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Noise diminution in Fetal Ultrasound Pictures

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ABSTRACT

This study offers an inventive way to decrease the stain sound, which is linked with ultrasound imaging. This revolves around humanizing the input image and raise the human analytical presentation. It uses an Undecimated Wavelet Transform UWT to decay the image signal to the coefficients, to take the oblique coefficient and applied Independent Directional Mask after replacing the value of each pixel in this coefficient with the comparable pixel in the innovative image; this result yields after applying a middle filter in a container the value of the pixel is smaller than the entrance value which is pre-specified. We suitable the Directional filter and transmit the design of the new oblique coefficient, and then make the converse wavelet renovate to form the resulting image after dropping the sound of it. The method showed a clear enhancement of numerous ultrasound images via conventional arithmetical measurements and outperformed the other methods used in common to diminish the Noise.

Keywords: *Undecimated Wavelet Transform, Smoothing Directional Filter, Independent Directional Mask, Ultrasound Images, Noise*

I. INTRODUCTION

The images are the fewer eminence and difference between all medicinal images kinds. This yields since the kind of Noise, which appears as black and white spots known as Noise. Many researchers relied on dissimilar ways, but most of them depending on the wavelet transform. This is because of its proficient properties, chiefly the De-Correlation goods of the mechanism of the image with the elevated and small reliability satisfied.

Some researchers have used different techniques for the putrefaction to get details and estimated information. Others use a dissimilar wavelet type than the evade wavelet, i.e., Haar wavelet type. The researcher Mondal resorted to some putrefaction levels, reaching the third stage. And reduction techniques based on Gaussian allocation for resulted coefficients. But some researchers use filters as a Weiner Filter with wavelet transform. Others work on the incorporation of Filters with each other in order to decrease the amount of Noise as a Mean Filter with a Median Filter. Some used the Homomorphic Filtering to change Noise (Multiplicative Noise) to additive one.

II. RESEARCH OBJECTIVES AND ITS METHODS

Decrease noise works to develop the ultrasound image in conditions of visual emergence and this, in turn, raises the appearance of medical analysis. And reduce this type of Noise described as Multiplicative Noise (multiply with an image signal) is important and difficult to prepare at the same time. We used undecimated wavelet transform UWT, Directional Dependent Masks DDM, and Directional Smoothing Filters DSF.

A. Un-decimated Wavelet Transform

Undecimated wavelet transforms like Discrete Wavelet Transform DWT, but it does not enclose Down-Sampling operations, which is not to reduce the level of components resulting from the decomposition of each stage. Consequently, all of the generated coefficients will have the same size of the innovative signal, either when we rebuild the signal, we raise the stage of mechanism, and it will work to increase the signal length (Dilation), and consequently that the signal will decrease the accuracy with increasing decomposition levels. Figure 1 illustrates how the decomposition of the input signal up to the third level. The undecimated UWT of a 1D signal c0, W using the filter bank (h,g) is a set W={w1,. . . , wJ, cJ } where wj are the wavelet coefficients at scale j, and cJ are the coefficients at the coarsest resolution. In order to obtain wavelet coefficients at one resolution from another, we can apply these following equations:

$$c_{j+1}[l] = \left(\bar{h}^{(j)} * c_j\right)[l] = \sum_k h[k] c_j[l + 2^j k] \quad (1)$$

$$w_{j+1}[l] = \left(\bar{g}^{(j)} * c_j\right)[l] = \sum_k g[k] c_j[l + 2^j k] \quad (2)$$

Where * denotes to convolution operator, and h, g corresponding to Analysis Filter pairs, respectively.

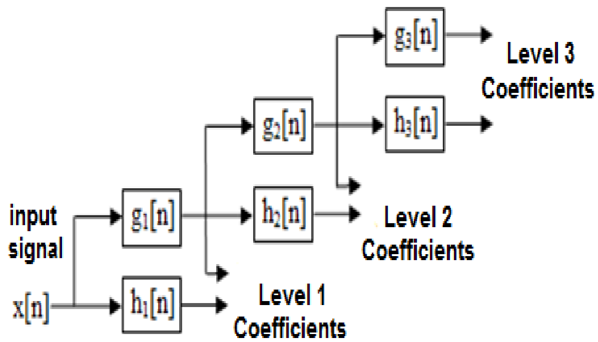

Figure (1). Decomposition Process for UWT.

The lack of down-sampling operations maintains the input image information and consequently does not get any loss of data in the decay stage or else DWT.

B. Directional Dependent Mask and Directional Smoothing Filter

To decide whether there are Edges on the pixels that have been confidential as high-level Pixels, we are using the Mask based on the Direction (Direction Dependent Mask DDM) as in Figure (2), and here in case one of the dark squares in this Mask containing at least one high-level pixels, then we replace the value of this pixel of the other to be adopted according to the research plan.

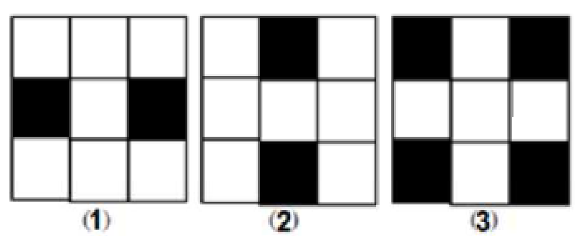

figure (2). Edge Detection Mask. 1- Mask for horizontal details, 2- Mask for vertical details, 3- Mask for diagonal details.

Boundaries are typically indistinct when we are trying to take away noise spots. To defend those edges of Blurring, we use Directional Smoothing Filter DSF. This filter algorithm work as the following: First, we choose mask size (3 * 5 * 3 or 5 or 7 * 7). Then Taking the Mean rate of pixels in each way and accumulate the production in raw matrix V (n), where n = 4, as shown in Figure (3).

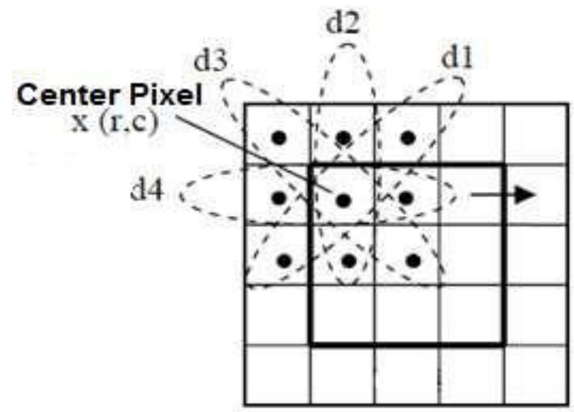

Figure (3). Direction Smoothing.

$v(n) = \frac{1}{R}\ \Sigma i \Sigma j\ y(m-i, n-j)$……… (3)

After that, we find V1 (n) by equation (4), as follows: Directional reliant Mask and Directional Smoothing Filter:

$v1(n) = abs(v(n) - x(r,c))$………. (4)

Where x (r, c) in the middle pixel of the facade. Lastly, we try to find index V1 (n), which gives a lesser value.

$Index = \min(v1)$…………………….. (5)
Change the value of the pixel x (r, c) value of v (Index). Then replicate the process until the complete image had been scanned by this Mask.

III. DISCUSSION

We have executed a sequence of steps on numerous ultrasound images. Figure 4 is the block diagram of the proposed method.

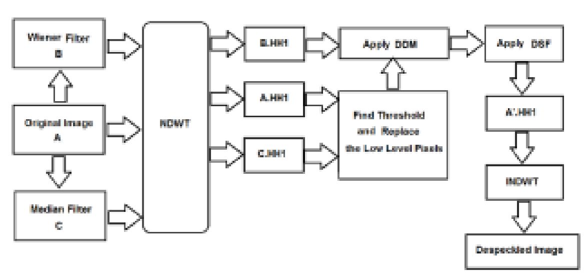

Figure (4). Box scheme for the proposed method

Where we apply the Wiener filter and Median filter on the input image A and the ensuing images are B and C correspondingly. After that, we apply the undecimated wavelet transform UDWT on the three images A, B, C., and then we take the oblique coefficients containing sound resulting from the level of the first putrefaction level HH1. We calculate the threshold value equivalent to the standard value for the HH1 sub-band. We restore all Pixels which their values less than the resulted entrance value (Low-Level Elements) with the corresponding fundamentals in the C Image as the next figure shows.

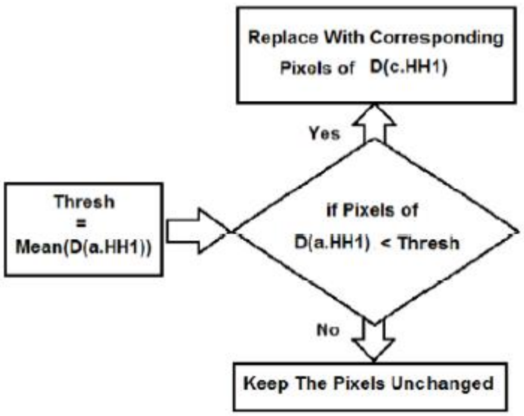

Figure (5). Replacing Low-Level Pixels

After that, we apply the aimed at reliant Mask which replicated the oblique course for each of the resulting pictures from the prior phase and image B, replace all pixels under the dappled elements in the heading for Mask which have the lesser value than the entrance value with the corresponding pixels in B image. As figure (6) shows

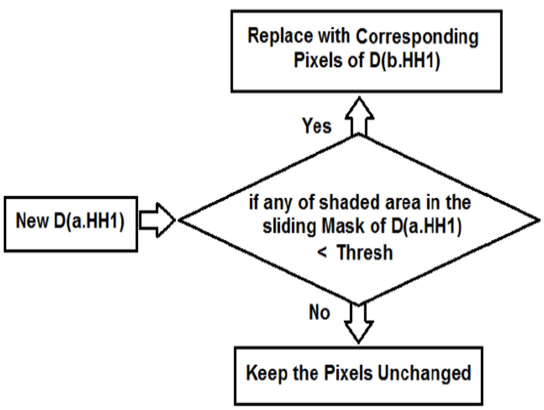

Figure (6). Apply DDM.

Then we appropriate the Directional Smoothing of the resulting image, and lastly, we use invalidate wavelet modify to get the filtered picture.

IV. RESULTS

We pertained the projected method of dissimilar fetal ultrasound images, as figure 7 shows.

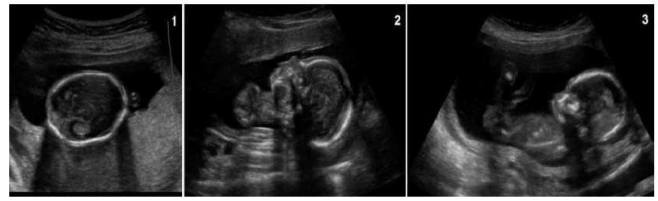

Figure (7). Fetal Ultrasound Images

The request of earlier steps on some ultrasound images to eliminate a huge quantity of Noise denotes that our method takes away impair Noise professionally, as figure 8 shows.

Figure (8). 1-Original image contains Speckle Noise, 2- De-Speckled Image, 3- The Difference between the two images.

We comment that when we amplify the noise discrepancy, we decrease the PSNR measurement, though we still have the best presentation via using these sequences of steps mentioned before. As figure (9) shows

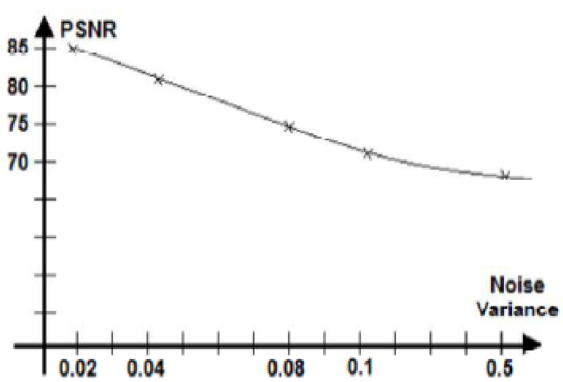

Figure (9). Relationship between Noise variance and PSNR

CONCLUSION

Behind we reasonable the normal ways which they used to diminish Noise in ultrasound images, we found that our planned method has given the best result. This sequence of steps success in eliminating a large amount of Noise and overcome the rest of the other techniques. Furthermore of the techniques which depend on Gaussian liberation of Wavelet Coefficients like diminution algorithms, and the other ways which relied on Homomorphism Filtering. Though Wiener Filter which is suitable for Additive noise (Gaussian Noise), as well as Median Filter which suffers from blurring consequence when we apply it on a noisy image.

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