INTERNATIONAL JOURNAL OF COMPUTER ENGINEERING & TECHNOLOGY (IJCET)

ISSN 0976 – 6367(Print)
ISSN 0976 – 6375(Online)
Volume 5, Issue 4, April (2014), pp. 65-72
© IAEME: www.iaeme.com/ijcet.asp
Journal Impact Factor (2014): 8.5328 (Calculated by GISI)
www.jifactor.com

IJCET

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IMAGE DENOISING USING TRADITIONAL WAVELET THRESHOLDING

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ABSTRACT

Edge-preserving denoising is of great interest in image processing. This paper presents a wavelet-based multiscale products thresholding scheme for noise suppression of the images. A dyadic wavelet transform (A Canny edge detector-) is also employed.

An adaptive scale correlation wavelet thresholding technique is then proposed. In which the adaptive threshold will be calculated which is imposed on the products, instead of on the wavelet coefficients. This proposed scheme suppresses the noise effectively and preserves the edges features than other wavelet-thresholding denoising methods. In the result we can see the better visual quality and increment in the signal to noise the last node will die in the network is to be discussed.

1.1 INTRODUCTION TO WAVELETS AND WAVELET TRANSFORMS

Wavelets are used to transform the signal under investigation into another representation which presents the signal information in a more useful form. When working with signals, the signal itself can be difficult to interpret. Therefore the signal must be decomposed or transformed in order to see what the signal actually represents.

The continuous wavelet transform is the most general wavelet transform. The problem is that a continuous wavelet transform operates with a continuous signal, but since a computer is digital, it can only do computations on discrete signals. The discrete wavelet transform has been developed to accomplish a wavelet transform on a computer.

Wavelets and wavelet transforms are used to analyze signals. The transformed signal is a decomposed version of the original signal, and can be converted back to the original signal. No information is lost in the process. When studying a musical tone, one of the features that is interesting is the frequency. The frequency for a clean A is 440Hz, see top plot in Figure 1.1. To determine the frequency of the signal one must measure the period of each wave, and calculate the frequency. The period of one wave is the time it takes from it is at one point in the wave, until it reaches the same position again. For example the time between two wave tops.

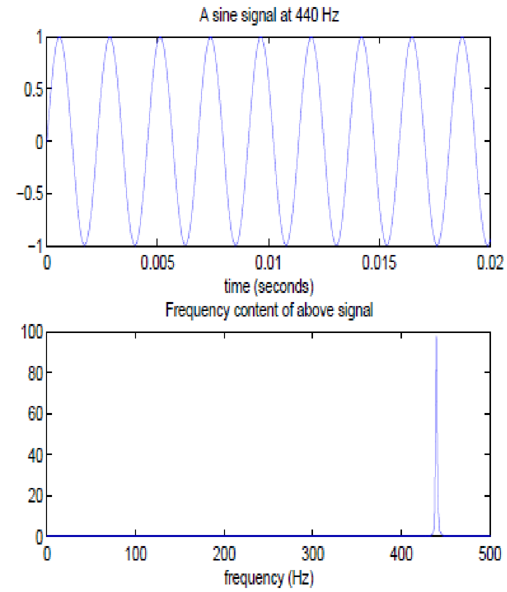

Figure 1.1: A sine wave at 440 Hz, and its Fourier transform

Using different transforms, the signal can be transformed into other representations. For this example, instead of having amplitude as a function of time, it would be better to have the amplitude as a function of frequency. This can be done by using the Fourier transform. Once one knows what frequencies are present, one can easily determine which tones the signal consists of, in the case of a musical signal. The bottom part of Figure 1.1 shows that it is easy to determine that the signal in the upper part of Figure 1.1 actually is an A when you perform the Fourier transform. Wavelet transforms can do the same, but they can also tell you when the tone A appeared in time, effectively giving you amplitude, time and frequency, all in one.

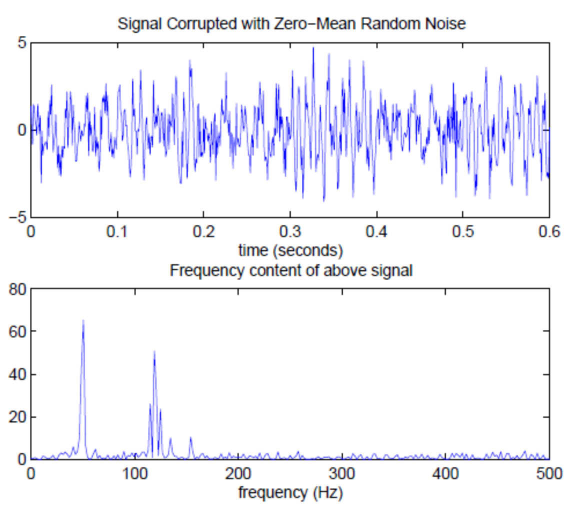

Figure 1.2: A noise input signal, and corresponding Fourier transform.

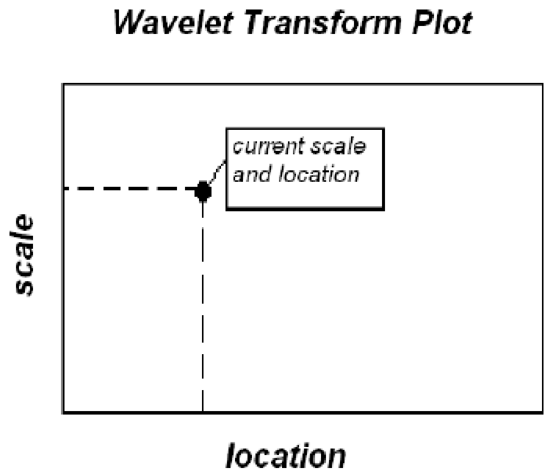

Figure 1.3: Wavelet Transform Plot

1.2 LITERATURE SURVEY

The author "Yaobin Zou" et.al. gave a method of relatively simple yet highly effective thresholding method based on the template matching idea. A reference template is first produced by sampling edge pixel so fan input gray level image. A series of input patterns are sequentially obtained by extracting the boundaries of objects in the binary version of gray level image, where the binary images are sequentially generated by thresholding the input gray level image with each possible gray level from 0 to 255. A newly proposed arctangent Hausdorff distance (AHD) measure is applied to estimate an input pattern Eopt that is most similar to the reference template. The binary image corresponding to the input pattern Eopt is then regarded as the final thresholding result. Experimental results show that the segmentation quality of the proposed approach surpasses 11 existing thresholding methods.

The author "Kai-qi Huang" et.al. says that Recent research in transform-based image denoising has focused on the wavelet transform due to its superior performance over other transform. Performance is often measured solely in terms of PSNR and denoising algorithms are optimized for this quantitative metric. The performance in terms of subjective quality is typically not evaluated. Moreover, human visual system (HVS) is often not incorporated into denoising algorithm. This paper presents a new approach to color image denoising taking into consideration HVS model. The denoising process takes place in the wavelet transform domain. A Contrast Sensitivity Function (CSF) implementation is employed in the subband of wavelet domain based on an invariant single factor weighting and noise masking is adopted in succession. Significant improvement is reported in the experimental results in terms of perceptual error metrics and visual effect.

The author "Z. Azimifar" et.al. says that the statistical characterization of multiscale wavelet coefficients corresponding to random signals and images. Virtually all approaches to wavelet shrinkage model the wavelet coefficients as independent; we challenge that assumption and demonstrate several cases where substantial correlations may be present in the wavelet domain. In particular, the correlation between scales can be surprisingly substantial, even for pixels separated by several scales. Our goal, initiated in this paper, is to develop an efficient random field model describing these statistical correlations, and demonstrate its effectiveness in the context of Bayesian wavelet shrinkage for signal and image denoising.

The author "Florian Luisier" et.al. says that a new approach to orthonormal wavelet image denoising. Instead of postulating a statistical model for the wavelet coefficients, we directly parametrize the denoising process as a sum of elementary nonlinear processes with unknown weights.We then minimize an estimate of the mean square error between the clean image and the denoised one. The key point is that we have at our disposal a very accurate, statistically unbiased, MSE estimate—Stein's unbiased risk estimate— that depends on the noisy image alone, not on the clean one. Like the MSE, this estimate is quadratic in the unknown weights, and its minimization amounts to solving a linear system of equations. The existence of this a priori estimate makes it unnecessary to devise a specific statistical model for the wavelet coefficients. Instead, and contrary to the custom in the literature, these coefficients are not considered random anymore. We describe an interscale orthonormal wavelet thresholding algorithm based on this new approach and show its near-optimal performance—both regarding quality and CPU requirement—by comparing it with the results of three state-of-the-art non redundant denoising algorithms on a large set of test images. An interesting fallout of this study is the development of a new, group-delay-based, parent–child prediction in a wavelet dyadic tree.

The author "Pankaj Hedaoo" et.al. says that the original image corrupted by Gaussian noise is a long established problem in signal or image processing .This noise is removed by using wavelet thresholding by focused on statistical modeling of wavelet coefficients and the optimal choice of thresholds called as image denoising . For the first part, threshold is driven in a Bayesian technique to use probabilistic model of the image wavelet coefficients that are dependent on the higher order moments of generalized Gaussian distribution (GGD) in image processing applications. The proposed threshold is very simple. Experimental results show that the proposed method is called BayesShrink, is typically within 5% of the MSE of the best soft-thresholding benchmark with the image. It outperforms Donoho and Johnston Sure Shrink. The second part of the paper is attempt to claim on lossy compression can be used for image denoising .thus achieving the image compression & image denoising simultaneously. The parameter is choosing based on a criterion derived from Rissanen's minimum description length (MDL) principle. Experiments show that this compression & denoise method does indeed remove noise significantly, especially for large noise power.

The author "Wajdi Ghezaiel" et.al. says that speech communication and speaker identification suffer from the problem of co-channel speech. This paper deals with a multi-resolution dyadic wavelet transform method for usable segments of co-channel speech detection that could be processed by a speaker identification system. Evaluation of this method is performed on TIMIT database referring to the Target to Interferer Ratio measure. Co-channel speech is constructed by mixing all possible gender speakers. Results do not show much difference for different mixtures. For the overall mixtures 95.76% of usable speech is correctly detected with false alarms of 29.65%.

The author "S. Grace Chang," et.al. says that an adaptive, data-driven threshold for image denoising via wavelet soft-thresholding. The threshold is derived in a Bayesian framework, and the prior used on the wavelet coefficients is the generalized Gaussian distribution (GGD) widely used in image processing applications. The proposed threshold is simple and closed-form, and it is adaptive to each subband because it depends on data-driven estimates of the parameters. Experimental results show that the proposed method, called BayesShrink, is typically within 5% of the MSE of the best soft-thresholding benchmark with the image assumed known. It also outperforms Donoho and Johnstone's SureShrink most of the time. The second part of the paper attempts to further validate recent claims that lossy compression can be used for denoising. The BayesShrink threshold can aid in the parameter selection of a coder designed with the intention of denoising, and thus achieving simultaneous denoising and compression. Specifically, the zero-zone in the quantization step of compression is analogous to the threshold value in the thresholding function. The remaining coder design parameters are chosen based on a criterion derived from Rissanen's minimum description length (MDL) principle. Experiments show that this compression method does indeed remove noise significantly, especially for large noise power. However, it introduces quantization noise and should be used only if bit rate were an additional concern to denoising.

The author "James S. Walker" et.al. says that the 1990s witnessed an explosion of wavelet-based methods in the field of image processing. This article will focus primarily on wavelet-based image compression. We shall describe the connection between wavelets and vision, and how wavelet techniques provide image compression algorithms that are clearly superior to the present JPEG standard. In particular, the wavelet-based algorithms known as SPIHT, ASWDR, and the new standard JPEG2000, will be described and compared. Our comparison will show that, in many respects, ASWDR is the best algorithm. Applications to denoising will also be briefly referenced and pointers supplied to other references on wavelet-based image processing.

The author "Maarten Jansen" et.al. says that Wavelet threshold algorithms replace small magnitude wavelet coefficients with zero and keep or shrink the other coefficients. This is basically a local procedure, because wavelet coefficients characterize the local regularity of a function. Although a wavelet transform has decorrelating properties, structures in images, like edges, are never decorrelated completely, and these structures appear in the wavelet coefficients: a classification based on a local criterion-like coefficient magnitude is not the perfect method to distinguish important, uncorrupted coefficients from coefficients dominated by noise. We therefore introduce a geometrical prior model for configurations of important wavelet coefficients and combine this with local characterization of a classical threshold procedure into a Bayesian framework.

The author "L. Evers" et.al. says that the application of thresholding to the estimation of possibly sparse single sequence data observed subject to noise. In such problems, accuracy can be greatly improved by selecting a threshold that adapts to the unknown signal strength. We set out a classification and regression tree approach aimed at partitioning a sequence of inhomogeneous strength into component homogeneous regions where we can independently set a locally adaptive threshold and thus improve estimation. Our method places a mixture prior on each coefficient consisting of an atom of probability at zero and a symmetric probability density. The mixing weight is chosen via Empirical Bayes. The decision on whether a split should occur is based on a score test. Having selected the partitioning and obtained the local mixing weight for each region, estimation is carried out using the posterior median. We evaluate the performance of our method in the single sequence case and for wavelet denoising on both simulated and real data. In the wavelet context we consider two alternative implementations, splitting the coefficients level wise and splitting the original domain. Our method is cheap to compute and in numerical comparisons our method shows excellent performance when compared with current thresholding techniques. This article has supplementary material online.

The author "Felix Abramovich" et.al. says that wavelet techniques have become an attractive and efficient tool in function estimation. Given noisy data, its discrete wavelet transform is an estimator of the wavelet coefficients. It has been shown by Donoho and Johnstone (Biometrika 81 (1994) 425-455) that thresholding the estimated coefficients and then reconstructing an estimated function reduces the expected risk close to the possible minimum. They offered a global threshold for j >Jo, while the coefficients of the first coarse jo levels are always included. We demonstrate that the choice of…….may strongly affect the corresponding estimators. Then, we use the connection between thresholding and hypotheses testing to construct a thresholding procedure based on the false discovery rate (FDR) approach to multiple testing of Benjamini and Hochberg (J. Roy. Statist. Soc. Set. B 57 (1995) 289-300). The suggested procedure controls the expected proportion of incorrectly included coefficients among those chosen for the wavelet reconstruction. The resulting procedure is inherently adaptive, and responds to the complexity of the estimated function and to the noise level. Finally, comparing the proposed FDR based procedure with the fixed global threshold by evaluating the relative mean-square-error across the various test-functions and noise levels, we find the FDR-estimator to enjoy robustness of MSE-efficiency.

The author "Changwei Hu" et.al. says that Under sampling k-space is an effective way to decrease acquisition time for MRI. However, aliasing artifacts introduced by under sampling may blur the edges of magnetic resonance images, which often contain important information for clinical diagnosis. Moreover, k-space data is often contaminated by the noise signals of unknown intensity. To better preserve the edge features while suppressing the aliasing artifacts and noises, we present a new wavelet-based algorithm for under sampled MRI reconstruction. The algorithm solves the image reconstruction as a standard optimization problem including a $\ell 2$ data fidelity term and $\ell 1$ sparsity regularization term. Rather than manually setting the regularization parameter for the $\ell 1$ term, which is directly related to the threshold, an automatic estimated threshold adaptive to noise intensity is introduced in our proposed algorithm. In addition, a prior matrix based on edge correlation in wavelet domain is incorporated into the regularization term. Compared with nonlinear conjugate gradient descent algorithm, iterative shrinkage/thresholding algorithm, fast iterative soft-thresholding algorithm and the iterative thresholding algorithm using exponentially decreasing threshold, the proposed algorithm yields reconstructions with better edge recovery and noise suppression.

The author "H.D. Cheng" et.al. says that In this paper, a color image segmentation approach based on homogram thresholding and region merging is presented. The homogram considers both the occurrence of the gray levels and the neighboring homogeneity value among pixels. Therefore, it employs both the local and global information. Fuzzy entropy is utilized as a tool to perform homogram analysis for 1nding all major homogeneous regions at the 1rst stage. Then region merging process is carried out based on color similarity among these regions to avoid over segmentation. The proposed homogram-based approach (HOB) is compared with the histogram-based approach (HIB). The experimental results demonstrate that the HOB can 1nd homogeneous regions more e6ectively than HIB does, and can solve the problem of discriminating shading in color images to some extent.

The author "Paul Bao" et.al. says that Edge-preserving denoising is of great interest in medical image processing. This paper presents a wavelet-based multiscale products thresholding scheme for noise suppression of magnetic resonance images. A Canny edge detector-like dyadic wavelet transform is employed. This results in the significant features in images evolving with high magnitude across wavelet scales, while noise decays rapidly. To exploit the wavelet interscale dependencies we multiply the adjacent wavelet subbands to enhance edge structures while weakening noise. In the multiscale products, edges can be effectively distinguished from noise. Thereafter, an adaptive threshold is calculated and imposed on the products, instead of on the wavelet coefficients, to identify important features. Experiments show that the proposed scheme better suppresses noise and preserves edges than other wavelet-thresholding denoising methods.

The author "Javier Portilla" et.al. says that for removing noise from digital images, based on a statistical model of the coefficients of an over complete multiscale oriented basis. Neighborhoods of coefficients at adjacent positions and scales are modeled as the product of two independent random variables: a Gaussian vector and a hidden positive scalar multiplier. The latter modulates the local variance of the coefficients in the neighborhood, and is thus able to account for the empirically observed correlation between the coefficient amplitudes. Under this model, the Bayesian least squares estimate of each coefficient reduces to a weighted average of the local linear estimates over all possible values of the hidden multiplier variable. We demonstrate through simulations with images contaminated by additive white Gaussian noise that the performance of this method substantially surpasses that of previously published methods, both visually and in terms of mean squared error.

1.3 PRESENT WORK

It was analyzed that previous traditional thresholding techniques are not giving satisfactory result for image denoising. Disadvantage of this technique is that the SNR ratio decreases with the increase in image size and this technique is time variant. So we proposed a new method named Scale Correlation Wavelet thresholding method with the help of 2D dyadic wavelet. Advantage of 2D dydaic wavelet is that it is time invariant , also changes only scale parameter. So using this, an adaptive wavelet can be designed to enhance instantaneous feature of the image.

A New sure approach to Image Denoising: Interscale Orthonormal Wavelet Thresholding beyond the point wise approach, more recent investigations have shown that substantially larger denoising gains can be obtained by considering the intra- and interscale correlations of the wavelet coefficients. In addition, increasing the redundancy of the wavelet transform is strongly beneficial to the denoising performance. We have selected three such techniques reflecting the state-of-the-art in wavelet denoising, against which we will compare our results.

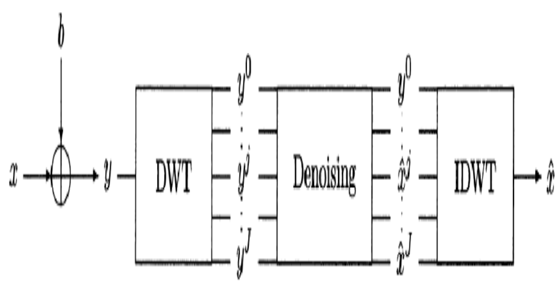

Figure 4.1: Principle of wavelet denoising

1.4 CONCLUSION AND FUTURE SCOPE

This paper proposes an image denoising scheme using an adaptive scale correlation wavelet thresholding technique. Unlike traditional schemes that directly threshold the wavelet coefficients, the proposed scheme multiplies the adjacent wavelet subbands to amplify the significant features and then applies the thresholding to the multiscale products to better differentiate edge structures from noise. The distribution of the products was analyzed and an adaptive threshold was formulated to remove most of the noise. Experiments on the input images show that the proposed scheme not only achieves high SNR and VISUAL QUALITY measurements but also preserves more edge features.

By this adaptive scale correlation wavelet thresholding technique we get high quality of image and better value for the signal to noise ratio. This can be used in the medical images because edge features preserving nature. We can also design the further effective technique by forwarding this for getting more clear visuality and better in signal to noise ratio. By getting more correctively threshold value get the better in the output which is further beneficial in many areas.

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