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A Survey on Image Denoising based on Wavelet Transform

Jyotsna Sardar, Pradeep Rusiya
Department of CSE, OP Jindal University, Raigarh, Chhattisgarh, India

ABSTRACT

The processing of images results in a huge amount of noise in the processed image inevitably.Hence, it is required to apply image denoising techniques to improve quality of the image.So far many algorithms have been proposed under different conditions to achieve better performance.These algorithms consist of some filtering and threshold parameters. Because of higher performance rate of Wavelet Transform method,it has been used widely. In this paper, we are going to go through image denoising techniques and focus mainly on the wavelet transform method used for denoising image.

Keywords : Genetic Algorithm, Image Denoising, Threshold, Wavelet Transform, Gaussian Noise

I. INTRODUCTION

Image denoising is necessary to improve the quality of image.The most common noise found in image is white gauss noise and its removal is an important direction in image denoising research. Apart from gaussian noise, there are other type of noises such as, Salt and Pepper noise and Poison noise also known as quantum noise . Each algorithm has filtering methods amd threshold parameters. A key problem is to set these parameters in the algorithm.

Simple linear filters are used to filter images such as Gauss Filter,which will lead to loss of information of image. Recently, a large number of complex denoising algorithms have been developed based on non-linear filter.

(A) Linear Filters

A mean filter is the optimal linear filter for Gaussia noise in the sense of mean square error. Linear filters too tend to blur sharp edges, destroy lines and other fine image details, and perform poorly in the presence of signal-dependent noise. The wiener filtering method requires the information about the spectra of the noise and the original signal and it works well only if the underlying signal is smooth.

(B) Median Filter Principle

This method is a effective noise supression non-linear technique based on order statistical theory.In this, a sample point is replaced by median value of all the neighbouring points in a specific area. Pixel gray values are also replaced and then the isolated points are removed.

The Operation is performed in a specific window which can be of different shapes. The main advantage ogf using median filter is that it is a simple operation and has faster speed. It also has excellent performance in filtering adding white noise. Median Filtering should not be used for some more details such as for point.

(C) Wavelet Transform

The basic principle in wavelet transform method is that ,noise s contained mostly in the high frequency area. Therefore, noise information is mostly concentratd in sub blocks with infra-low frequency, infra-high frequency, and high frequency. The idea is

to substitute all the higher frequency blocks with zero and suppress it with the low frequency blocks to denoise the image.

The wavelet mehod of denoising consist of generally three steps : Wavelet transform,threshold determination of detail coefficient,reconstruction.

Each algorithm has some threshold parameters and due to variety of image content,how to set these parameters is the key problem.

II. WAVELET THRESHOLD

2.1 WAVELET TRANSFORM METHOD

The major steps of wavelet transform denoising are as follows:

Step 1:Input noisy image will be decomposed by using wavelet function and will be converted into N layer wavelets.

Step 2:In this the threshold is calculated using different parameters in that image and that threshold function is applied to the coefficients.

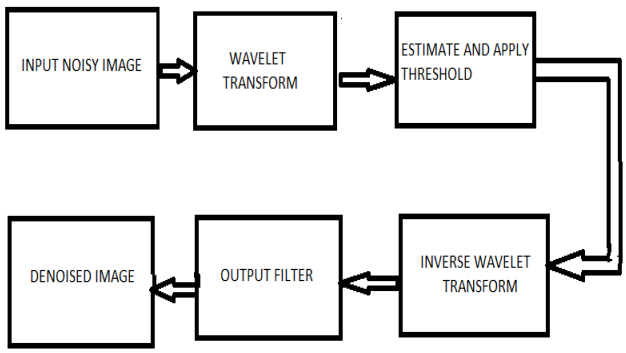

Fig.1 Wavelet Tranform Method

Step 3:Then inverse wavelet transform method is applied to reconstruct the image.

Step 4: The image is hen passed through the output Filter and after that the denoised image is constructed.

Wavelet transform is one of the best approach so far for image denoising. Wavelet domain is advantageous because Discrete Wavelet transform (DWT) make the signal energy concentrate in a small number of coefficients, hence, the DWT of a noisy image consists of number of coefficients having high Signal to Noise Ratio (SNR) while relatively large number of coefficients is having low SNR.

2.2 THRESHOLDING METHOD

Hard and soft thresholding techniques are used for purpose of image denoising. In image denoising, Peak signal to noise ratio (PSNR) needs to be maximized, hence optimal value should be selected.

If we select asmaller threshold, it will allow all the noise coefficients to pass and the resultant image will contain more amount of noise.If we select larger threshold,it will make most of the coefficient as zero and hence provides smoothness but may cause blur of image which in turn can result in loss of signal values.

A.Universal Threshold

The universal threshold for image denoising is:-

$$T=\sigma\sqrt{2\log(N)}$$

N being the signal length and σ is the noise variance. It is the optimal threshold in the asymptotic sense and minimizes the cost function of the difference between the function. One can surmise that the universal threshold may give a better estimate for the soft threshold if the number of samples is large.

B.Visu Shrink

Visu Shrink was introduced by Donoho. It uses a threshold value t that is proportional to the standard deviation of the noise. It follows the hard threshold rule. VisuShrink does not deal with minimizing the mean squared error. Another disadvantage is that it

cannot remove speckle noise. It can only deal with an additive noise.

C.Sure Shrink

A threshold chooser based on Stein‟s Unbiased Risk Estimator (SURE) was proposed by Donoho and Johnstone and is called as Sure Shrink. It is a combination of the universal threshold and the SURE threshold. The goal of Sure Shrink is to minimize the mean squared error. The Sure Shrink threshold t^* is defined as

$$t^*=\min(T,\sigma\sqrt{2\log(N)})$$

Where t denotes the value that minimizes Stein's Unbiased Risk Estimator, is the noise variance and **N** is the size of image.

III. IMPLEMENTATION

After applying the threshold function to all the coefficients,the image is then reconstructed using genetic algorithm and is compared with the original image to evaluate its performance.For example

Fig.2 Original image on left side and denoised image on right side.

IV. CONCLUSION

According to the study of various denoising techniques, wavelet transform is the efficient method used for denoising. The results using each techniques are evaluated using genetic algorithm for processing image and by comparing the signal to noise ratio. For all kind of image denoising methods, it is important to reduce noise present in the image and maintain its quality while removing additive noise from the image. Since the concept of wavelet threshold has been proposed, for its optimal estimate in the Besov space, much attention has been paid on it and various algorithms based on it have been developed. Wavelet thresholding used for denoising is according to the adjustion of wavelet coefficients in the wavelet domain. Then we can clear the noise by setting threshold. In this paper, wavelet transform is discussed in detail for the image denoising, and the genetic algorithm is used to estimate the denoising results.

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