart, breast, muscles, tendons, arteries and veins. While it may afford less anatomical detail than technique such as CT or MRI, it has some advantages which make it best in numerous situations. Advantage of ultrasound denoising, can use ultrasound to identify blood flow all the way through vessels. Most ultrasound exams are rapid and painless. Ultrasounds do not cause any health trouble, and there are no known hurtful effects to humans.

Methodology-Speckle noise reduction is an main stage for the imaging of soft tissue by means of an ultrasound system. There are several methods to denoise ultrasound images. If the edges of ultrasound images are preserved by image denoising then, the proposed method has been performed well. Noise reduction is extracting noiseless image from noisy image. The block diagram for noise reduction is Fig. 1.

BLOCK DIAGRAM DESCRIPTION

There are the two digital image signal I_{nfree} is the original image without any noise, M_{noisy} is the noisy image. A noisy input is given to the 2D FIR filter, which produce an output with reduced noise with Mccellan transform as a coefficient, by using ABC algorithm ,the optimized filter

coefficient is obtained and it is again given to 2D FIR Filter and finally median filter is used to acquire the denoised image (Fig.1).

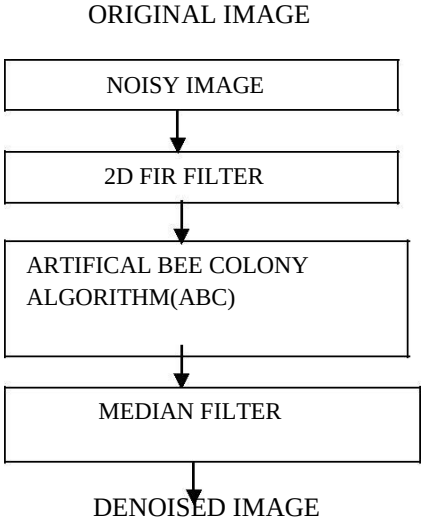


Fig.1. Overall block diagram

A. NOISY IMAGE

Multiplicative noise is added to the medical ultrasound image, this is because original image have less noise and so it is difficult to identify. Speckle noise arises because it is sensitive to transducer

B. 2D FIR FILTER

2D FIR FILTER is stable and have phase linearity is achieved by a non-recursive algorithm . It does not require any feedback. Generally for designing FIR filters is the Parks-McClellan filter design algorithm is used. The steps to perform 2D FIR filter are:

- Create a 1-D FIR filter with the desired number of filter co-efficient
- Apply inverse FFT to 1 D FIR filter
- Create a transform matrix T
- Use T , 1D filter and Chebyshev polynomials to compute 2D FIR filter coefficients.
- Apply the 2D FIR filter to image.

C.ARTIFICAL BEE COLONY ALGORITHM

The general design of the ABC algorithm is as follows:

Initialization phase

REPEAT
Employeed Bees
Onlooker Bees
Scout Bees

Memorize the best solution so for

UNTILL

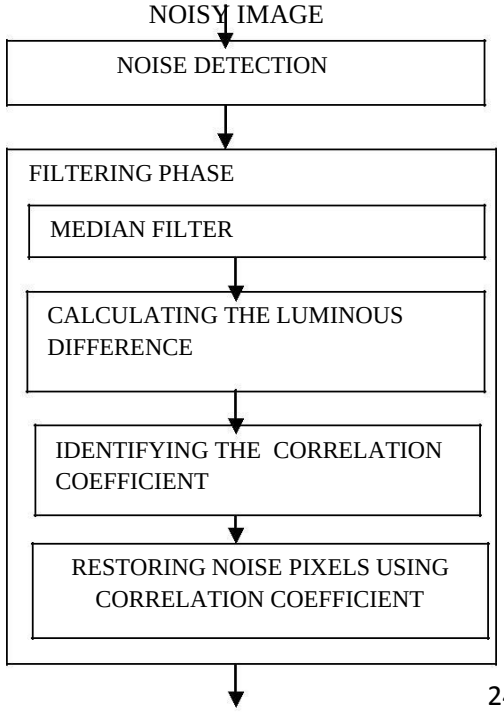
PROCEDURE OF ABC ALGORITHM

Initially set the colony size as 40 and the dimension as 10. The control parameters are initialized . Employed bees is the half of the colony size. Calculate the fitness values for the employed bees. In the employed phase , Calculate the new solution for all the bees . For the obtained solution ,calculate the fitness value and greedy selection is done by, compare it with initial fitness value of the employed bees. The best value is save in the initial value of the employed bees. Calculate probability for the employed bees. In the onlooker phase , Calculate the new solution for all the bees . For the obtained solution ,calculate the fitness value and greedy selection is done by, compare it with final value of the employed bees. The best value is save in the initial value of the employed bees. Calculate probability for the onlooker bees. Memorize the best solution . Scount bees will search the new value if the attained value crossed the limit.

D. MEDIAN FILTER

Median filtering is a non-linear filter and it have ability to remove impulsive type noise and it preserve sharp edges. It is an order statistics filter. The median filter is calculated by sorting neighbourhood pixels in ascending order and replace it in middle pixel.

E. NOISE ADAPTIVE SWITCHED MEDIAN FILTER (NASMF)



DENOISED IMAGE

Fig.2. NASMF block diagram

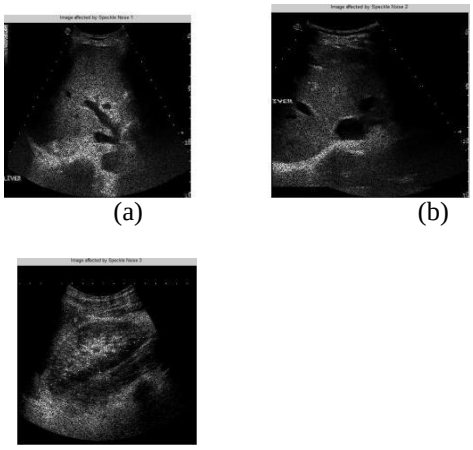
Noise adaptive fuzzy switching median (NAFSM) Fig.2 is replaced instead of median filter because it have good effect in preserving edge of the image. Initially, NASMF filter have the detection stage which is used to identify noise pixels. For the second stage of the filtering stage the detected noise pixels is given , while noise-free pixels are detected and left unprocessed.

III. PERFORMANCE EVALUATION

The output images are evaluvated in terms of Mean square error(MSE) and the Peak signal to Noise ratio(PSNR) and Signal to Noise ratio(SNR).PSNR is the ratio between output signal power to noise power and MSE is the average of square of differences in pixel intensity values of original and processed image. The parameters estimate the quality of a processed image with respect to an original image.Denoised image with higher PSNR and less MSE are consider better. The qualitative performance of the algorithm is measured using the output image and it is seen that from the output images that the visual quality of output image processed by Noise Adaptive Switched Filter.

The PSNR ,SNR and MSE values of the proposed filter and modified filter are shown in the Table 1 for three different ultrasound image 512 x 512.

IMAGE AFFECTED BY SPECKLE NOISE

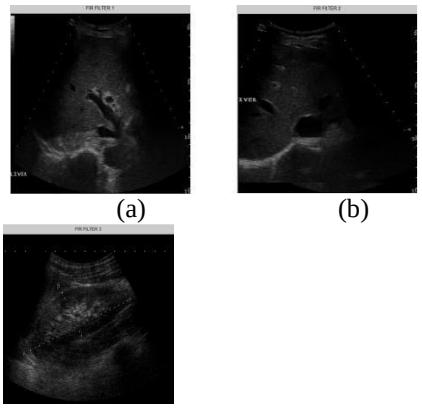


(a) (b)

(c)

Fig.3.1 Ultrasound image is affected by speckle noise (a),(b),(c)

RESULTS OF 2D FIR FILTER



(a) (b)

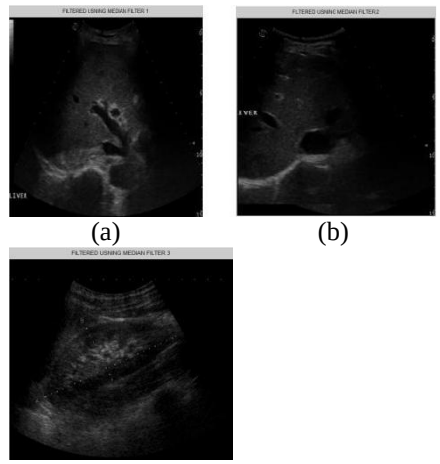
(c)

Fig.3.2 Output image affected by speckle noise is filtered by 2D FIR filter(a),(b),(c).

OUTPUT OF ABC ALGORITHM

Coefficient for 2D Filter

1.0138 1.0193
1.0204 1.0225
1.0302 1.0554
1.1109 1.2158
1.4823 2.1978



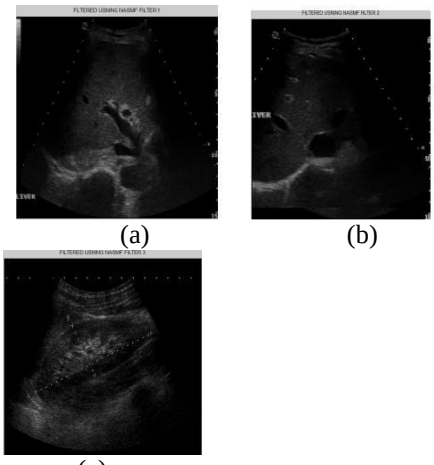
(a) (b)

(c)

Fig.3.3 Output image of proposed algorithm using median filter (a),(b),(c).

TABLE 1 PSNR ,SNR and MSE estimates the performance of the proposed filter and modified filter.

IMAGE	MEDIAN FILTER			NOISE ADAPTIVE SWITCHED MEDIAN FILTER		
	PSNR	MSE	SNR	PSNR	MSE	SNR
US liver image 1	23.9881	0.0204	8.3922	24.1227	0.0212	8.5268
US liver image 2	26.5185	0.0242	8.2699	26.5363	0.0242	8.2877
US image Abdomen	24.5771	0.021	8.0130	24.9415	0.0232	8.3775

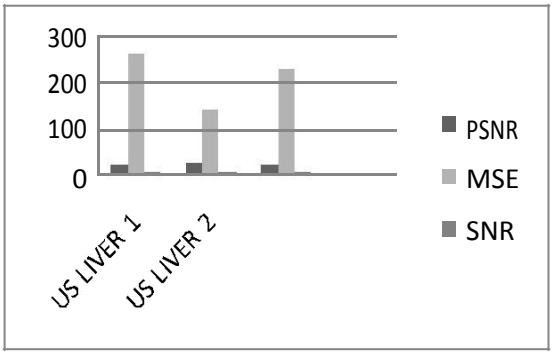


(a) (b)

(c)

Fig.3.4 Output image of proposed algorithm using NASM filter (a),(b),(c).

Comparison results of proposed algorithm with the above results in terms of PSNR,SNR and MSE for three different ultrasound liver of size 512 x 512are plotted and is shown in the Fig.4.6,Fig.4.7,Fig.4.8 respectively. It is seen from the PSNR ,SNR and MSE values of noise adaptive switched median filter is better when compared to proposed filter.



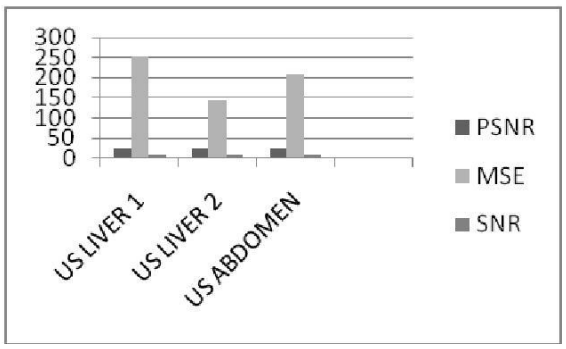


Fig.3.5 and 3.6 PSNR, MSE, SNR comparison using Median FilterNoise Adaptive Switched Median Filter

IV.CONCLUSION

The purpose of speckle noise denoising using a 2D FIR filter designed with the ABC algorithm and Median filter, MSE, PSNR and SNR values were calculated to measure the performance of the proposed method. The image denoising is done successfully by using a population based computational scheme. The greatest advantage of the system is its being very easy to implement and its obtaining better results for speckle noise elimination according to proposed filters. Any ultrasound image can be denoised using the obtained filter coefficients and median filters. The experimental results were analysed using the parameters viz., PSNR ,MSE, SNR. The proposed work is modified using the Noise Adaptive Switched Median Filter(NASMF). It is seen from the PSNR ,SNR and MSE values the noise adaptive switched median filter is better when compared to proposed filter.

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