

An Approach for Speckle Noise Reduction from US Images using Enhanced Sticks Filtering

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Abstract: Digital images are generally affected by noise due to acquisition process or by transmission process [7]. In most of the images we can found a large variety of noise. The numbers of algorithms are used to remove noise from the image depending upon noise model. Number of researchers are working on the field of de-noise the images [10]. In this paper we proposed an enhanced sticks filtering technique to reduce speckle noise from ultrasound images. We also studied different existing de-noising algorithms and compare them with the proposed method. The performance comparisons in terms of improvement in signal to noise ratio (SNR) of the proposed scheme, MSE (Mean Square Error) of the proposed method etc.

Keywords: Image acquisition, De-Noise, Speckle Noise, SNR, MSE.

I. Introduction

Digital images play a vital role both in daily life applications such as satellite television, magnetic resonance imaging, computer tomography as well as in the area of research and technology such as medical images etc. In medical imaging Ultrasound is an indispensable diagnostic tool because of its non-invasive, non-ionizing, real time portable and low cost nature [1]. Ultrasound imaging uses high frequency sound waves to view soft tissues such as muscles and internal organs. Since speckle is a major shortcoming of Ultrasound, reducing or eliminating speckle is great interest to system designers. Reducing noise from Medical images is a challenge for researchers in digital image processing. Speckle noise is commonly found in synthetic aperture radar images and Medical images [21].

Various methods available in literature for speckle noise reduction are multi look method, spatial averaging and homomorphic filtering [18]. The multi look process is usually done during data acquisition stage and speckle reduction by spatial filtering is performed on the image after it is acquired.

The homomorphic filtering approach operates in logarithmic domain. Irrespective of the method used to reduce speckle noise from images, the ideal speckle reduction method must preserve radiometric information and the textural information i.e. the edges between different area and spatial signal variability [8, 11]. The spatial filters are of two types which are adaptive or non-adaptive. A non-adaptive filter takes the parameters of the whole image signal into consideration and leave out the local properties of the sensors [6]. These kinds of filters are not appropriate for not-stationary scene signal. Fast Fourier Transform (FFT) is an example for such filters. The adaptive filters accommodate changes in local properties as well as the nature of sensors. Adaptive filters reduce speckle while preserving the edges and these filters modify the image based on statistical extracted from the local environment of each pixel [4]. A filter that adapts the stretch to the region of interest produces a better enhancement. These filters are Mean, Median, Lee, Lee-sigma, Frost and Gamma MAP. In homomorphic filtering approach, the multiplicative speckle noise is first converted to additive noise then one of the additive noise model is applied for noise reduction and finally speckle reduced image is obtained by taking the exponential of the image obtained in second step [2]. In this paper we proposed a method for speckle noise reduction using enhanced sticks filtering technique.

II. Problem Formulation

The scope of ultrasound imaging systems covers many areas like cancer detection, obstetric sonography during pregnancy etc. In Ultrasound images speckle noise shows its presence while doing the visualization process. It will produce negative effect on Ultrasound image which may further leads to human error or individual bias. Existing filters are not much efficient in removing speckle noise, they may cause to loss of details in low contrast border regions. Alternatively we are proposing a system to use sticks filter as a smoothing filter.

The sticks filtering algorithm takes on the challenge of filtering speckle in Ultrasound images without losing edge detail by determining whether a linear feature passes through pixel (x, y) and then calculating the filtered pixel intensity $g(x, y)$, which is the arithmetic mean of neighboring pixel in the direction of sticks. Enhanced sticks filtering method will remove speckle noise completely and produce better results as compared to other existing filters.

III. Objectives

- To preprocess the ultrasound image that involves Image Cropping, Smoothing, Sharpening, Binarization of the image, Modification of the Image and Image Thinning.
- To implement, the existing filters such as NL-Mean, Lee etc.
- To implement the proposed method over the preprocessed ultrasound image in an attempt to reduce the speckle noise and produce a better resulting image as compared to resulting image produced by the existing filters.
- To compare the resulting images from the various filters such as Sobel, Prewitt, and proposed filtering technique on the basis of various parameters such as MSE, SNR, RMSE, PSNR etc.

IV. Methodology

We proposed a system which will take an Ultrasound image as an input which contains speckle noise. To remove speckle noise we can apply NL-Mean filter and Lee filter on the given image and then we can apply proposed enhanced sticks filter on the given image to remove speckle noise. From the above said procedure we can get three different images as output images then we consider MSE, RMSE, SNR and PSNR parameters to compare the quality of output images. The Method is given in Fig1 as:

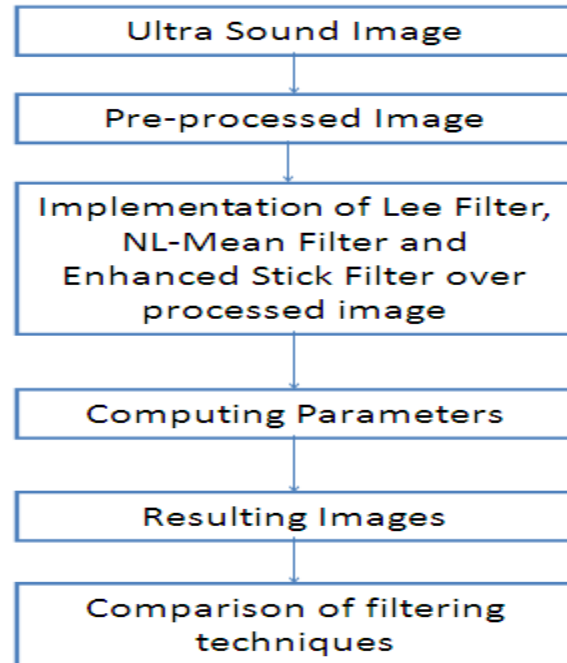


Fig1: Proposed Methodology

V. Conclusion

From the literature, we get the idea that Ultrasound imaging system is widely used diagnostic tool for modern medicine. But during the image acquisition process, due to the introduction of speckle noise, it shows its presence in visualization process. Existing filters for speckle noise shows inefficiency in removing speckle as their processing causes loss of detail in low contrast regions. Proposed enhanced sticks filtering method will remove the speckle noise completely and produce better results as compared to other existing filters.

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