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An Efficient Denoising Technique Using Filters With Noise Estimator

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ABSTRACT

Magnetic resonance medical images are generally corrupted by random noise from the measurement process which reduces the accuracy and reliability of any automatic analysis. Development in computerized medical image reconstruction has make medical imaging into one of the most important sub-fields in scientific imaging. The quality of digital medical images becomes an important issue with the use of digital imaging to diagnose a disease. It is necessary that medical image must be clean, sharp and noise free to obtain a best possible diagnosis. As the technology became advance the quality of digital images continue to improve, the result is in improvement in the resolution and quality of images, removing noise from these images is one of the challenging task because they could blur and mask important parameter of the images.

These are different images de-noising methods each having their own advantages and disadvantages. De-noising methods are often applied to increase the signal to noise ratio (SNR) and improve image quality. The search for efficient image de-noising methods is still a valid challenge at the crossing of functional analysis and statistic. Many de-noising methods have been developed over the years, among this method, wavelet thresholding is one of the most popular approaches. In wavelet thresholding a signal is decomposed into its approximation (Low frequency) and detail (high frequency) sub-bands; since most of the image information is connected in a few large coefficients, the detail sub-bands are processed with hard or soft thresholding operations.

Keywords: 2D-Images, Noise Signals, signal to noise ratio, frequency, Wavelet, DWT, SSTC, Median Filter

I. INTRODUCTION

Basic Noise Theory

Noise is defined as an unwanted signal that interferes with the communication or measurement of another signal. A noise itself is an information-bearing signal that conveys information regarding the sources of the noise and the environment in which it propagates.

The types of Noise are following:-

- Amplifier noise (Gaussian noise)
- Salt-and-pepper noise

- Amplifier noise (Gaussian noise)

The standard model of amplifier noise is additive, Gaussian, independent at each pixel and independent of the signal intensity. In color cameras where more amplification is used in the blue color channel than in the green or red channel, there can be more noise in the blue channel. Amplifier noise is a major part of the "read noise" of an image sensor, that is, of the constant noise level in dark areas of the image.

- Salt-and-pepper noise

An image containing salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions [4]. This type of noise can be caused by dead pixels, analog-to-digital converter errors, bit errors in transmission, etc. This can be eliminated in large part by using dark frame subtraction and by interpolating around dark/bright pixels.

Denoising Approach

Wavelet

A wavelet means a small wave (the sinusoids used in fourier analysis are big waves) and in brief, a wavelet is an oscillation that decays quickly. Wavelets are a mathematical tool that can be used to obtain information from different class of data along with audio signals and images, mathematically, the wavelet is a function of zero average, having the energy concerted in time. The discrete wavelet transforms can be considered as finite scale multi-resolution description of a discrete function. DWT is a fast linear process on a data vector, where length is in image power of 2. This transform exibit the property of orthogonal in which the inverse transform wavelet basis or function, Unlike sines and cosines is in fourier transform, is usually initialized in space but similar sines and cosines. Individual wavelet functions are initialized in frequency.

The general wavelet de-noising procedure consist of following steps :

(1) Apply wavelet transform in the noisy signal to produce the noisy wavelet coefficients.
(2) Select appropriate threshold limit at such level and threshold method (hard or soft thresholding) to best remove the noises.
(3) Inverse wavelet transform of the thresholded wavelet coefficient to obtain a de-noised signal.

- **Median Filter**

The median filter comes under the class of nonlinear filter generally used to eliminate noise. Such noise elimination is a normal pre-processing step to enhance

Motivation

The digital images impact on modern society is tremendous. In science and technology images processing is now a critical component. It is necessary that medical image must be clean. Sharp and noise free to obtain a best possible diagnosis. As the technology became advance the quality of digital images continue to improve, the result is an improvement in the resolution and quality of images, removing noise from these images is one of the challenging task because they could blur and mask important parameter of the images. So far researchers image de-noising still remains a challenge. There are different image de-noising methods each having their own advantages and disadvantages.

II. METHODS AND MATERIAL

A. Literature Survey

Many papers have been published related with denoising of 2-D images. Basically they focused on noise removal of the image on the basis of type of noise. In this paper we discussed different methods for denoising of images.

- Sendur et al.(2002) presented a paper on wavelet based De noising using bivariate shrinkage function which exploiting its inter scale dependency. Most simple non linear tresholding rules for wavelet-based de-noising assume that the wavelet coffecients are independent. However,wavelet coffecients of natural images have significant dependency. In this paper they consider only the dependency between the coffecients and their parents. For this purpose, new non-gaussian byvariate distribution function is proposed and corresponding non linear threshold function i.e. shrinkage function is derived from the models using Bayesian estimation theory. The new shrinkage function does not assume the independence of wavelet coffecients. Therefore, they maintain the simplicity, efficiency and intuition of the classical soft thersholding approach. Image de-noising performance of new bivariate shrinkage ruleis compared with effective data-driven technique, VisuShrink, SureShrink, BayesShrink and hidden marcove models. The performance of sub band adaptive data driven system is also demonstrated on the dual tree complex wavelet transform. In this papper, investigation of classical soft thresholding approach of Donoho and Johnstone colud be modified to take into account parent-child statictic. As a result, it was found that using local adaptive method in combination with bivariate shrinkage may further improve the de-noising(1).
- S.Sudha Et. Al in 2007 worked on wavelet based image de-noising using adaptive thresholding. In this work various de-noising method like wiener filter,VisuShrink, OracleShrink and BayesShrink are

compared. In this paper, a simple and sub band adaptive is proposed to address the issue of image recovery from its noisy counterpart. It is based on the generalized Gaussian distribution madelling of sub band coffecients. The image denoising algorathim uses soft thresholding to provide smoothness and better edge preservation at the same time. Experiments are conducted to excess the performance of the proposed shrink in comparison with the oracle shrink VisuShrink, BayShrink and thewiener. The result show that this remove noise significantly and remain within 4%of oracle shrink and out performs SureShrink, BayShrink, NormalShrink and wiener filtering most of the time. More over it is 4% faster than BayesShrink and remain 3% within NormalShrink It is further suggested that the proposed threshold may be extended to the compression frme work, which may further improve the denoising performance(2).

- Selenick Et al. proposed the double density discrete wavelet transform method for de-noising purpose. This paper takes up the design of discrete wavelet transform based on over sampled filter bank. The wavelet form an over complete basis or frame. The desigining of system is such that they are analogus to daubechies orthonormal wavelets that are the design of minimal length wavelet filters satisfying certain polynomial properties. The wavelet are much smoother than orthonormal wavelets. The over sampled discrete wavelet transform is based on single scaling function and two distinct wavelet . Having more wavelets than necessary gives a closure spacing between adjacent wavelet within the same scale. The over sampled discrete wavelet wavelet transform is redundant by a factor of 2 independent of the number of level. The over complete discrete wavelet transform is less shift-sensitive than orthonormal wavelet rebasis and has fewer rectangular artifacts(3).
- S.Kother Mohideen et .al in 2008 worked on image de-noising multi wavelet and threshold. In this paper, the image de-noising using discrete wavelet transform and multi wavelet transform is analysed the experiments were conducted to study the suitability of different wavelet and multi wavelet basis and also different window sizes the paper is proposed to indicate the suitability of different wavelet and multi wavelet based and a size of different neighborhood on the performance of image de-noising algorathim in terms of PSNR value. Finally it compares the suitablity of different wavelet and multi wavelet technique and size of different neighbourhood o the performance of image de-noising algorathim in terms of PSNR. The experiments were done using a window size of 3×3, 5×5, 7×7 for multi wavelet. The neighbourhood window of 3×3, 5×5 are good choices. Result also show that multi wavelet with hard threshold gives better result than modified NeighShrink, NeighShrink, weiner filter and Visushrink(4).
- Ivan W. Selenick in 2004 presented a paper on double density dual tree DWT. This paper introduces the double density dual tree discrete wavelet transform (DWT), which is a DWT than combines the double density DWT and the dual tree DWT, each of which has its own characteristics and advantages, The transforms to a new family of dyadic wavelet tight frames based on two scaling functions and four distinct wavelets. One pair of the four wavelets are designed to be offset from the other pair of wavelet so that theinteger translates of one wavelet pair for midway between the integer translates of the other pair.
- Sahil Burak Gokturk, Carlo Tomasi, Bernd Girod and Chris Beaulieu (2001) et .al proposes Medical image compression based on region of interest with application to COLON CT images. This paper discusses a hybrid model of lossless compression in the region of interest, with high-rate, motion-compensated, lossy compression in other regions. This hybrid scheme is appropriate for efficient and accurate compression of 3D medical images. In this paper the colon wall segmentation is used.
- Amit S. Tajne, Pravin S. Kulkarni (2015) et .al give A survey on Medical image compression using Hybrid technique. In this survey, the investigation mainly on the various types of medical image compression techniques that are existing and putting it together for literature survey. In these techniques unique characteristics is used to compress medical images with some drawbacks.
- Lim Sin Ting, David Yap Fook Weng and Nurulfajar Bin Abdul Manap (2015) et .al proposes A Novel Approach for Arbitrary-Shape ROI Compression of Medical Image Using Principal Component Analysis. In this study, first attempt to apply PCA technique on arbitrary shape ROI instead of block information only was proposed. The new

algorithm serve faithfully extract the ROI desired by user and compress the selected ROI with different degree of compression ratio.

- Prabhdip Kaur (2015) et .al proposes Hybrid PCA-DCT Based image Fusion for Medical Images. The purpose of image fusion is to merge relevant information from multiple images right into a single image. In this paper, by conducting the review it has been discovered that the majority of the existing techniques are based upon transform domain therefore it could results in some artefacts which might decrease the execution of the transform based vision fusion techniques. Moreover it is already been discovered that the issue of the uneven illuminate has already been neglected in the absolute most of existing focus on fusion. Therefore to overcome these issues, a fresh method which integrates the larger valued Alternating Current (AC) coefficients calculated in iterative block level principal component averaging (IBLPCA) domain base fusion with illuminate normalization and fuzzy enhancement has been proposed in this paper. The experimental results show the efficiency of proposed algorithm over existing work.
- G. Reishofer, S. Ropele and R. Stollberger (2007) et .al proposes Optimized Data Compression and denoising with PCA using a kurtosis Based selection Criterion. The goal is to find a new data representation with less redundancy which is an optimal compromise between compression factor and information content of the data. Thus far, candidate Principal Components (PCs) was selected manually by skilled operators after visual inspection or by applying a cut-off criterion with a constant threshold. Since the number of PCs which are removed for data compression is crucial, an adaptive, operator independent selection criterion is necessary to guarantee reproducible results. Since the first few PCs represent mixtures of tissue signals and the last few PCs represent noise, the optimum number of PCs to be removed is given if the information content of the reconstructed DSC-MRI time series is a maximum and noise is a minimum. Using more than the optimal number of PCs for reconstruction result in insufficient noise suppression, using less PCs causes a loss of information due to the removed tissue signal components. In this work we propose a novel approach based on 4th order statistics, to find the optimal number of PCs automatically.
- Se-Kee Kil, Jong-Shill Lee, Dong-fan Shen, Je-Goon Ryu, Eung-Hyuk Lee, Hong-Ki Min and Seung-Hong hong (2006) et .al proposes Lossless Medical image compression using Redundancy Analysis. In this paper, two image characteristics, the smoothness and the similarity, which give rise to local and global redundancy in image representation. The smoothness means that the gray level values within a given block vary gradually rather than abruptly. The similarity means that any patterns in image repeat itself anywhere in the rest of image. The proposed method segments the image into variable block size (VBS) and encodes them depending on the characteristics of the blocks.

B. Advantage And Disadvantage

- It is used for reducing the amount of intensity variation between 1 pixel and the other pixel.
- Provide large filtering area in relatively small floor space.
- Filter cloths are easily renewable.
- Operation and maintenance are straight forward.
- Provides fast recovery.
- A different threshold is selected for each pixel.
- These pixel wise thresholds are adapting by time.

III. CONCLUSION

In this proposed work, first we solve base paper and verified its outcome with the original once. It completely agree the result given in that paper. Second we find a desired algorithm that does the accurate segmentation of given medical images. In this proposed method two totally different characteristic noise signals are tried to remove. Its performance should be better than the other methods which removes only one type of noise signals and fails to remove other noise signals. Again for future scope we can combine these two block based algorithm and can obtain higher compression as well as higher PSNR.

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The proposed payment system combines the Iris recognition with the visual cryptography by which customer data privacy can be obtained and prevents theft through phishing attack [8]. This method provides best for legitimate user identification. This method can also be implemented in computers using external iris recognition devices.

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