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Performance analysis of image denoising with wavelet transform and median filter over AWGN channel

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ABSTRACT
Image Denoising is an important part of diverse image processing and computer vision problems. The important property of a good image denoising model is that it should completely remove noise as far as possible as well as preserve edges. One of the most powerful and perspective approaches in this area is image denoising using discrete wavelet transform (DWT). In this paper, comparison of denoising methods using Wavelets transform and median filter at different decomposition levels has been done.Peak Signal to Noise Ratio (PSNR) of image gets ncreased and Root Mean Square Error (RMSE) get decreased.
Keywords*: Denoising, Filters, Wavelet Transform*

1.1. Introduction

An image is often corrupted by noise during its transmission. The de-noising process is to remove the noise while retaining and not distorting the quality of the processed image. The traditional way of image de-noising is filtering. The main goal is remove the noise from image without losing much detail. For this we can use Median Filter and Mathematical Function known a WT to localize image into different frequency component. The main advantage of WT and Median Filter is that the image which obtains after reconstruction is visually lossless. We can take an image & convert it into serial form and then these data pass through AWGN channel using Phase Shift Key (PSK) Technique. Means the main goal is to find the effect of image on AWGN channel, for that set the Signal to Noise ratio (SNR), as the SNR increases, it will effect on Root Mean Square Error (RMSE) and on Peak Signal to Noise Ratio (PSNR).
There are different types of technique used for Image denoising i.e. the technique which remove the noise from an Image. In this Paper, Wavelet transforms denoising, Median filter denoising used and Image is transmitted through AWGN channel using PSK system.

1.2. Amplifiernoiseor Additive white Gaussian noise (AWGN)

Distortion due to additive white Gaussian noise (AWGN) can be caused by poor quality image acquisition, images observed in a noisy environment or noise inherent in communication channels.

The standard model of amplifier noise is additive, Gaussian, independent at each pixel and independent of the signal intensity, caused primarily by Johnson–Nyquist noise (thermal noise). Thermal noise is caused by the thermal motion of electrons in all dissipative component like resistors, wires and so on. [4]

Representation of a random signal is the sum of a Gaussian noise random variable and a DC signal.

That is,

Where, is a random signal,

is dc component

and is Gaussian noise random variable

1.3. Discrete Wavelet Transform

Image Reconstruction with wavelet transform used 2D version of the analysis and synthesis filter banks. In the 2D (image) case, the 1D analysis filter bank is first applied to the columns of the image and then applied to the rows. If the image has N1 rows and N2 columns, then after applying the 1D analysis filter bank to each column, two subband images are created, each having N1/2 rows and N2 columns; after applying the 1D analysis filter bank to each row of both of the two subband images, four subband images are generated, each having N1/2 rows and N2/2 columns.

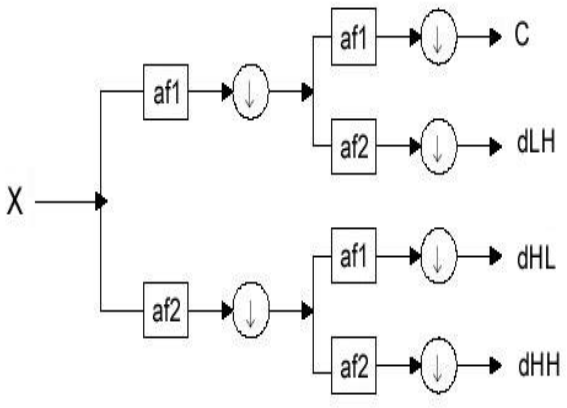

Figure 1: One stage in multi-resolution wavelet decomposition of an image

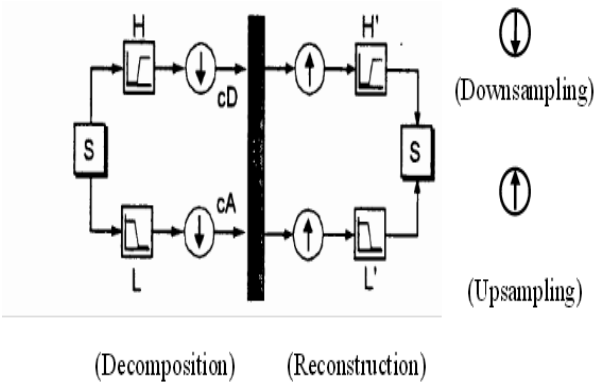

Figure 2: DWT and Inverse DWT of 1-D signal

1.4. Median Filter

Median Filter is able to perform some kind of noise reduction on an image or signal. The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing.

The Median Filter is calculated by first sorting all the pixel values from the surrounding neighbourhood into numerical order and then replacing the pixel being considered with the middle pixel value.

123	125	126	130	140
122	124	126	127	135
118	120	150	125	134
119	115	119	123	133
111	116	110	120	130

In above figure, Neighbourhood values are:

115, 119, 120, 123, 124, 125, 126, 127, 150

Median value is 124

1.5. Phase Shift Key (PSK)

Phase Shift Keying (PSK) was developed during the early days of the deep space program; psk is now widely used in both military and commercial communications system. The general analysis expression for psk is

Phase Shift Key (PSK) is one of the best Communication System in which image can be transfer from one place to another through a communication channel. Hence the channel plays a very important role in Communication System. Sometimes ideal image cannot be received by receiver because of an Additive White Gaussian noise (AWGN) channel. In short image can be affected by communication Channel. The following simple system model shows the communication process.

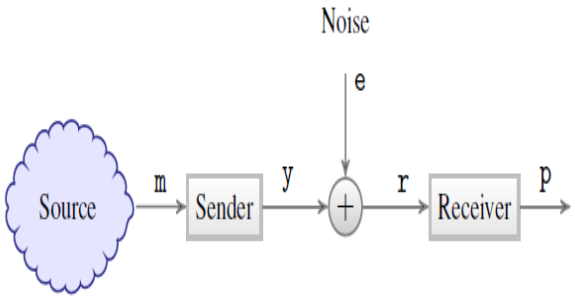

Figure 3: Communication Model

1.6. Image Denoisng

Any system needs a proper designs and specifications before being simulation. The design starts with the overall design of the system in the form of an overall design diagram as shown in Figure 4.

Image Denoising is performed by Wavelet Transform and Median Filter. Wavelet denoising is performed in two steps. First step is to find Wavelet Coefficients. Wavelet Coefficient is obtained by applying transform after Image conversion. And second step image is reconstructed from Wavelet Coefficient by applying Inverse Wavelet Transform. Median denoising is obtained by applying Median filter on output image of PSK system or after Image conversion. Comparison between this two denoising method shown by calculating PSNR & RMSE values. It can be represented as in figure 4.

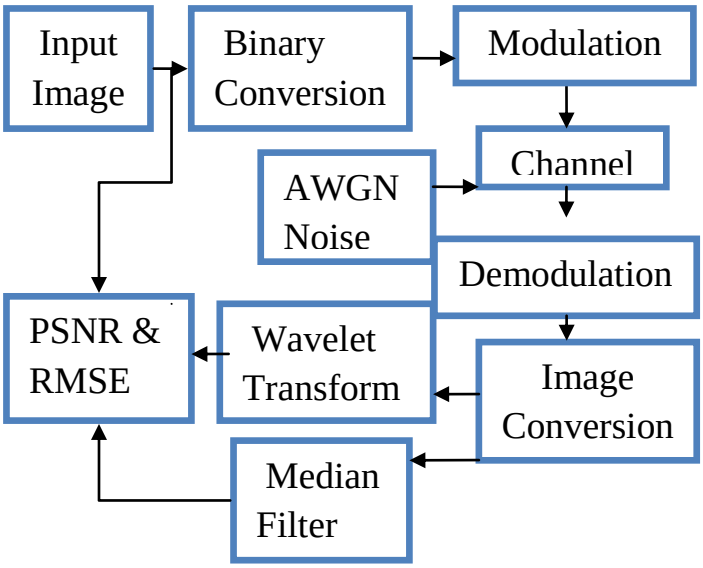

Figure 4: Block diagram for Image Denoising

1.7.Results

Figure 5 shows original image of facebook and reconstructed image using Inverse Discrete wavelet Transform (IDWT) & Median Filter

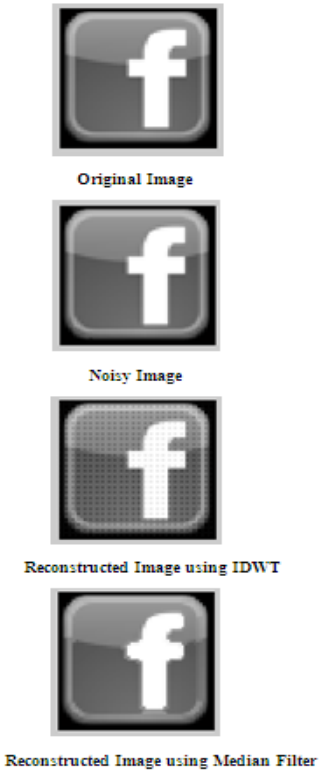

Figure 5: Original Image of facebook, Noisy Image and reconstructed Image using IDWT & Median Filter

Figure 6 shows Bit Error Rate (BER) performance of PSK over AWGN channel for image. It has been observed that with increase in SNR values BER values decreases.

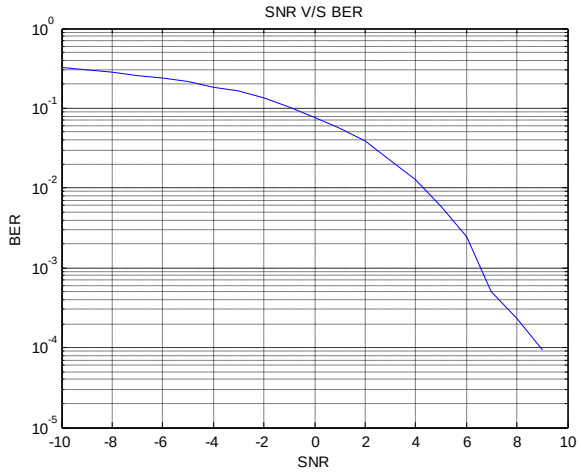

Figure 6: BER performance of PSK over AWGN channel for facebook Image

Figure 7 shows Root Mean Square Error (RMSE) performance of PSK over AWGN channel for image using WT and Median Filter. It has been observed that with increase in SNR values RMSE values decreases.

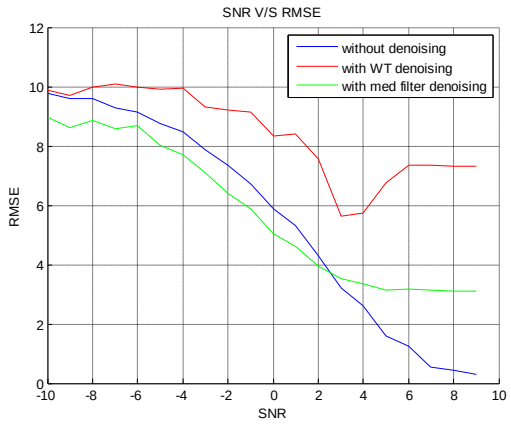

Figure 7: RMSE performance of PSK over AWGN channel for facebook Image

Figure 8 shows Peak Signal to Noise Ratio (PSNR) performance of PSK over AWGN channel for image using WT and Median Filter. It has been observed that with increase in SNR values PSNR values increases

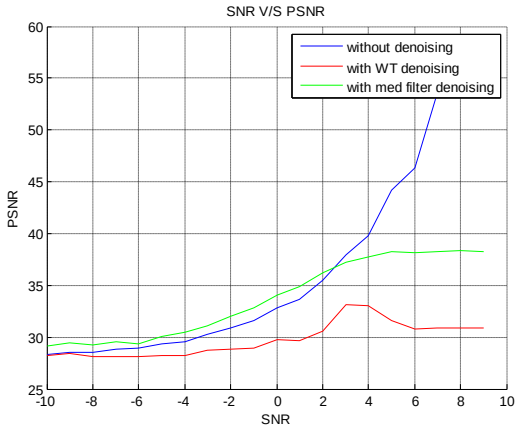

Figure 8: PSNR performance of PSK over AWGN channel for facebook Image

1.8.Conclusion

The simulation of Image transmission over AWGN channel has been done successfully and the performance of transmission are evaluated on the basic of BER, PSNR and RMSE. denoising of Image Median Filter and Wavelet Transform are used. The Median Filter was given the better improvement as compare to the Wavelet transform but some features are losses using Median Filter.

REFERENCES

[1]Rajni,Anutam," Image Denoising Techniques-An Overview", International Journal of Computer Applications (0975 – 8887) Volume 86 – No 16, January 2014

[2]Anutam1 and Rajni2," PERFORMANCE ANALYSIS OF IMAGE DENOISING WITH WAVELET THRESHOLDING METHODS FOR DIFFERENT LEVELS OF DECOMPOSITION", The International Journal of Multimedia & Its Applications (IJMA) Vol.6, No.3, June 2014

[3] IEEE Transactions on Image Processing, "Image Denoising Using Derotated Complex Wavelet Coefficients" Volume 17, No. 9, September 2008

[4] International Journal of Research in Computer Science "IMAGE DE-NOISING USING WAVELET TRANSFORM AND VARIOUS FILTERS" Volume 2 Issue 2 (2012) eISSN 2249-8265