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Performance Analysis of Graphical Image with Fuzzy Logic in Wavelet Domain

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ABSTRACT

There are several methods for image reconstruction in spatial and transform domain. The current trends of the image reconstruction research are the evolution of mixed domain methods. In this paper, a mixed domain image reconstruction method is proposed, which is based on the wavelet transform, median filter and nonlinear diffusion based methods. The wavelet transform is used in this paper to convert the spatial domain image to wavelet domain coefficients. WT produce approximation, horizontal detail, vertical detail and diagonal detail coefficient which represent the various spatial frequency bands. The detail component are removed due to the most of the image part is in approximation part. The approximation coefficient is also filter by fuzzy filters and wiener filter separately. Median and moving average based fuzzy filter are used to apply the filtering on probabilistic way. The trapezoidal membership function are used for the filtering .The peak signal to noise ratio (PSNR) and mean square error (MSE) are used as the performance parameter. The Haar wavelet is used with various filters to optimize the performance of reconstruction. The combination of Haar wavelet and ATMED filter are giving the best reconstruction result.

Key word: ATMED, ATMEV, MSE, PSNR, Wavelet Transform.

1. INTRODUCTION

Reconstruction image is a method to make an image comprehensible to the human visual system. Digital image are often effect by noise or blurred. Every digital camera imperfection called noise that is nothing but noise which affects the image such as in visual quality and others. Noise may be classified as substitutive noise (impulsive noise: e.g., salt and pepper noise, random valued impulse noise, etc.)[1], additive noise (e.g., additive white Gaussian noise) and multiplicative noise (e.g. speckle noise). Types of image reconstruction are spatial domain methods and wavelet domain methods [2]. The special filtering is one of the classical linear filtering in spatial domain while the wavelet domain is a new signal estimation method [3]. Wiener Filter for image restoration of blurred image, Wiener Filter shows noise as random process and find estimate of the uncorrupted image such as mean square error between them in minimized e.g. wiener filter can be regarded as a linear estimating method[4]. when apply Wavelet transform on 2D image and work with their detail and approximate coefficient in wavelet domain ,the wavelet domain is used for disintegration of image, but still there is some draw backs for those we are using Fuzzy logic based on triangular member function (e.g. ATMAV, ATMED FILTERS[10]) and performance evaluated on MATLAB.

2. METHODS FOR RECUNSTRUCTION

2.1.Moving average filters

Fuzzy logic is a form of many-valued logic in which the truth values of variables may be any real number between 0 and 1. By contrast, in Boolean logic, the truth values of variables may only be 0 or 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false.[1] Furthermore, when linguistic variables are used, these degrees may be managed by specific functions.

Now as we are going to de-noise the image we have to use some standard moving average filters the value at the central pixel of the window is replaced by the mean value of the corresponding input neighborhood.

ATMED

The standard moving average filter ATMED is the abbreviation for Asymmetrical Triangular Median Filter. In a given neighborhood the filter takes into account the deviation of the pixel value with the median value and replaces the noisy pixel with a fitting output based on fuzzy triangular membership functions [9].

ATMAV

ATMAV is the abbreviation for Asymmetrical Triangular Moving Average Filter.The fuzzy filter with triangular function and mean value within a window as the center value.

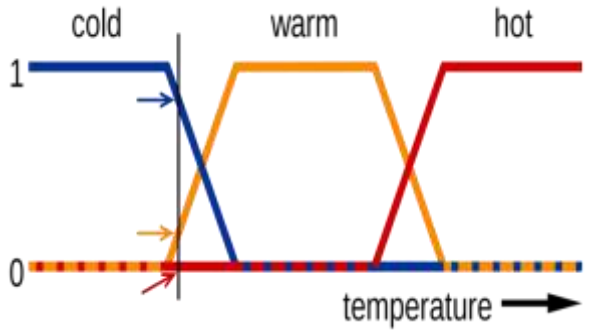

Figure 1: An example for Fuzzy logic

2.2. Wavelet Transform

A wavelet system is a set of building blocks to construct or represent a signal or function. While concerning 2-D image wavelet decomposition the transform can be carried out with a vertical operation to obtain finally four sub image representation [5]. As shown in figure1 two sub images are generate after 2D image decomposition original image into two parts one high frequency coefficient and low frequency. The image HL is the vertical direction high frequency component, LH the horizontal direction high frequency component and LL sub image is the horizontal and vertical direction low frequency component and the HH sub image is the diagonal direction high frequency component. [6].

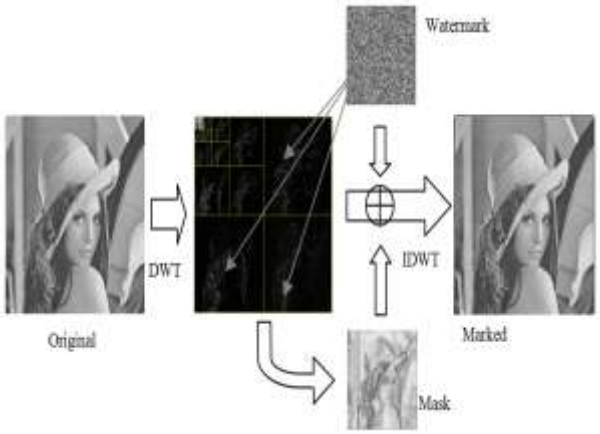

Figure 2: Graphical representation of image decomposition

3. METHODOLOGY

- First select an image, check, is it gray image or color image? If color image then firstly convert this image into gray image.
- Then use it as input image (tower.jpg).
- Now we add the noises in the standard image, the noises are Gaussian noise, salt and pepper noise, Poisson noise etc
- The next step will be to apply wavelet transform (DWT) to decompose the noisy image into four sub images: LL, HL, LH, and HH. After this adopt wiener filter for LL sub image and apply thresholding to remaining sub images.
- Next step we apply same logic nut this time first fuzzy filter (ATMAV) then haar wavelet.
- Then in next step we apply haar wavelet with fuzzy logic based filter ATMED filter.
- Then reconstructs image by wavelet inverse transform, and gets the de-noised image.

4. RESULTS

The analysis of performance of image reconstruction were tested on set of grayscale images such as Tower image, (512× 512). When we add the Gaussian noise in the image. Perform image reconstruction via wavelet and wiener filter and fuzzy logic with haar wavelet (ATMAV AND ATMED FILTER).

Table 4.1: PSNR values from different Algorithm

Table 4.1 shows the combination different methods (PSNR) at different noise level. The ATMED with haar wavelet are giving the best de-noising result.

	Reference[10]	My Work		
Noise Variance	**Wiener +wavelet**	**ATMAV + Haar**	**Haar +ATMED**	**% IMPROVE**
0.01	26.19	26.52	27.04	3.24
0.02	25.09	24.28	25.43	1.35
0.03	24.22	23.3	25.03	3.34
0.04	23.52	22.06	24.3	3.31
0.05	22.4	21.09	23.67	5.66
0.06	22.35	22.11	22.4	0.22
0.07	21.76	19.33	22.22	2.11
0.08	21.25	18.82	21.87	2.91
0.09	20.83	18.19	21.73	4.32
0.1	20.32	17.73	21.08	3.71

On the basis of above results we have simulated it into graphical representation, the graph shows clearly that when we apply wavelet transform (Haar) with Asymmetrical Triangular Median Filter (ATMED) giving an appropriate results

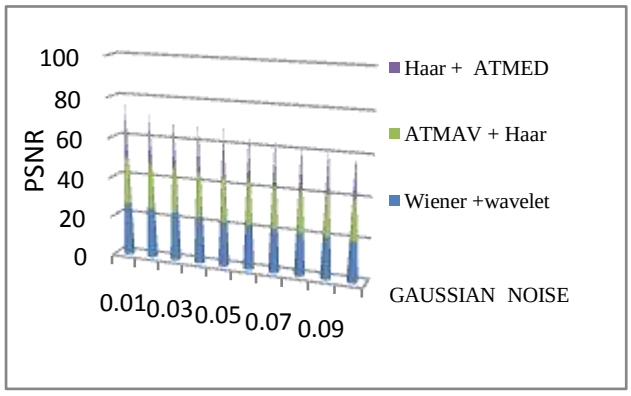

Figure 3: Graph between NOISE and PSNR

As the analysis of filters has been verified on the basis of their performance with respect to peak signal to noise ratio. Now we have another parameter root mean square error which should to be minimum.

Figure 4: Resulting images from different algorithm

5. CONCLUSION

The technique is fuzzy logic based filter i.e. ATMAV filter with Haar wavelet transform and 2nd technique for image denoising i.e. is also based on fuzzy logic filter ATMED with Haar wavelet transform.

After all this techniques results are carried out in two terms peak signal to noise ratio (PSNR) while comparative analysis of all techniques and Based on the result, we conclude that

- The ATMAV with haar gives worst result for image denoising.
- The ATMED with haar wavelet gives good result as compared to wiener filter.
- Thus we conclude that ATMED with haar wavelet is better technique for image denoising.

6. FUTURE WORK

- It may introduce Adaptive fuzzy logic which gives better result.
- We can apply multiple wavelet transform with present technique.
- On the basis of different types of noise there may possibility to reconstruct image more efficiently as there is different noise level.
- Apart from the Fuzzy filters there are so many filtering technique by which image can be reconstructed most efficiently.

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