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Efficient Analysis of Ultrasound Image Denoising using Different Type of filter

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Abstract

This paper proposes an efficient analysis of Ultrasound Image Denoising using different type of filtering methods. The search for efficient image denoising methods is still a valid challenge at the crossing of functional analysis and statistics. Image denoising has become an essential exercise in medical imaging especially the ultrasound image. This paper proposes a medical image denoising algorithm using discrete wavelet transform, Weiner, normal and median filter. The presence of noise in biomedical images is a major challenge in image processing and analysis. Denoising techniques are aimed at removing noise or distortion from images while retaining the original quality of the image. These images have been converted into grayscale and three types of noises have been added, including Speckle, Gaussians, and Salt & Pepper. In brief, this project succeeds to explore a new thresholding method with better performance in both PSNR and MSE. It reveals that median filter is the best filtering method to remove the Speckle, Gaussians, and Salt & Pepper noise. But in this paper we also used the different type of the Shrinks for the best result. For the implementation of this proposed work we use the Image Processing Toolbox under Matlab Software.

Keywords: Discrete wavelets transform, Weiner, normal and median filter, Ultrasound image, Speckle, Gaussians, and Salt & Pepper, PSNR, MSE and Shrinks.

Introduction

In the past two decades, many noise reduction techniques have been developed for removing noise and retaining edge details. Most of the standard algorithms use a defined filter window to estimate the local noise variance of a noise image and perform the individual unique filtering process. The result is generally a greatly reduced noise level in areas that are homogeneous. But the image is either blurred or over smoothed due to losses in detail in non-homogenous areas like edges or lines. This creates a barrier for sensing images to classify, interpret and analyze the image accurately especially in sensitive applications like medical field. The primary goal of noise reduction is to remove the noise without losing much detail contained in an image. To achieve this goal, we make use of a mathematical function known as the wavelet transform to localize an image into different frequency components or useful sub bands and effectively reduce the noise in the sub bands according to the local statistics within the bands. The main advantage of the wavelet transform is that the image fidelity after reconstruction is visually lossless. The wavelet de-noising scheme thresholds the wavelet coefficients arising from the wavelet transform. The wavelet transform yields a large number of small coefficients and a small number of large coefficients. Wavelets are especially well suited for studying non stationary signals and the most successful applications of wavelets have been in compression, detection and denoising.

Ultrasonic detection technology is a method provides the basis for discovery and diagnostics for diseases by measuring physiological tissue morphology and data which is applied to the human body detection. In actual clinical diagnostic applications, ultrasound imaging technology is collectively known as one of the four imaging technologies the field of modern medicine with X-ray, CT, and MRI, and it is a convenient, painless, intuitive, non-invasive important means of imaging techniques for medical analysis and diagnosis. Ultrasound image analysis of ultrasound-based diagnostic techniques become critical support for the clinical diagnosis and telemedicine technology because of its many advantages such as fast, wide range and timely diagnosis in the process of obtaining organic image, as well as disease diagnosis without

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danger and suffering, and it has important application status. The clinical diagnosis applications have high demands on the quality of ultrasound images. In order to provide ultrasound images as important diagnostic evidence for medical diagnosis, the search for more effective ways to remove noise in ultrasound images become a key issue. In the actual ultrasonic imaging process, as the ultrasonic transmitted from the emission source of the signal scattering inevitably when propagating to the deep tissues of the body organs, and the echo signals affect the imaging of ultrasound image, so multiplicative speckle noise formed in ultrasound images, interfering the detail features of the ultrasound image, thereby affecting the accuracy of medical diagnosis. Traditional de-noising method cannot effectively remove multiplicative speckle noise and ensure the detail features, result in lower accuracy of ultrasound image-based medical diagnosis.

In order to improve the effectiveness of medical ultrasound image denoising, the alpha ultrasound image denoising method is proposed. Taking into account the effect of multiplicative speckle noise in the image detail features, directly rigid filtering of the image is avoided.

Lakhwinder Kaur, Savita Gupta, R.C. Chauhan Deptt. of CSE SLIET,[8] Longowal Punjab (148106), India ,"Image Denoising using Wavelet Thresholding", In This paper proposes an adaptive threshold estimation method for image denoising in the wavelet domain based on the generalized Gaussian distribution (GGD) modeling of sub-band coefficients. The proposed method called Normal Shrink is computationally more efficient and adaptive because the parameters required for estimating the threshold depend on sub-band data.

Iram Sami, Abhishek Thakur, Rajesh Kumar, [9] "Image Denoising for Gaussian Noise Reduction in Bionics Using DWT Technique", Image denoising has been achieved using new technique of wavelet transform in combination with Weiner filters and results have been obtained that could be measured subjectively by viewing the pictures of restored image attained as above results and checking the PSF of final restored image that shows very less distortion parameter. Also, Image quality has been measured objectively using MSE value with different wavelets.

Sachin D Ruikar, Department of Electronics and Telecommunication [10], "Wavelet Based Image Denoising Technique", In This paper proposes different approaches of wavelet based image denoising methods. The search for efficient image denoising methods is still a valid challenge at the crossing of functional analysis and statistics.

The remainder of this paper is organized as the following. At first, in Section II we illustrate the various components of our proposed technique to denoising. Further, in Section III we present some key experimental results and evaluate the performance of the proposed system. At the end we provide conclusion of the paper in Section IV and state some possible future work directions.

Proposed technique

This section illustrates the overall technique of our proposed Denoising of ultrasound images. In this paper, we proposed an efficient analysis of Ultrasound Image Denoising using different type of filtering methods. The primary goal of noise reduction is to remove the noise without losing much detail contained in an image. To achieve this goal, we make use of a mathematical function known as the wavelet transform to localize an image into different frequency components or useful sub bands and effectively reduce the noise in the sub bands according to the local statistics within the bands. The main advantage of the wavelet transform is that the image fidelity after reconstruction is visually lossless. The wavelet de-noising scheme thresholds the wavelet coefficients arising from the wavelet transform. The main improvements in our work are the using of the different type of the filters. We proposed an efficient analysis of Ultrasound Image Denoising using different type of filtering methods or Shrinkages. In this we used different types of shrinkage:

A. Normal filter
B. DWT
C. Median filter
D. Wiener Filter

A. Normal filter

In signal processing, a filter is a device or process that removes from a signal some unwanted component or feature. Filtering is a class of signal processing, the defining feature of filters being the complete or partial suppression of some aspect of the signal. Most often, this means removing some frequencies and not others in order to suppress interfering signals and reduce background noise. However, filters do not exclusively act in the frequency domain; especially in the field of image processing many other targets for filtering exist. Correlations can be removed for certain frequency components and not for others without having to act in the frequency domain.

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B. DWT

In numerical analysis and functional analysis, a discrete wavelet transform (DWT) is any wavelet transform for which the wavelets are discretely sampled. As with other wavelet transforms, a key advantage it has over Fourier transforms is temporal resolution: it captures both frequency and location information (location in time). The Discrete Wavelet Transform (DWT) of image signals produces a non-redundant image representation, which provides better spatial and spectral localization of image formation, compared with other multi scale representations such as Gaussian and Laplacian pyramid. Recently, Discrete Wavelet Transform has attracted more and more interest in image de-noising. The DWT can be interpreted as signal decomposition in a set of independent, spatially oriented frequency channels.

C. Median filter

Median filtering is a nonlinear process useful in reducing impulsive or salt-and-pepper noise. It is also useful in preserving edges in an image while reducing random noise. Impulsive or salt-and pepper noise can occur due to a random bit error in a communication channel. In a median filter, a window slides along the image, and the median intensity value of the pixels within the window becomes the output intensity of the pixel being processed. The median filter is normally used to reduce noise in an image, somewhat like the mean filter. However, it often does a better job than the mean filter of preserving useful detail in the image.

D. Wiener Filter

In signal processing, the Wiener filter is a filter used to produce an estimate of a desired or target random process by linear time-invariant filtering an observed noisy process, assuming known stationary signal and noise spectra, and additive noise. The Wiener filter minimizes the mean square error between the estimated random process and the desired process. The most important technique for removal of blur in images due to linear motion or unfocussed optics is the Wiener filter. From a signal processing standpoint, blurring due to linear motion in a photograph is the result of poor sampling. Each pixel in a digital representation of the photograph should represent the intensity of a single stationary point in front of the camera.

Evaluation and results

To verify the effectiveness (qualities and robustness) of the proposed denosing technique, we conduct several experiments with this procedure on several ultrasound images.

In this work we load an ultrasound image and apply the different filtering technique on loaded image in the Image Processing Toolbox under the Matlab Software. Below steps of our proposed work is given:

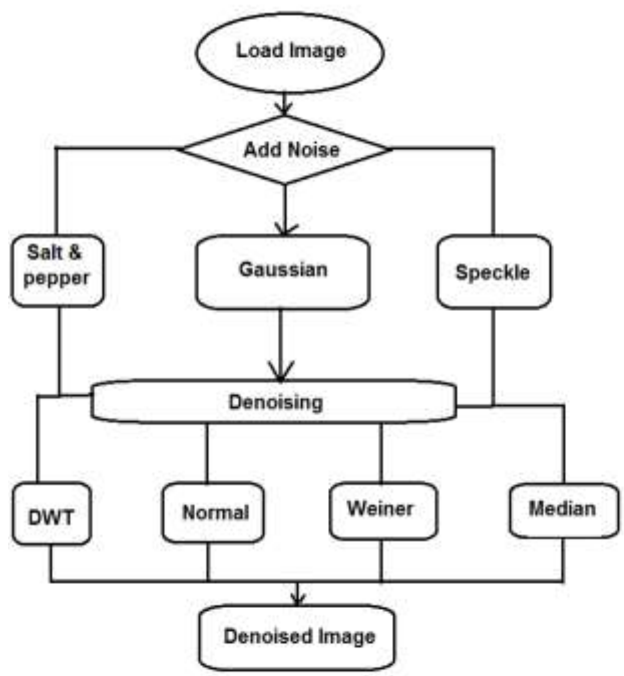
Phase 1: Firstly we develop a particular GUI for this implementation. After that we develop a code for the loading the Ultrasonic Medical image in the Matlab database.

Phase 2: Develop a code for the addition of noise in the image. We use Speckle, Gaussians, and Salt & Pepper noise in the proposed work.

Phase 3: Develop a code for the filtering methods. With the help of this we got the denoise image. Because by using the filter the chances of image corruption should be decrease.

Phase 4: After that we develop code for the calculation of the different parameters like PSNR, MSE etc. With the help of these parameters we can compare our proposed technique with previous proposed techniques.

Flow Chart of proposed method



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In our proposed method, we denoise the ultrasound images .there are three type of noise: i) salt & pepper, ii) Gaussian and iii) speckle Noise. All result is given in below figures:

Fig 1. Original Image

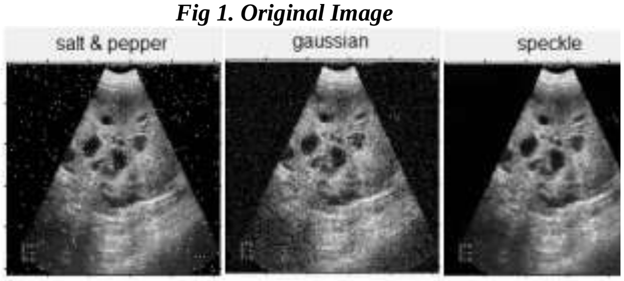

Fig 2. Noisy images

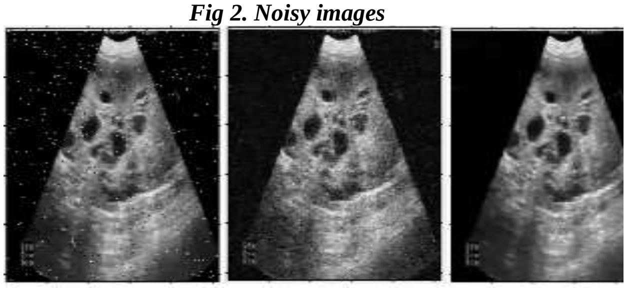

Fig 3. Denoise image using DWT

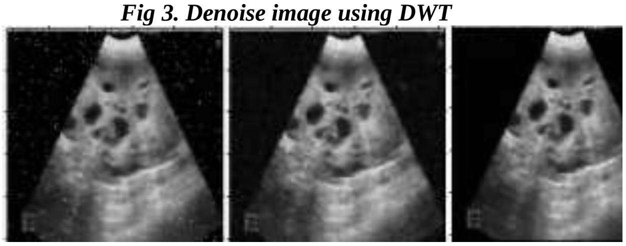

Fig 4. Denoise image using Weiner filter

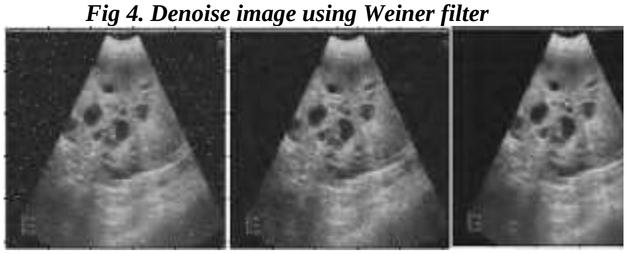

Fig 5. Denoise image using Normal filter

Fig 6. Denoise image using median filter

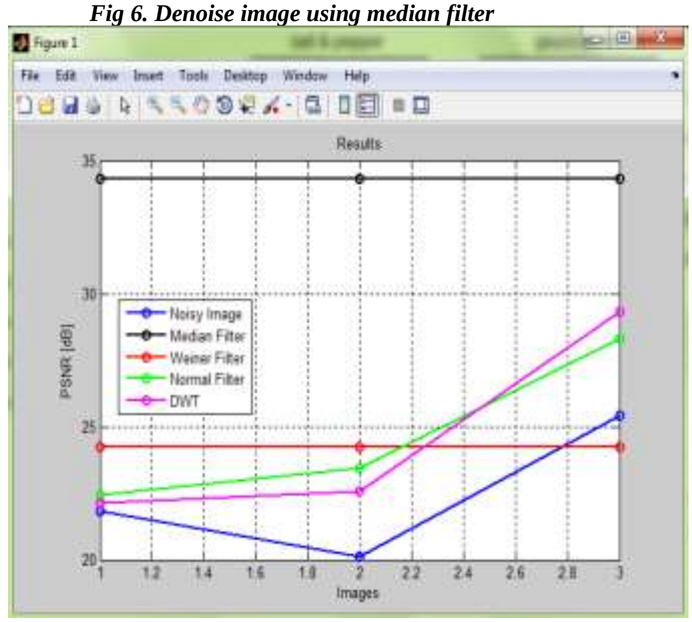

Fig. 7 PSNR Result

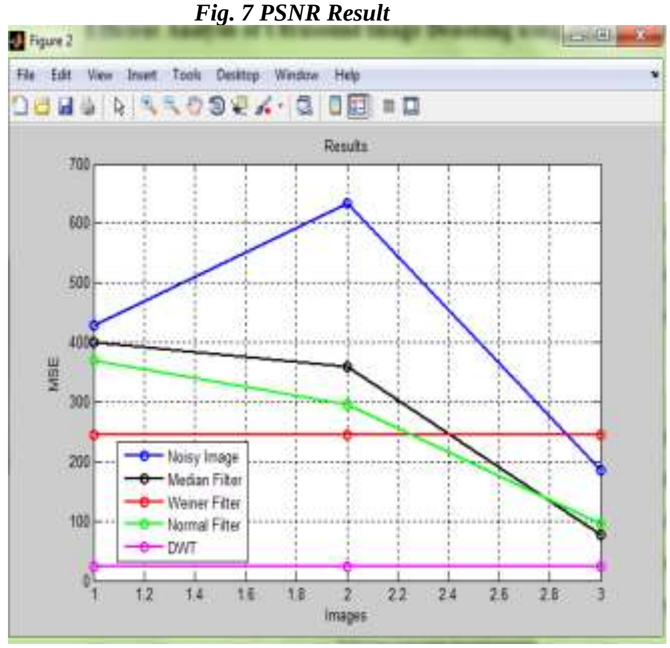

Fig. 7 MSE Result

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TABLE:

	PSNR			MSE		
NOISY IMAGE	SALT & PEPPER	GAUSSIAN	SPECKLE	SALT & PEPPER	GAUSSIAN	SPECKLE
	21.8013	20.1151	25.4325	429.4877	633.2448	186.1373
FILTERED IMAGE						
MEDIAN	34.3293	34.3293	34.3293	399.3615	359.4245	75.8883
WEINER	24.2411	24.2411	24.2411	244.8869	244.8869	244.8869
NORMAL	22.4450	23.4216	28.3153	370.3193	295.7466	95.8399
DWT	22.1171	22.5747	29.3291	23.9966	23.9966	23.9966

Table 1. PSNR and MSE Result

Conclusion

The ultrasound image denoising method is proposed in the present work. Though analysis and wavelet decomposition of ultrasound image, it is found that the ultrasound image signal has significant non-Gaussianity, and two-dimensional wavelet coefficients obey the alpha distribution, according to alpha distribution characteristics, adopt estimator using minimum average absolute error criterion to remove multiplicative noise in ultrasound images. Simulation experiments results show that the present method can remove multiplicative noise in ultrasound images on the basis of maximize the retention of the image detail characteristics, and can ensure the higher denoising validity and the diagnostic accuracy, and have high practical application value. In the present work we proposed an efficient analysis of Ultrasound Image Denoising using different type of filtering methods. This technique is computationally faster and gives better results. Some aspects that were analyzed in this paper may be useful for other denoising schemes, objective criteria for evaluating noise suppression performance of different significance measures. Our new technique is better as compare to other techniques.

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