Despeckling of Ultrasound Images Based on Artificial Bee Colony Algorithm by Using Hybrid Median Filter

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Abstract— Image processing usually refers to the digital image processing. Digital image processing is use of the computer algorithms to perform image processing on digital images. As a subcategory of digital signal processing, digital image processing has the many advantages over analog image processing. It allows a much wider range of the algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Ultrasound images are usually affected with an artefact called speckle. The presence of speckle is undesirable since it degrades image quality. Two-dimensional filters (2D) are used to process two-dimensional digital signals. For image quality determination metrics such as Mean Square Error, Peak Signal-to-noise ratio and Signal-to-noise ratio were used. The performance of the existing method is tested on several clinical ultrasound images such as those obtained liver tissues. The median filter method achieves 24.57(PSNR) and 226.66(MSE) which is higher than other existing method. The hybrid median filter with the ABC algorithm is used to obtain better higher PSNR and lesser MSE, which improve the better quality of image, will be the proposed system. 

Key words: Two-Dimensional Filters, PSNR, Signal to Noise Ratio, Ultrasound Images

I. INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get the enhanced image or to extract some useful information from it Medical ultrasonography uses high frequency broadband sound waves in the megahertz range that are reflected by tissue to varying degrees to produce (up to 3D) images. This is commonly associated with the images fetus in pregnant women. Uses of the ultrasound are much broader, however. Other important use involves the imaging of abdominal organs, heart, breast, muscles, arteries and veins. While it may provide the less anatomical detail than techniques such as CT or MRI scan, it has several advantages which make it ideal in numerous situations, in that particular it studies the function of moving structures in real-time, that emits no ionizing radiation, and contains the speckle that can be used in elastography. Ultrasound is used as a popular research tools for capturing the raw data, that can be made available through the ultrasound research interface, for purpose of the tissue characterization and implementation of new image processing techniques.

The concepts of ultrasound are differing from other medical imaging modalities in the fact that it is operated by the transmission and receipt of sound waves. The high frequency sound waves were sent into the tissue and depending on the composition of the different tissues; the signal will be attenuated and returned at separate intervals. A path of the reflected sound waves in a multilayered structure can be defined by input acoustic impedance (ultrasound sound wave) and the Reflection and transmission coefficients of the relative structures.

It is very safe to use and does not appear to cause any adverse effects. It is also relatively quick to perform. Ultrasound scanners can be taken to the critically ill patients in ICU, avoiding the danger caused while by moving the patient to radiology department. In real time, the moving image obtained can be used to guide for drainage and biopsy procedures.

II. RELATED WORK

Ashish Khare et al (2010),[1] The proposed method firstly detects strong edges using imaginary component of complex scaling coefficients and then applies shrinkage on magnitude of the complex wavelet coefficients in the wavelet domain at non-edge points. In the proposed system the shrinkage depends on the statistical parameters of complex wavelet coefficients of noisy image which makes it adaptive in nature. The Effectiveness of proposed method is compared on the basis of signal to mean square error (SMSE) and signal to noise ratio (SNR).

Chung Chan et al (2007),[2] The proposed approach was realized through a post reconstruction filter based on the nonlocal means (NLM) filter, which reduce the noise by computing the weighted average of voxels based on the similarity measurement between patches of voxels within the image. Dervis Karaboga et al (2008),[3] The algorithm is specifically based on the model proposed for the foraging behavior of honey bee colony. The model consists of three essential components: employed and unemployed foraging bees, and the food sources. The first two components, employed and unemployed foraging bees, where it search for rich food sources, which is close to their requirement.

Deep Gupta et al (1998),[4] This paper presents an edge preserved despeckling approach that combines the non-sub-sampled shearlet transform (NSST) with improved nonlinear diffusion equations. As a new image representation method with the different features of localization, directionality and multiscale, the NSST is utilized to provide the effective representation of the image coefficients. The anisotropic diffusion approach is applied to the noisy coarser NSST coefficients to improve the noise reduction efficiency and effectively preserves the edge features. Hossein Talebi et al (2014),[5] Here the proposed method have two-fold. First, give a statistical analysis of proposed global filter, based on the spectral decomposition of its corresponding operator, and the effect of truncation of this spectral decomposition. Second, derive an approximation to the spectral (principal) components using the Nyström extension. Using these, demonstrate that this global filter can be implemented efficiently by sampling a fairly small percentage of the pixels in the image.
Mohana et al (2014),[6] There are two typical ways to reduce the noise in the images. One way is to acquire the data several times and average them. However, it increases the acquisition time. Another way is to denoise the images by using the post processing methods. Yi Zhan a et al (2014),[7] A nonlocal means method using weight refining for ultrasonic speckle reduction is proposed. Based on the signal-dependent speckle model, the novel similarity weight is derived by Bayesian framework. The weight is iteratively refined in the lower dimensional subspace using principal components analysis to improve accuracy of weight and reduce its computational complexity.

III. PROPOSED METHODOLOGY
The proposed system performances can be done by considering the following flow chart as follows:

A. Original Image:
The original ultrasound image of liver and abdomen required for the noise reduction process is as follows:

B. Noisy Image:
The original image is added with speckle noise in order to show the denoising clearly.

C. Two-Dimensional Digital Filters:
Two-dimensional filters are used to process the two-dimensional digital signals. There is one important difference between the design of 1-Dimensional and 2-Dimensional digital filter problems. In 1-Dimensional case, the design and the implementation of filters can be more easily considered separately. The filter can be designed and then the appropriate manipulations of the coefficients required by a particular network structure can be determined. While in the 2-Dimensional case, the design and implementation are more closely related. This means that an arbitrary multi-dimensional transfer function can be manipulated into a form required by a particular implementation. It can realize only factorable transfer functions, and then our design algorithm must be tailored to design only filters of this class. In general, Digital filters can be categorized into two main types, namely finite impulse response (FIR) and infinite impulse response (IIR). 2-Dimensional FIR digital filter is achieved by a non-recursive algorithm structure while 2-Dimensional IIR digital filter is achieved by a recursive feedback algorithm structure.

D. Artificial BEE Colony Algorithm
In ABC, the colony of artificial bees contains 3 teams of bees: used bees related to specific food sources, viewer bees looking the dance of used bees inside the hive to settle on a food supply, and scout bees checking out food sources willy-nilly. Each onlookers and scouts are known as idle bees.

Initially, all food supply positions square measure discovered by scout bees. Thereafter, the nectar of food sources square measure exploited by used bees and viewer bees, and this continual exploitation can ultimately cause them to become exhausted. Then, the used bee that was exploiting the exhausted food supply becomes a scout bee in search of more food sources all over again. In alternative words, the used bee whose food supply has been exhausted becomes a scout bee. In ABC, the position of a food supply
represents a attainable answer to the matter and therefore the 
nectar quantity of a food supply corresponds to the standard 
(fitness) of the associated answer. The quantity of used bees 
is up to the quantity of food supplies (solutions) since every 
used bee is related to one and just one food source.

The main steps of the algorithmic program square 
measure given below:

- Initial food sources square measure created for all 
  used bees
- REPEAT
- Each used bee goes to a food supply in her memory 
  and determines a neighbor supply, then evaluates 
  its nectar quantity and dances within the hive
- Each viewer watches the dance of used bees and 
  chooses one among their sources reckoning on the 
  dances, then goes to it supply. When selecting a 
  neighbor around that, she evaluates its nectar 
  quantity.
- Abandoned food sources square measure 
  determined and square measure replaced with the 
  new food sources discovered by scouts.
- The best food supply found up to now is registered.
- UNTIL(requirements square measure met).

E. Hybrid Filter:

This hybrid filter is that the combination of the each Median 
and wiener filter. When we arrange these filters in series we 
get the desired output. First we tend to take away the 
impulse noise and so pass the result to the wiener filter. 
The following steps are followed once we filtered the image:

- If the image is colored convert it within the grey 
  scale image.
- Convert the image to double for higher exactitude.
- Find the median by sorting all the values of the 3*3 
  mask in increasing order.
- Replace the middle picture element price with the 
  average.
- Estimate the Signal to Noise quantitative relation.
- De-convolution perform is applied to filter the 
  image.

IV. RESULT AND DISCUSSION

The Existing method is tested for two different gray scales 
on input test image of size 512 x 512. In this first step, the 
original image is added with the speckle noise of maximum 
variance. After this, the input image is processed with 2D 
FIR filter, Artificial Bee Colony (ABC) algorithm and 
median filter.

![Liver](image1) ![Liver 2](image2)

Fig. 6: Illustrates Noise Reduction Image by Hybrid Median 
Filter

The output images are evaluated 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 two parameters use a 
standard mathematical model to measure an objective 
difference between two images. The parameters estimate the 
quality of a reconstructed image with respect to an original 
image. The basic idea is to compute a single number that 
reflects the quality of the denoised image. Denoised image 
with higher PSNR and less MSE are judged better.

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 existing method. Any 
ultrasound image can be denoised using the obtained filter 
coefficients and hybrid median filters. The experimental 
results were analyzed using the parameters viz., PSNR, 
MSE, SNR.

<table>
<thead>
<tr>
<th>IMAGE</th>
<th>MEDIAN FILTER</th>
<th>HYBRID MEDIAN FILTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PSNR</td>
<td>MSE</td>
</tr>
<tr>
<td>Ultrasound liver image 1</td>
<td>23.988</td>
<td>259.577</td>
</tr>
<tr>
<td>Ultrasound liver image 2</td>
<td>26.518</td>
<td>144.954</td>
</tr>
</tbody>
</table>

Table 1: Comparison of the Filter

V. CONCLUSION

Speckle noise reduction is a pre-processing step and is very 
important to improve the results of later stages for the 
diagnosis of disease from ultrasound images. By performing 
denoising using 2D FIR filter designed with ABC algorithm 
and median filter most of the noise is removed to obtain a 
clear output for diagnosis purpose.

VI. ACKNOWLEDGEMENT

Special thanks to the references that have made several 
suggestions to significantly improve the paper.

REFERENCES

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