Adaptive Bilateral Filter for Multi-Resolution in Brain Tumor Recognition

P Kavitha, S Prabakaran

Abstract: ***At present, the medical image processing is an important and development field. The various diagnosis of disease is CT, MRI and PET scanned image. These technologies are found to detect small defects in the human body. The main result of this paper, the earlier detection of brain tumor using Pre-processing techniques of median, bilateral and adaptive bilateral method was compared both filtering methods and proved the adaptive bilateral method is suitable method for MRI images. In Proposed, there are three main contributions are implemented in this filter method. (1)The extension of adaptive bilateral method to apply sub-bands of low frequency signal decomposed using wavelet transform. A wavelet threshold is combined with adaptive bilateral method to form an innovative structure in image de-noising method. It's very efficient to eliminate noise in original noisy images. (2) First detected block boundary and texture regions discontinuities to adapt or control the parameters of spatial and intensity in bilateral filter. The adaptive method can improve the restored image quality in this test result compared with standard bilateral filter. (3)The improvements of fast bilateral method using the combination of Gaussian filter. I proposed the various image resolution of adaptive bilateral method was proved better results.***

Keywords: Wavelet thresholding, Median, Bilateral, Image de-noising, MRI image.

I. INTRODUCTION

From the corrupted image [2] is going to remove the noise of 3x3 size was selected and centered in the corrupted image. The entire image pixel are sorting minimum to maximum value and finding the middle value of the pixel denoted by pixmed, minimum value denoted by pixmin and the maximum value denoted by pixmax of the vector denoted by v0. Now, the vector vo of primary and last element is pixmin, pixmax correspondingly and the pixmed is median element value of the vector. The range of pixmin < pix(x, y) < pixmax. pixmin >0 and pixmax<255 it is classified as uncorrupted pixel and left unchanged. Otherwise the corrupted pixel is classified as pix(x, y). If the corrupted pixel pix(x, y) is following two cases: In the first case, pixmin< pixmed< pixmax and 0< pixmed<255 to replace the corrupted pixel pix(x, y) with pmed, In the Second case, if the first case condition is not satisfied then pixmed is noisy pixel. To compute each pair of the adjacent pixel across the sorted vector V0 and difference vector VD. Then finding the maximum difference in the VD and processed the corresponding pixel V0 as mark it. These type methods are processed in the entire image. The median filter method is impaired in extremely impulse noise. The noise ration from 10% to 98% preserving high quality of restored image. There are two main implementation was proposed in this paper. First method, wavelet transform method was proposed based GGD model. Second method, the image was compressed and de-noising the image. The proposed method adaptive wavelet threshold is easy and it is adaptive to each sub-band because it depends on estimates of data driven parameters. To test a image, to add Gaussian noise with standard deviation values 10, 20, 30 of de-noising the image was used four methods. First, the Bayes Shrink wavelet threshold method [3], the different noise variations were estimated using median robust median filter method [4]. The bilateral method was applied and reduces noisy [1]. Based on this experiments results were discussed with previous methods, using parameters of bilateral method value is · d = 1.8, · r=2*· n, and the image size 11x11. The previous methods were compared with proposed technique adaptive bilateral filter.

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II. METHODOLOGY

A. Bilateral Filter

In 1998, Tomasai and Manduchi [1] are first presented by bilateral method and also a new concept of bilateral method was presented. Bilateral method is smoothing image and preserving edges, its similar methods of Gaussian to generate with range domain and its computing weighted value in spatial domain for Gaussian filtering method. The filter method is simple, local and non-iterative. It combines both color image and gray image is similar to both photometric and geometric closeness and it preserves nearby value to distant values in both range and domain. The extend ranging from linear denoted by L1 and non-linear denoted by L2. The weighted of bilateral method takes sum of pixel in a internal neighborhood. The weight value is depends on both intensity and spatial distance. Mathematically, a location of pixel x, the output is calculated as,

$$\tilde{I}(\mathbf{x}) = \frac{1}{C} \sum_{y \in N(x)} e^{\frac{-\|\mathbf{y}-\mathbf{x}\|^2}{2\sigma_d^2}} e^{\frac{-|I(\mathbf{y})-I(\mathbf{x})|^2}{2\sigma_r^2}} I(y) \quad \text{------- (1)}$$

Where, the parameter σ_d and σ_r are calculating the weights in intensity domain and spatial domain, correspondingly, I(x) of pixel is a spatial neighborhood in N(x) and the element C is constant value of normalization:

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$$C = \sum_{y \in N(x)} e^{\frac{-\|\mathbf{y}-\mathbf{x}\|^2}{2\sigma_d^2}} e^{\frac{-|I(\mathbf{y})-I(\mathbf{x})|^2}{2\sigma_r^2}} \quad \text{------ (2)}$$

The input noisy signal is top right image, intensity Gaussian is top left image and middle image shows spatial Gaussian.

B. Proposed Method

I proposed the various image resolutions of adaptive bilateral method using wavelet threshold. The main contribution of this technique:

Adaptive bilateral filter for multi-resolution

In Bilateral method, the parameters of spatial domain (σ_d) and intensity domain (σ_r) to change multi variation of image resolution. An experimental study of optimal parameter values should change the noise variance of image de-noising application. The relationship among the parameter σ_d, σ_r and standard deviation σ_n. To reduce noise in input image using bilateral method was applied and test multi-variance of image resolution using the parameters σ_d and σ_r. The efficient noise variance was repeated and MSE and PSNR values were recorded.

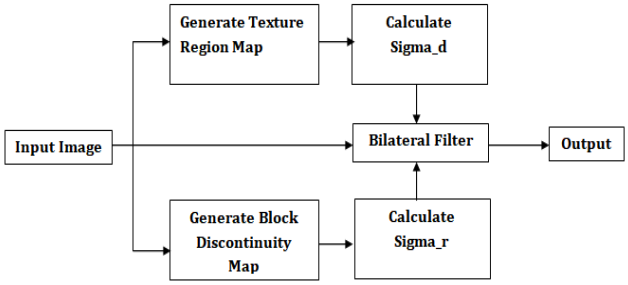


Figure1. Architecture diagram of Adaptive bilateral method

The parameter σd range from 1.5 to 2.0 and then σr value change significantly as the standard deviation σn value changes. Figure1.To change the various image resolution analyses is one of the best effective methods for reducing noise and it is possible to discriminate between image and noise in sequence is enhanced one image resolution level to another. In the various image resolution of adaptive bilateral method were combine with wavelet threshold. The adaptive bilateral method was applied sub-bands to reducing low frequency noise components.

Block Artifacts Reduction

The second contribution of this technique to diagnoses the block discontinuities in the input image filtered with horizontal boundary [-1, 0, 1] and vertical boundary [-1, 0, 1]. The parameter σr value is equal to this value to be more effective. To detect block discontinuities, to apply bilateral method along the boundaries are not eliminated the blocks. To generate single block, to apply a bilateral method along the boundaries it's easily to move the discontinuities to within the block. To reduce the block efficiently, the bilateral method should be applied entire block.

III. EXPERIMENTAL RESULTS

I found the performance of proposed image de-noising quantitatively and visually.
The input noisy image was de-noised using various filtering methods and the MSE and PSNR results were calculated.

A. Comparison of PSNR value for De-noising Image

To test the sample image, to add Gaussian noise with standard deviation values 10, 20, 30 of de-noising the image was used four methods. First, the Bayes Shrink wavelet threshold method [3], the different noise variations were estimated using median robust median filter method [4]. The bilateral method was applied and reduces noisy [1]. Based on this experiments results were discussed with previous methods, using parameters of bilateral method: σd = 1.8, σr=2*σn, and the image size 11x11. The previous methods were compared with proposed technique adaptive bilateral filter. In this proposed, to set the parameter value σd = 1.8, σr=1.0*σn, and the image size is 7x7 at each level. The MSE and PSNR values were compared with previous methods the proposed adaptive bilateral method was proved better result.
Table 1 A comparison of MSE value using various methods.

Sample Image	Median [5]	Bilateral [1]	Proposed
Image_1	79.218	64.08	62.377
Image_2	80.135	68.374	67.319
Image_3	83.724	61.192	59.427
Image_4	80.239	66.135	65.194
Image_5	82.192	70.493	69.196

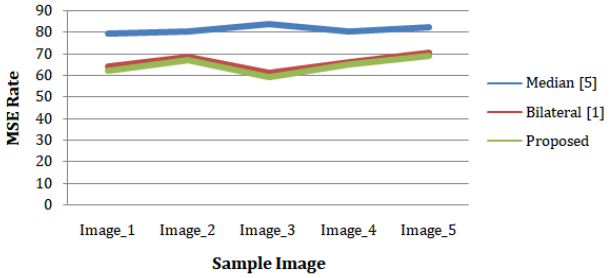


Figure2. Comparative results of MSE

Table2. A comparison of PSNR value using various methods.

Sample Image	Median [5]	Bilateral [1]	Proposed
Image_1	32.47	32.89	33.96
Image_2	32.97	33.41	33.53
Image_3	31.63	32.27	34.51

Image_4	32.81	33.01	33.89
Image_5	31.77	33.61	34.77

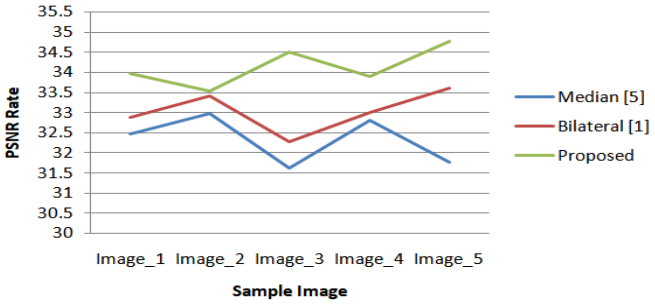
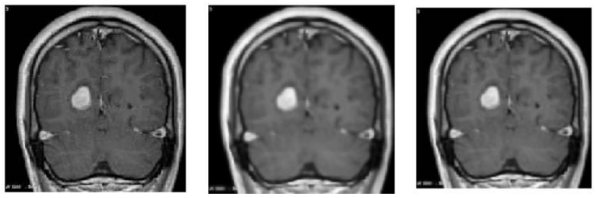


Figure3. Comparative results of PSNR

In the pre-processing, an evaluation of both filter methods was done and measures the performance of median filter, bilateral method and adaptive bilateral filter. The MSE and PSNR rate are shown in Table 1 and Table2. Comparative results are shown in The Figure2 and Figure3. From the filtering results, the adaptive bilateral method has given better accurate rate compared with median filter and bilateral filter.



(a) (b) (c)

Figure 4: (a) Input Image (b) Bilateral method [1] σ_d =1.8 and σ_r =2, (c) Proposed method, σ_d =1.8, σ_r =1.0 and σ_n at each level.

Figure4. Shown in the input image with noise and discussed with previous section to set the parameter value σd =1.8 and σr =2 of standard bilateral filter. I proposed to change the various image resolution analyses is one of the best effective methods for reducing noise and it is possible to discriminate between image and noise information is better than one resolution level to another resolution level. In the various image resolution of adaptive bilateral method were combined with wavelet thresholding. The adaptive bilateral method was applied to sub-bands to reducing low frequency noise components.

IV. CONCLUSION

The aim of this research, reducing noise and improve the image quality using various filtering technique. I proposed the extension of adaptive bilateral method to apply the low frequency sub-bands of signal decomposed using a wavelet transform. The wavelet threshold is combined with adaptive bilateral filter. This technique is very efficient to eliminate noises in original noisy images and then to detected block boundary and texture regions discontinuities to adapt or control the parameters of spatial and intensity in bilateral method. The results show that MRI brain image de-noising using multi-resolution bilateral method is more effective pre-processing technique.

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