MNK Publication

International Journal of Latest Research in Science and Technology
Vol.1,Issue 2 :Page No.106-108 (2012)
https://www.mnkjournals.com/journal/ijlrst/index.php

ISSN (Online):2278-5299

A NEW APPROACH FOR DENOISING ULTRASONOGRAPHIC IMAGES USING DTCWT

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Received : 05 July 2012; Accepted : 28 July 2012 ; Published : 31 August 2012

Abstract- Ultrasound imaging is a non invasive, non destructive and low cost technique. It is used for imaging organs and soft tissue structures in human body. Medical images are corrupted by noise in their acquisition and transmission process. Ultrasound images are very noisy. In addition to the system noise, a significant noise source is the speckle phenomenon. Speckle is created by a complex interference of ultrasound echoes made by reflectors spaced closer together than the ultrasound system's resolution limit. In this paper, an efficient method based on Dual Tree Complex Wavelet Transform (DTCWT) has been proposed to denoise the ultrasound images. Testing shall be made on a set of medical images. It is proposed that results achieved with DTCWT will be better than the other existing methods like Discrete Wavelet Transform (DWT).

Keywords - DTCWT, filter, medical, speckle, ultrasound

I INTRODUCTION

In medical image processing, for an accurate diagnosis, image denoising has become very essential exercise. Thus, the ultimate goal of any image denoising technique is to compromise between the noise suppression and preservation of image details so that image modality can provide the best possible information to clinician, to make an accurate diagnosis. The main objective of image denoising techniques is to remove such noises while retaining the maximum possible information signal. Ultrasonic imaging is a widely used medical-imaging procedure. It is economical, comparatively safe, and adaptable. One of its main shortcomings is the poor quality of images. Here, images are affected by speckle noise. The adaptive weighted median filter can reduce speckle. But, it does not preserve useful detail like edges of the image properly. Conventional linear filtering methods based on the first order statistical models

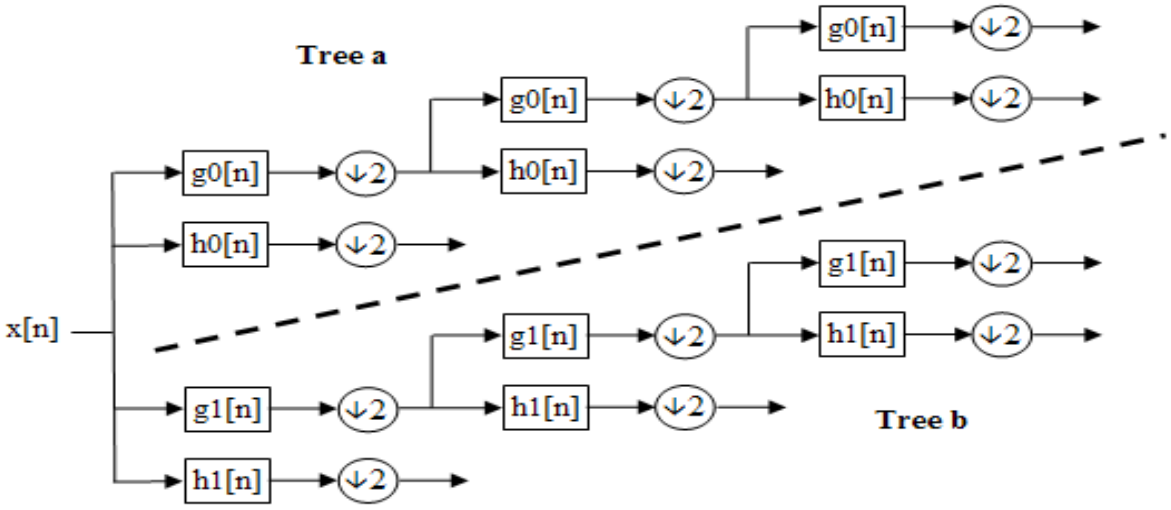

Fig 1: Tree diagram of Dual-tree complex wavelet transform

are not optical tools for reducing the speckle noise. They tend to suppress the noise at expense of overly smoothing the image details [1],[2]. Over a period various speckle reduction techniques have been developed [3],[4]. Since speckle cannot

be directly correlated with specific reflectors, or cells, in the body, it is necessary to analyze an ultrasound system to understand the origins of speckle. In this regard, dual-tree complex wavelet transform (DTCWT) is assumed as the best solution. In this paper, study of DTCWT technique has been carried out.

II. TOOLS AND METHODOLOGY

Dual tree complex wavelet transform: The DTCWT is a relatively recent enhancement to the discrete wavelet transform (DWT), with important additional properties like; it is nearly shift invariant and directionally selective in two and higher dimensions. It achieves this with a redundancy factor of only 2d for d-dimensional signals, which is substantially lower than the undecimated DWT. The multidimensional (M-D) dual-tree CWT is non-separable. It is based on a computationally efficient, separable filter bank (FB). DTCWT calculates the complex transform of a signal using two separate DWT decompositions (tree a and tree b). It is shown in Fig. 1. If the filters used in one are specifically designed different from those in the other it is possible for one DWT to produce the real coefficients and the other the imaginary.

This redundancy of the two provides extra information for analysis but at the expense of extra computational power. It also provides approximate shift-invariance (unlike the DWT). It allows perfect reconstruction of the signal. In this paper, a method based on Dual Tree Complex Wavelet Transform (DTCWT) has been proposed to denoise the ultrasound images. MATLAB is very powerful toolbox with many additional functions. Matlab as a toolbox is used for ultrasound image denoising. Testing shall be made on a set of medical images. An algorithm for the proposed method is given in table 1;

TABLE 1: ALGORITHM OF THE PROPOSED METHOD

Step1. A set of medical images is acquired.
Step2. A particular image is selected from the acquired set, and the chosen image is checked for its monochrome or colored nature.
Step3. The image is changed to monochrome, if it is of colored nature.
Step4. Registration of selected image is performed.
Step5.Gabor filtering as Gabor wavelets is applied on the registered image while considering both of its angular and magnitude details.
Step6. Discrete wavelet transform of 'haar' family is applied on the image to denoise it.
Step7. Next, Dual-tree complex wavelet transform is applied on the noisy image to denoise it using self made, 'Super Resolution' function. This is done, as there are no direct commands for DTCWT in MATLAB.
Step8.Mean square error and PSNR values of denoised image are calculated for both of the methods.
Step9.Compare the result of DTCWT and DWT.

III. CONCLUSION

In this paper for the despeckling of ultrasound images, the wavelet transform has been proved a more effective tool than the Fourier transform. The discrete wavelet transform lacks the shift-invariance property. In multiple dimensions it does a poor job of distinguishing orientations, which is important in image processing. For these reasons, to obtain some applications improvements, the Separable DWT is replaced by Complex dual tree DWT which has been done by using self build function. This method not only reduces the speckle noise but also preserves the detail features of image. The Peak Signal-to-Noise Ratio (PSNR) and Mean Square Error (MSE) parameters shall be used to compare the performance of DWT & DT-CWT.

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