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A hybrid method for image Denoising based on Wavelet Thresholding and RBF network

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Abstract

Digital image denoising is crucial part of image pre-processing. The application of denoising process in satellite image data and also in television broadcasting. Image data sets collected by image sensors are generally contaminated by noise. Imperfect instruments, problems with the data acquisition process, and interfering natural phenomena can all degrade the data of interest. Furthermore, noise can be introduced by transmission errors and compression. Thus, denoising is often a necessary and the first step to be taken before the images data is analyzed. In this paper we proposed a novel methodology for image denoising. Image denoising method based on wavelet transform and radial basis neural network and also used concept of soft thresholding. Wavelet transform decomposed image in to different layers, the decomposed layer differentiate by horizontal, vertical and diagonal. For the test of our hybrid method, we used noise image dataset. This data provided by UCI machine learning website. Our proposed method compare with traditional method and our base paper method and getting better comparative result.

Keywords

Image denoising, Wavelet thresholding, RBF

1. Introduction

Image Denoising has remained a fundamental problem in the field of image processing. Wavelets give a superior performance in image denoising due to properties such as sparsity and multi resolution structure [5]. With Wavelet Transform gaining popularity in the last two decades various algorithms for denoising in wavelet domain were introduced. The focus was shifted from the Spatial and Fourier domain to the Wavelet transform domain. The basic idea behind this paper is the estimation of the uncorrupted image from the distorted or noisy image, and is also referred to as image "denoising". There are various methods to help restore an image from noisy distortions. Selecting the appropriate method plays a major role in getting the desired image. The denoising methods tend to be problem specific [6, 7]. For example, a method that is used to denoise. Satellite images may not be suitable for denoising medical images. Each method is compared and classified in terms of its efficiency. In order to quantify the performance of the various denoising algorithms, a high quality image is taken and some known noise is added to it. This would then be given as input to the denoising algorithm, which produces an image close to the original high quality image[12,13]. The performance of each algorithm is compared by computing Signal to Noise Ratio (SNR) besides the visual interpretation. Also we find in general problem in image denoising process used wavelet transform and artificial neural network model. we proposed a novel methodology for image denoising. Image denoising method based on wavelet transform and radial basis neural network and also used concept of soft thresholding. Wavelet transform decomposed image in to different layers, the decomposed layer differentiate by horizontal, vertical and diagonal. The soft thresholding decide the parameter of improved of denosied image quality. One of these methods is wavelet thresholding developed first by Donoho and Johnstone [12].This method removes the noise in an image by removing the wavelet coefficients that are too noisy and preserving or shrinking the coefficients that contain important image signals. The success of the method depends heavily on the choice of the threshold parameters.

As a result, various wavelet thresholding methods have been evolved, which use different approaches to determine the threshold parameters, have been reported Wavelet transforms are multiresolution representations of signals and images. They decompose signals and images into multiscale details[15]. The basic functions used in wavelet transforms are locally supported; they are nonzero only over part of the domain represented. Sharp transitions in images are preserved and depicted extremely well in wavelet expansions. This special treatment of edges by wavelet transforms is very

attractive in image filtering. The rest of this paper is organized as follows. In section II related technique for image denoising. Section III gives a proposed method. Section IV experimental result analysis V concludes this paper.

2. Related Work and Image Denoising

In this section we discuss existing image denoising method based on wavelet transform and artificial neural network technique. We study various research paper and journal and know about image denoising and wavelet transform and ANN. All methodology and process are not described here. But some related work in the field of image denoising in concern of wavelet and neural network, discuss. fuzengyang, yanna tian and liangliang yang in etl.[12] A new agricultural image de-noising algorithm Based on hybrid wavelet trans form in this title authors describe a hybrid method based on wavelet transform for image denosing described as The conventional de-noising methods cannot achieve an excellent result in de-nosing of agricultural images. To solve this problem, a new de-noising method based on Genetic Algorithm (GA) and Wavelet Transform was presented, which combines the advantage of Wavelet Transform de-noising and Wiener Filter together. Yulin Zhang and Xia Zhu etd [14] Image De-Noising Algorithm Study and Realization Based on Wavelet Analysis in describe the image filtration process on the basis of different form of wavelet such as hear bio orthogonal transform and its application in image denosing process as describe as The algorithm based on wavelet analysis which we have introduced does not need any transcendental information of the image, and does not depend on the image size to estimate the de-nosing limits, and even does not need the information of square difference, has the function to reduce image noise blindly. Javad Jafaryahya , Alireza Moghaddamjoo , Ahad Tavakoli and Arghavan Bahadori etd [13] Road Tracking from High Resolution Satellite Images Using a New Set of Profiles and Bayesian Filtering describe the image filteration process based on Bayesian filtering for satellite image . The authors proposed method describe as semi-automatic method for road extraction in urban or non-urban areas is presented to produce a geographical map and updating it.

Anna Fabijanska etd [24] Variance Filter for Edge Detection and Edge-Based Image Segmentation describes the image filtration process based on variance filter and used in the scope of edge detection and image segmentation. The authors describe a proposed method as the proposed method utilizes variance filter to determine edge position. Results of edge detection using the new approach on synthetic and real images are presented and compared with results provided by the traditional i.e. image-derivative based approaches. High variance corresponds with edges where intensity changes sharply, while low variance is assigned to mostly uniform non-edge areas.

3. Proposed Method for Image Denoising

We proposed a novel methodology for image denoising based on wavelet thresholding and radial biases neural network. Initially the discrete wavelet transform function is applied into input image. Now input image decomposed in to layer structure form. After that we calculate horizontal, vertical and diagonal coefficient of input image, after that we apply soft thresholding technique and generate trained pattern using ACP algorithm. In RBF network we used Gaussian based kernel function. The ACP algorithm generates a trained pattern for the removal of noise. In that process the variance factor of noise is increase and the target PSNR value is achieved. As known, the high-order statistical relationship does play an important part in image filtration technique area. So in order to take advantage of the high-order statistical relationship among variables, so we used ACP algorithm for training the network. Proposed denoising filter is a three-layer neural network with inputs derived from an NxN neighborhood of the transformed image and appropriately selected neuron activation functions. As shown in Figure 4.5, the network takes Yp and ΔYk as the inputs, where Yp is the wavelet transform coefficient under consideration, which is the center of a N x N processing window, and ΔYk=Yk -Yp is the difference value between Yp and the coefficient Yk (k=0,1,…,N2-1, kΔp) of the other points in the N x N window. Figure 4.6 shows an example of a processing window with a size of 3 x 3 pixels. In this example, Y12 is the center of the window, and ΔYk Y12(k=0,1,…,24, kΔ12).ablest, so we used ACP algorithm for training the network.

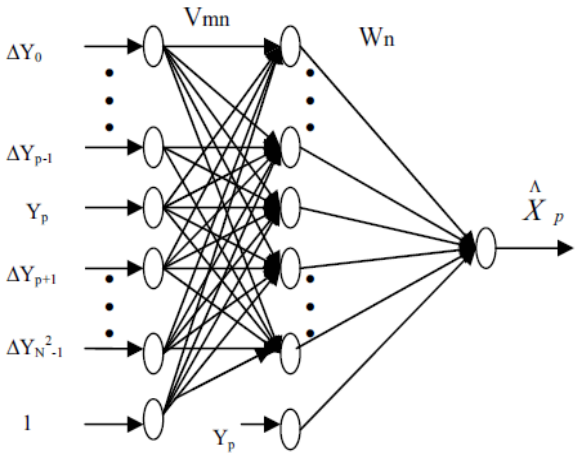

Figure 1: Neural network structure

Y0	Y1	Y2
Y3	Y4	Y5
Y6	Y7	Y9
Y0	Y1	Y2

Figure 2: shows that unit input vector pixel

The output of network is linear activation function.that activation function perform the targeted output of PSNR value. Step for proposed methodology.

Input degraded image

1. Perform wavelet transform and image decomposed in layers.
2. Find horizontal, vertical and diagonal coefficient of wavelet.
3. Apply soft thresholding of wavelet
4. Check value of coefficient of wavelet
5. Decide the size of vector input 3*3
6. Trained the network.
7. Apply target value of activation function
8. Find PSNR with variance
9. Image denoised result.

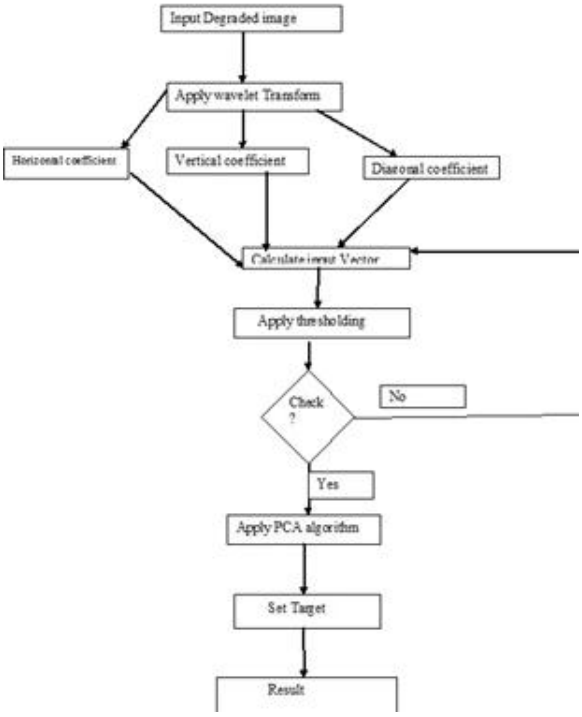

Figure 3: Block diagram of proposed method

4. Experimental Result Analysis

To investigate the effectiveness of the proposed method for image denoising and image filtration. We perform some experimental task; all these tasks perform in matlab 7.8.0 software and well famous image data set such as Lena, Barbara, and cameraman and x-ray image of finger. For experimental evaluation of our proposed algorithm for image denoising we used very famous image such as Lena, Barbara, finger and cameraman. All images are gray scale and size of resolution is 512*512. These image shows in figure 3.

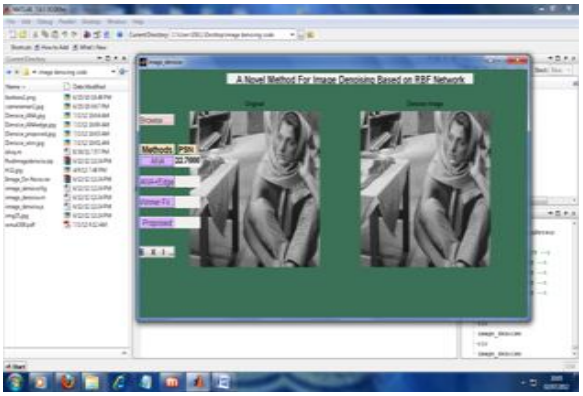

Figure 4 : shows that input image for denoised method ANN and PSNR value of improved image is 22.76

For Lena image resolution 512* 512 and variance 0.006

Table.1: shows the PSNR value of all method applied on Lena image.

Denoised method	PSNR(DB)
ANN	32.37
ANN + Edge Preserving	30.75
Winner Filter	33.30
Proposed	33.62

For finger image resolution 512* 512 and variance 0.006

Table. 2: shows the PSNR value of all method applied on finger image

Denoised method	PSNR(DB)
ANN	23.19
ANN + Edge Preserving	23.14
Winner Filter	23.73
Proposed	26.11

For Barbara image resolution 512* 512 and variance 0.006

Table.3: shows the PSNR value of all method applied on camera man image

Denoised method	PSNR(DB)
ANN	25.76
ANN + Edge Preserving	25.89
Winner Filter	28.50
Proposed	29.47

Comparative Result Analyses

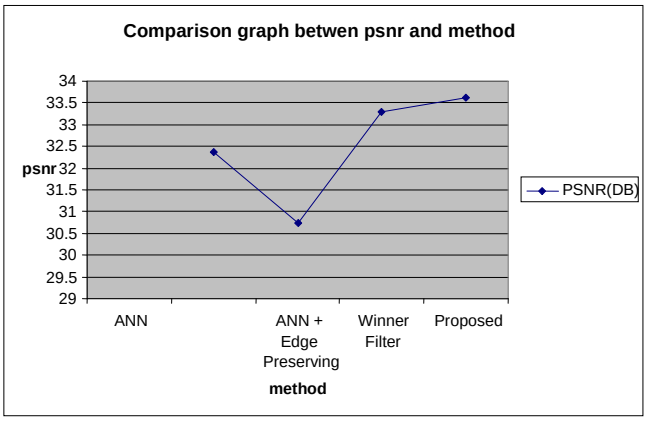

Figure 5 : Shows that comparative PSNR value for image improvement for Lena image.

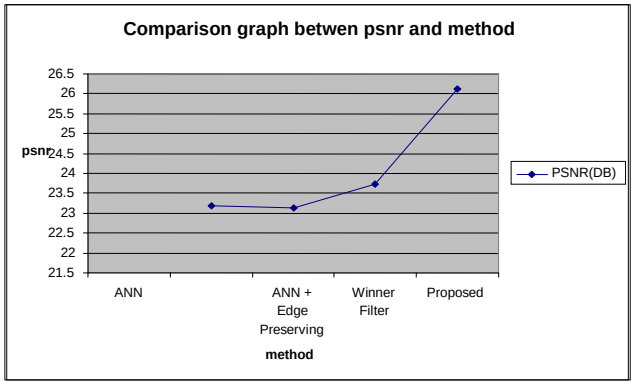

Figure 6: shows that comparative PSNR value for image improvement for finger image.

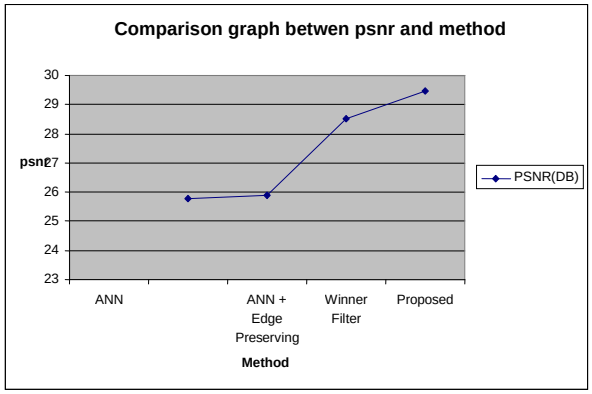

Figure 7: shows that comparative PSNR value for image improvement for camera man image.

5. Conclusions

In this paper a hybrid wavelet-based method based on multiscale wavelet edge detection and neural networks is proposed. RBF were used to find correlation between noised and original wavelet coefficients and approximation. Also multiscale wavelet edge detection was used for achieving a better de-noising quality. Experimental results showed capability of proposed method to remove noise in terms of PSNR and visual quality. Different architectures and different activation functions is considered. The experimental results show the mean with the traditional denoising methods, the proposed threshold-based denoising digital image denoising algorithm for mixed digital image denoising is relatively clear, especially in the more noise, more complex cases", can show its good performance. In the denoising process in order to achieve better denoising effect, the system takes more time to pay, the other for color digital image processing has not been a good result. Therefore, focus on late goals and improve the efficiency of color image denoising. However, the algorithm has a disadvantage of needing more computing time when select a larger hybrid generation. This will be a key problem to solve in the following work. Our experimental result shows that better result in compression of old and traditional method of image denoising. But the computational time of process is increase. In future we used optimizations method for the reduction of time and improvement of quality of image.

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