Denoising of Images Using Wavelet Transform,Weiner Filter and Soft Thresholding

Mersen Longkumer[1], Himanshu Gupta[2]

[1]*M.Tech Student, Dept. of Computer Science and Engineering, Uttaranchal Institute of Technology, Dehradun.*
[2]*Assistant Professor, Dept. of Computer Science and Engineering, Uttaranchal Institute of Technology, Dehradun.*

Abstract - As we speak about image processing, the eradication of image noise becomes a key topic. When we speak about image denoing, there are numerous proposed methods and ways of denoising. This paper proposes a method that uses wavelet transform on the input noised image and uses Weiner Filter and Thresholding methods on its components.

***KeyWords*: Denoising, Thresholding, Weiner filter, Wavelet Transform, Image Processing .**

1. INTRODUCTION

Images with noises are very difficult to deal with and hard to eradicate. Since the uses of images are significant in our day to day lives, therefore its removal also becomes quite important and essential. For this many methods and ways exist for its eradication each with its own benefits. The main and most important part of a method is to remove noise while it preserves the important elements of the image. .Image de-noising is classified into Spatial Filtering and Transform Domain Filtering. Transform Domain Filtering is supervision of transformation fields and after the transformation the coefficients are processed. Then the noised is removed by inversing the transformation example of it is wavelet transform. In this paper we use discrete wavelet transform on the input image and from the components received after the transformation, we apply Wiener Filter on the Approximation coefficient and perform Soft Thresholding on the Detail coefficients.

2. LITERATURE REVIEW

Literature review of some selected methods based on wavelet transform in recent years

G.Y Chen[1],used digital complex ridgelet transform to denoise image. Which was infected with Gaussian White Noise. The method preserved sharp edges as well as did the good job of removing white noise .

F. Xiaoa et al.[2] worked on wavelet based noise removal technique through Thresholding. According to their result they found out that BayesShrink and Feature-Adaptive Shrink are best suited for wavelet based methods.

V. Bruni et al.[3] Worked on a method which used WISDOW-Comp for denoising and compression .In result, they observed that it performs better in comparison to other state of the art compression and denoising in rate and distortion wise.

A. Jaiswala et al.[4] suggested a method for removing Salt & Pepper noise which used filtering methods ,Wavelet based technique using threshold, Hard Thresholding and Weiner filter in stages .They observed good results in terms of PSNR & MSE.

H. Rabbani et. Al[5]worked on a method that captured heavy tailed nature of wavelet co-efficients & local parameters .The results showed good results visually & PSNR wise.

3. Proposed Method

In the method as shown in figure 1 Gaussian and Salt and Pepper noise is added to the image ,which is fed into the proposed method as input and the method performs denoising on the already noised image . the performance of this algorithm is evaluated in terms of PSNR and MSE.

Methodologies:

1) **Input:** We take an image to where noise is to be added. Fig 3

2) **Addition of noise***:* When the selection of the input image is done, Gaussian noise & Salt & Pepper noise with variance 0.1 & 0.1 respectively is added to the image.Fig 4

3) **Noised image:** After the addition of the noises we receive noised images on which we apply denoising method.

4) **Discrete Wavelet transform***:* The noised image is made to go through db4 Wavelet transformation. The noised image is splitted into 4 sub bands HH, HL, LH and LL sub bands *as* shown in fig-2.

5) **Filter and thresholding:** We apply Weiner Filter on the LL sub band and soft thresholding method on the HH,HL,LH.

6) **Inverse Wavelet Transform***:* We then inverse the wavelet transformation and observe the result as shown in figure and calculate its PSNR and MSE .

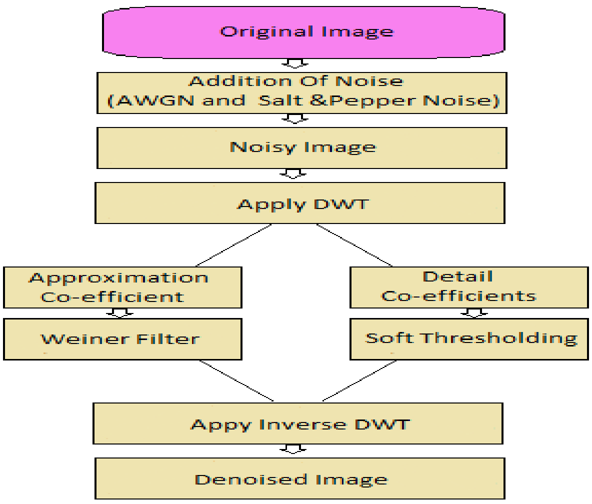


Fig -1: Proposed Denoising Method

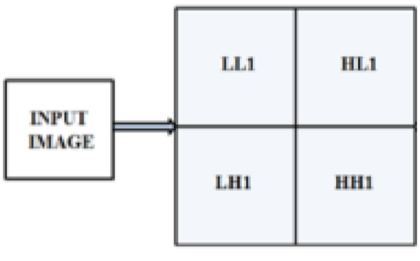
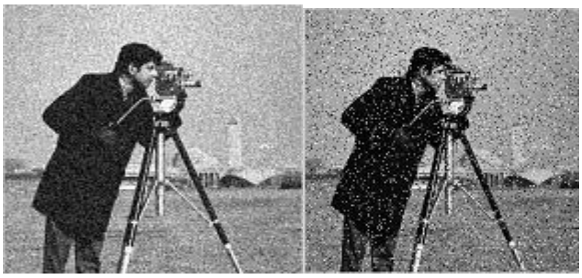


Fig -2: Image Decomposition

Fig -3: Selected original Cameraman Image



a) With Added AWGN **b)** With Added Salt And Pepper noise

Fig -4: Noisy Cameraman Image with a)With AWGN variance0.1& b)With Salt&Pepper Noise variance 0.1

4. EXPERIMENTAL RESULT AND DISCUSSION

We make use of two parameters namely PSNR and MSE for the denoised image.

4.1 Mean Square Error(MSE)

The calculation of the MSE is given by the formula

$$Mean\ Square\ Error\ (MSE) = \sum_{i=j=0}^{N} \frac{[f(i,j) - F(i,j)]^2}{N^2}$$

f(i,j) represents the original image, F(i,j) represents the approximated version and N is the dimension.Lower the MSE better the denoising result.

4.2 Peak Signal To Noise Ratio(PSNR)

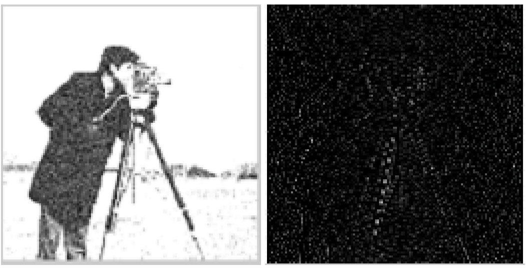
The calculation of PSNR is given by the formula

$$PSNR = 10\log_{10}\left(\frac{MAX_I^2}{MSE}\right) = 20\log_{10}\left(\frac{MAX}{MSE}\right)$$

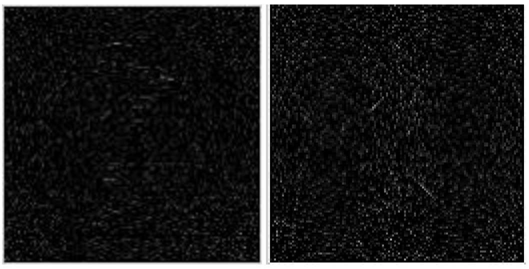
It makes use of MSE given by

$$Mean\ Square\ Error\ (MSE) = \sum_{i=j=0}^{N} \frac{[f(i,j) - F(i,j)]^2}{N^2}$$

MAX_i is possibly the maximum value a pixel in the image can have.

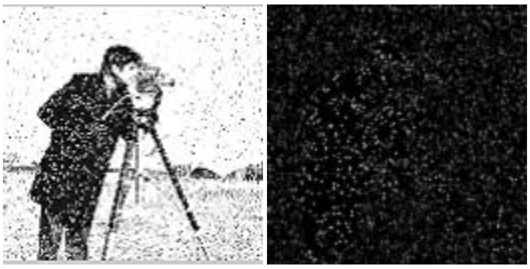


a) LL Coefficient **b)** HL Coefficient

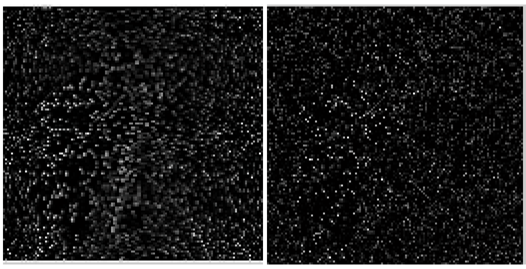


c) LH Coefficient **d)** HH Coefficient

Fig -5: After The decomposition of the image with AWGN variance 0.1.



a) LL Coefficient **b)** HL Coefficient



c) LH Coefficient **d)** HH Coefficient

Fig -6: After The decomposition of the image with Salt&Pepper Noise with variance 0.1

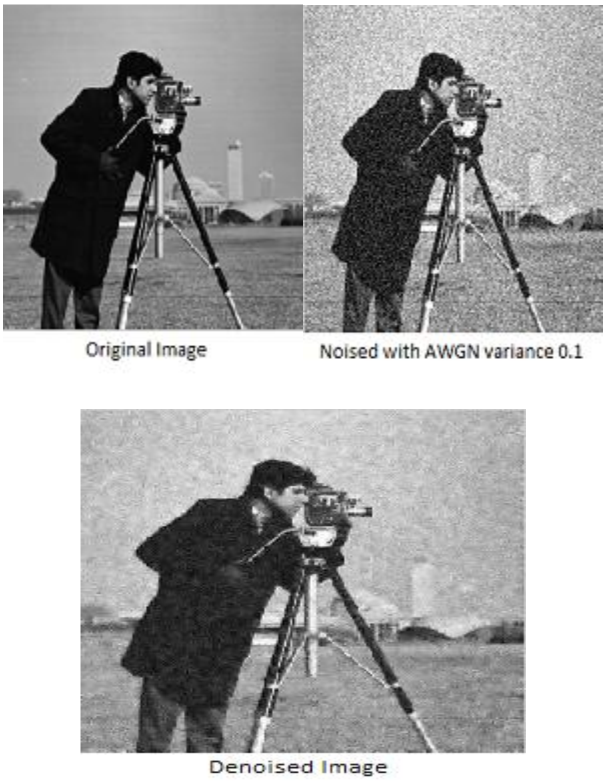


Fig -7: Application of proposed method on AWGN added image woth variance 0.1

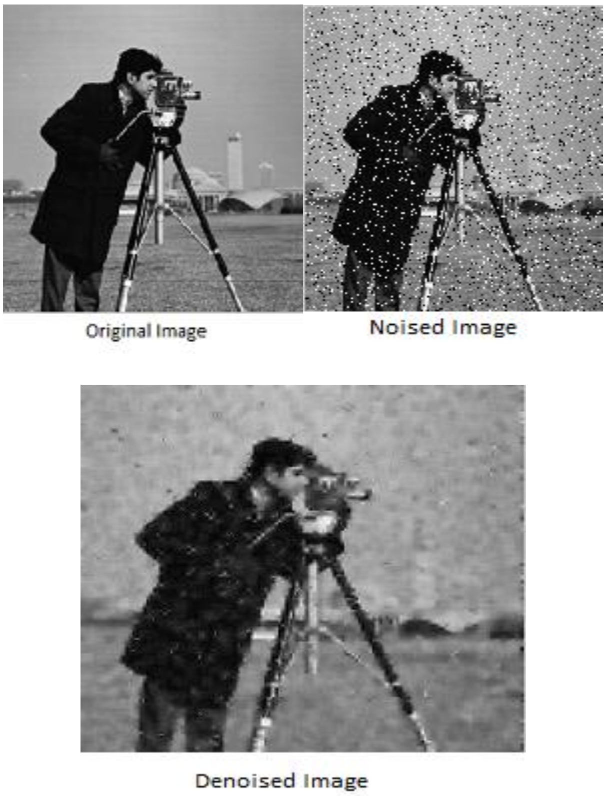


Fig- 8: Application of proposed method on Salt&Pepper Noise added image with variance 0.1

In table 1 we compare the MSE and PSRN of the noised images with AWGN and Salt & Pepper Noise with those of the Proposed Method's

Table -1: Results in terms of MSE and PSNR

Variance=0.1	MSE	PSNR
Noised image with AWGN	0.0197	65.1911
After applying Proposed Method	0.0128	67.0718
Noised Image with Salt&Pepper Noise	0.0311	63.2084
After Applying Proposed Method	0.0056	70.6555

3. CONCLUSIONS

In the paper, investigation of some papers on the field of image denoising was done and their performance analysed.A new method based on db4 wavelet transformation was developed which uses Weiner filter on the Approximation coefficients and Soft Thresholding on the Detail coefficients. Competitive performance was observed in comparison with other methods. The PSNR and the MSE values of the method gave a clear idea about the effectiveness of the algorithm.

REFERENCES

[1] G.Y. Chen, B. Kgl,"Image denoising with complex ridgelets",science direct. Pattern Recognition 40 (2007) 578 - 585.

[2] Fei Xiaoa and Yungang Zhanga,"A Comparative Study on Thresholding Methods in Waveletbased Image Denoising",Advanced in Control Engineeringand Information Science, Procedia Engineering 15, science Direct, pp.3998 - 4003, 2011.

[3] V. Bruni, D. Vitulano,"Combined image compression and denoising using wavelets", Elsvier, sciencedirect, Signal Processing: Image Communication 22 (2007) 86-101.

[4] Ayushi Jaiswala, Jayprakash Upadhyay, Ajay Somkuwar, "Image denoising and quality measurements by using filteringand wavelet based techniques", sciencedirect, Int. J. Electron. Commun. (AE) 68 (2014) 699-705.

[5] Hossein Rabbani, Mansur Vafadust, "Image/video denoising based on a mixture of Laplace distributions with local parameters in multidimensional complex wavelet domain", science direct, Signal Processing 88 (2008) 158-173.

[6] Yamini P. Chaudhari , Dr. P. M. Mahajan" Image Denoising of Various Images using Wavelet Transform and Thresholding Techniques" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 p-ISSN: 2395-0072