# Noise Reduction in Computed Tomography Image Using WB – Filter

S.Senthilraja, Dr.P.Suresh, Dr.M.Suganthi

**Abstract:** Image processing concept play a important role in the field of Medical to diagnosis of diseases. Noise is introduced in the medical images due to various reasons. In Medical Imaging, Noise degrades the quality of images. This degradation includes suppression of edges, blurring boundaries etc. Edge and preservation details are very important to discover a disease. Noise removal is a very challenging issue in the Medical Image Processing. Denoising can help the physicians to diagnose the diseases. Medical Images include CT, MRI scan, X-ray and ultrasound images etc. This paper we implemented a new filter called WB-Filter for Medical Image denoising. WB-Filter mainly focuses on speckle noise & Gaussian Noise removal especially in the CT scan images. Experimental results are compared with other three filtering concepts. The result images quality is measured by the PSNR, RMSE and MSE. The results demonstrate that the proposed WB – Filter concept obtaining the optimum result quality of the Medical Image.

**Index Terms** – Computed Tomography (CT), Image Denoising, WB – Filter, PSNR, RMSE, MSE.

## 1 INTRODUCTION

In medical image processing, to obtain a precise images to facilitate accurate Observation. Medical images are subject to a wide variety of distortions, during acquisition, processing, compression, storage, transmission and reproduction, any of which may result in a degradation of visual quality. Images such as magnetic resonance imaging, computed tomography, ultrasound, X-ray images are collected by different types of sensors and they are contaminated by different types of noises. Noises include speckle noise, Gaussian noise, salt and pepper noise etc. Normally, low quality images are not effective and very difficult to measure. Therefore, there is a fundamental need of noise reduction form medical images. Generally speckle noise; Gaussian noise, salt and pepper noise mostly occurred in the MRI, CT scan and ultrasound images. In medical image processing many methods are used for noise reduction. Each method can effectively working any one of the noise only not for all types of noises. Noise removal filters can produce the best results depends upon its parameter. In this paper we introduced the new proposed WB – Filter for noise reduction. The new filter can have the capability of removing two types of noise, such as speckle noise and Gaussian noise from CT scan images. It produce the best results when compare to previously used methods and it can be proved with the experimental results.


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## 2 WB – FILTERING

WB – Filter is a technique to removing speckle noise and Gaussian noise from CT scan images and it produce optimum result. In WB – Filter, Each pixel is replaced by a weighted average of its neighbors. So it can be used for image denoising and image enhancement etc. New filter depends only on two parameter that indicate the contrast and size of the features to preserve.

WB – Filtering is achieved by the combination of wiener and bilateral filter. We propose a procedure that combines both wiener filtering and bilateral filtering to determine more accurate value of each pixels of noisy image. The filter parameters are window size, standard deviation. The drawback of the WB – Filter is it does not produce best result for salt and pepper noise reduction. It is very effective to remove noise in the high frequency but gives the less performance in the low frequency noise removal.

## 3 IMPLEMENTATION OF WB – FILTER

WB – Filter is used to remove Gaussian noise and speckle noise from medical image, it produce the optimum result. This filter can be achieved by combining the concept of bilateral filter and wiener filter. One filter works at each pixel in an image is replaced by a weighted average of intensity values from nearby pixels, and second filter used to minimize the mean square error between estimated and the desired.

The WB – Filter achieved by the following points

$$I(x) = k^{-1}(x) \iint_{-\infty}^{\infty} f(\xi)\, c(\xi,x)\, s(f(\xi), f(x))\, d\xi \qquad (1)$$

Above, formula works at each pixel of an image and pixel replaced by the weighted average of values from the nearby pixels.

$$s\hat{}(t) = g(t) * [s(t) + n(t)] = \int_{-\infty}^{\infty} g(T)\,[s(t-T) + n(t-T)]\,dr \quad (2)$$

Equation (2) is used to minimize the mean square error between estimated and the desired processing.
We can combine the equation (1) and (2) which describes the WB-Filtering as follows:

$$W'(f)=\iint_{-\infty}^{\infty} W(f)\,[I(x)+S(x)] \quad (3)$$

Where W' (f) is used to measure the output of new filter,W(f)-filter takes the input from the equation (1) – I(x) and equation (2) S(x).WB – Filter is a non-iterative method. The optimal result performance of the new filter is depends upon the parameters of the filter.
We have implemented WB – Filter using MATLAB 2009. The optimum value of PSNR, RMSE and MSE is achieved.

## 4 Measurement of Performance

To measure the performance of the noise removal techniques several parameters are available for the comparision. Common parameters are peak signal noise ratio (PSNR), root mean squared error (RMSE), mean squared error (MSE) etc. In this paper peak signal noise ratio (PSNR) is chosen as the performance parameter.
The PSNR defined as:

$$PSNR\ (dB) = 10 \log_{10} (255 \times 255) / MSE \quad (4)$$

Where MSE and RMSE used to calculated by taking difference between two images pixel by pixel, and it is defined as:

$$MSE = \sum ( S_{orginal} - S_{noisy} )^2 / \sum 1 \quad (5)$$

$$RMSE = \sqrt{MSE} \quad (6)$$

Higher value of PSNR of denoised and original image implies that the performance of the denoising filter method and visual quality of the denoised image is good.

## 5 Experimental Results

The proposed method WB – Filtering is very promising algorithm for removing the noise such as gaussian noise and speckle noise from CT scan image. The lumbar spine CT scan images are corrupted by gaussian noise (variance 0.03) then WB – Filtering is applied. The parameters of WB – Filter can be tuned to find optimal performance. The following figures (Figure 1. to Figure 5.) shows the gaussian noisy image and gaussian noise filtered CT scan images .

Figure 1 – Gaussian Noisy Image

Figure 2. Median filtered image

Figure 3. Wiener filtered image

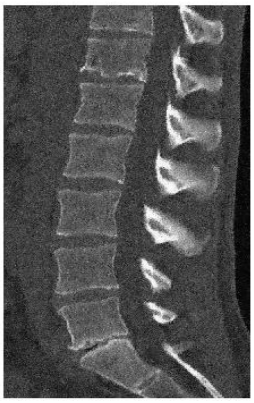

Figure 4. bilateral filtered image

Figure 5. WB – Filtered image

The lumbar spine CT scan images are corrupted by speckle noise (variance 0.03) then WB – Filtering is applied. The parameters of WB – Filter can be tuned to find optimal performance. The following figures (Figure 6 to Figure 10.) shows the speckle noisy image and speckle noise filtered CT scan images .

Figure 6. Speckle noisy image

Figure 7. Median filtered image

Figure 8. Wiener Filtered image

Figure 9. Bilateral filtered image

Figure 10. WB – Filtered image

Test our proprsed WB – filter we use the speckle noise and gaussian noise CT scan image. To determine the performance of the output Gaussian & Speckle noise filtered image PSNR, RMSE and MSE are used. The comparision results of median, wiener, bilateral filters with our proposed method WB – filter are summarized in the Table 1.

Table 1. Comparision results of different filtering method with the proposed WB-Filtering method.

| Image Name | Noise | Filtering Method | PSNR | MSE | RMSE |
|---|---|---|---|---|---|
| Lumbar Spine CT Scan Image | Gaussian Noise | Median Filter | 25.07191 | 203.83969 | 14.27724 |
| | | Wiener Filter | 10.30329 | 6111.54776 | 78.17639 |
| | | Bilateral Filter | 71.57056 | 0.00456 | 0.06756 |
| | | **WB - Filter** | **74.69066** | **0.00223** | **0.047171** |
| | Speckle Noise | Median Filter | 29.22571 | 78.32650 | 8.85023 |
| | | Wiener Filter | 27.55364 | 115.11079 | 10.72897 |
| | | Bilateral Filter | 76.81770 | 0.00136 | 0.03693 |
| | | **WB – Filter** | **77.15157** | **0.00125** | **0.03556** |

From the table 1. It is clear that our WB – Filter method shows the better result for speckle nosie and gaussian noise reduction from medical image than median filter, wiener filter and bilateral filter.

## 6 Conclusion

We have presented simple and efficient WB – Filter to denoise the medical images. WB – Filter is a combination of median filtering and bilateral filtering to determine the better perfomance compare to median, wiener, and bilateral filters. Experimental results shows that our WB-Filter method performs much better than the other filtering methods.The WB – filter works at each pixel in an image is replaced by a weighted average of intensity values from nearby pixels, and minimize the mean square error between estimated and the desired.

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