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RESEARCH ARTICLE

AN EFFICIENT FIXED NOISE REMOVAL METHOD FROM IMAGES USING DUAL TREE COMPLEX WAVELET TRANSFORM

Miss. DHADBHANJAN REKHA[1], Mr. CH SRINIVASULU[2], Mr. P PRAKASH[3]

[1]M.TECH (Software Engineering), J.B. Institute of Engineering & Technology
E-Mail: rekhaexcelever@gmail.com

[2]Associate Professor (IT), Department of Information Technology, J.B. Institute of Engineering & Technology. E-Mail: chsrinivasulu@jbiet.edu.in

[3]Assistant Professor (IT), Department of Information Technology, J.B. Institute of Engineering & Technology. E-Mail: Prakash.jbiet@gmail.com

***Abstract:** This paper presents a unique thanks to cut back noise introduced or exacerbated by image sweetening strategies. Output images of spray-based strategies tend to exhibit noise with unknown distribution. In order to avoid assumptions that are made inappropriately on the applied mathematics characteristics of noise, a special one is formed.. In fact, the non-enhanced image is taken into account to be either free from noise or laid low with non-perceivable levels of noise. Taking advantage of the upper sensitivity of the human sensory system to changes in brightness, the analysis is restricted to the luma channel of each of the non-enhanced and enhanced image. Unlike the separate riffle remodel, the DTCWT permits for distinction of knowledge radial asymmetry within the remodel house. For every level of the remodel, the quality deviation of the non-enhanced image coefficients is computed across the six orientations and then it's normalized. Then result's a map of the directional structures. Same map is then taken to shrink the coefficients of the improved image. Finally, a noise-reduced version of the improved image is computed via the inverse transforms. A radical numerical analysis of the results has been performed so as to verify the validity of the projected approach.*

***Index Terms:** Dual-tree advanced riffle remodels, DTCWT, image sweetening, noise reduction, random sprays, and shrinkage*

1. INTRODUCTION

The Present scenario of rapid growth of Internet increases the usability of digital media in the form of digital image, audio, video. DIGITAL images are subject to a wide variety of distortions during image processing, transmission, compression, acquisition, reproduction and storage, any of which may lead to the degradation of visual quality. The only "correct" method of quantifying visual image quality is through subjective assessment of the performance, for those applications in which images are viewed by human beings in an ultimate manner. Practically, however, subjective evaluation is usually too inconvenient, time-consuming and expensive. Images are often corrupted by noise during acquisition and transmission, which will lead to significant degradation of image quality for human interpretation and post-processing tasks. The main goal of image denoising is to reduce the noise, while preserving the image features. The goal of research in objective image quality assessment is to develop quantitative measures that can automatically predict perceived quality of the image. In image processing applications objective image quality metric plays a variety of roles. It can be first used to monitor dynamically and adjust image quality. Image enhancement techniques are the algorithms which improve the quality of images by removing blurring and noise, increasing contrast and sharpness of digital medical images. There are various approaches (theories) for image enhancement, like Normalization, Histogram flattening, Range compression, and noise smoothing. A certain amount of trial and error usually is required before a particular image enhancement approach is selected. For image enhancement there is no general theory. When an image is under the process of visual interpretation, it is the viewer who will ultimately judge about the working of a particular method. The Process of Visual evaluation of image quality is highly subjective.

Image

An image is a two-dimensional picture, similar to some subject usually a physical object or a person. A two-dimensional image is a photograph or a screen display. Also a statue can be referred to as a three-dimensional image. The images can be captured by optical devices such as cameras and mirrors. Lenses, telescopes, microscopes are few other optical devices. In a broader sense, image can be also referred to as a two-dimensional figure such as a map or an abstract painting. It can be represented by a graph or in the form of a pie chart. The word image can also be used in a wider sense, where images can be rendered manually by drawing, or in the form of a painting, carving. Thus these can be automatically rendered by printing or computer graphics technology.

Fig 1: gray and color images

An image is a rectangular grid of pixels that has a definite height and width. These pixel's are square's and have a fixed size on a given display. Different computer monitors may use different sized pixels. The pixels together form an image and are ordered as a grid in the form of rows and columns. Each pixel consists of numbers representing magnitudes of brightness and color. Thus pixel has a color, which is a 32-bit integer. The redness of the pixel is determined by the first eight bits, whereas the next eight bits determine the greenness, and the preceding eight bits determine the blueness, and the transparency of the pixel is determined by the remaining eight bits.

Image File Sizes

Image increases in Image file size is expressed as the number of bytes that increases with the number of pixels, by composing an image, and the color depth of the pixels.

1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1
Transparency	Red	Green	Blue

Fig 2: Planes of Color image.

Increase in the number of rows and columns, increases the image resolution and file size. Also, each pixel of an image increases in size when its color depth increases, an 8-bit pixel (1 byte) stores 256 colors, a 24-bit pixel (3 bytes) stores 16 million colors, the latter known as true color. Digital image is represented and manipulated as matrices containing the light intensity or color information at each sampled point (pixel). Color image contains three planes such as Red, Green and Blue. The combinations of the intensities of these RGB represent the color and intensity at each pixel. Thus a color image can be represented by 3 dimensional matrices.

Size = (no of rows X no of columns X 3 colors).

If 'f' represents an image, 'x' represents number of rows, 'y' represents number of columns and 'z' represents the RGB plane, then to represent at position (x, y, z) this f(x, y, z) is used. If we use 8 bits to represent intensity of each color, then we can represent 28 intensities (levels), i.e. from 0 to 255 levels. Therefore the value of f(x, y, z) falls between 0 to 255(L-1), where L represents number of levels.

The Previously mentioned technique is effective only in one form. But these techniques are highly effective. Independently of the precise remodel used, the overall assumption in multi-resolution shrinkage is that image information provides rise to thin coefficients within the remodel house. Thus, American state noising is achieved by compression (shrinking) those coefficients that compromise information inadequacy. Such method is sometimes improved by associate degree elaborate applied mathematics analysis of the dependencies between coefficients at totally different scales. Yet, whereas effective, ancient multi- resolution strategies area unit designed to solely take away one explicit style of noise (e.g. mathematician noise).

PDE

A partial differential equation (PDE) is a differential equation that contains unknown multi variable functions and their partial derivatives. This varies from ordinary differential equations, since ordinary differential equations deal with functions of a single variable and their derivatives. To formulate problems, various functions of several variables are involved for which PDEs are used and are either solved manually. To create a relevant computer model PDEs are used.. PDEs can also be used to describe a wide variety of phenomena such as sound, heat, electrostatics, electro dynamics, fluid flow, elasticity, or quantum mechanics. Thus these physical phenomena can be formalized similarly in terms of PDEs. Ordinary differential equations often model one-dimensional dynamical systems, whereas, partial differential equations, model multidimensional systems.

A Partial differential equation (PDE) is an equation involving functions and their partial derivatives for example, the wave equation

$$\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}=\frac{1}{v^2}.\frac{\partial^2\psi}{\partial t^2}$$

In general, partial differential equations are much more difficult to solve analytically than are ordinary differential equations. Bäcklund transformation is used sometimes to solve them .They may also be solved using, integral transform, Green's function or by numerical methods such as finite differences.

Wavelet Transform

Wavelets are the mathematical functions defined over a finite interval. These have an average value of zero that transform data into different frequency components. Each component represents a resolution matched to its scale accordingly. The basic idea of the wavelet transform is to represent any arbitrary function as a superposition of a set of such wavelets or basis functions. The baby wavelets or the basic functions are obtained from a single prototype wavelet called the mother wavelet, by dilation's or contractions (scaling) and translations (shifts). They have advantages over traditional Fourier methods in analyzing physical situations where the signal contains sharp spikes and discontinuities. Many new wavelet applications such as image compression, turbulence are developed in recent years, which also include human vision, radar, and earthquake prediction. In wavelet transform the basic functions are wavelets. These Wavelets tend to be irregular and symmetric. All wavelet functions, $w(2kt - m)$, are derived from a single mother wavelet, $w(t)$. This wavelet is a small wave or pulse like the one shown in Figure.

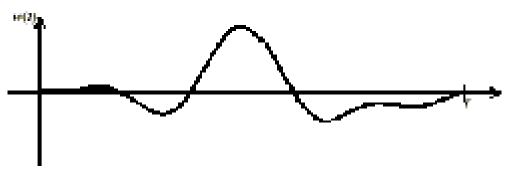

Fig 3: Mother wavelet w (t)

To avoid inappropriate assumptions on the applied mathematical characteristics of noise, a special one is formed. In fact, the non-enhanced image [7] is taken into account to be either freed from noise or laid low with non-perceivable levels of noise. Taking advantage of the upper sensitivity of the human sensory system to changes in brightness, the analysis is restricted to the luma channel of each the non-enhanced and enhanced image. The analysis is performed through the dual-tree advanced riffle remodel due to the importance of directional content in human vision. Unlike the separate riffle remodel, the DTCWT permits for distinction of knowledge radial asymmetry within the remodel house. For every level of the remodel, the quality deviation of the non-enhanced image coefficients is computed across the six orientations of the DTCWT, and then it's normalized. Then result's a map of the directional structures within the non-enhanced image [9]. Same map is then taken to shrink the coefficients of the improved image. The shrinked coefficients and also the coefficients from the non-enhanced image area unit are then mixed in keeping with information radial asymmetry. Finally, a noise-reduced version of the improved image is computed via the inverse transforms.

DTCWT

A new implementation of the Discrete Wavelet Transform is presented, that is suitable for a range of applications. These applications include signal and image processing. In order to obtain the real and imaginary parts of complex wavelet coefficients, it employs a dual tree of wavelet filters. This introduces limited redundancy (4:1 for 2-dimensional signals) and allows the transform to provide approximate shift invariance and directionally selective filters (properties lacking in the traditional wavelet transform) while preserving the usual properties of perfect reconstruction and computational efficiency. Thus in order to solve certain problems that arise with the traditional Discrete Wavelet Transform (DWT) as well as other more advanced methods such as the Steerable Pyramid Transform (SPT), Kingsbury developed the Dual Tree Complex Wavelet Transform(DTCWT). An application to texture synthesis is presented Although the Discrete Wavelet Transform (DWT) in its maximally decimated form (Mallet's dyadic filter tree) has established an impressive reputation as a tool for image compression, yet it has been hampered by two main disadvantages in its use for other signal analysis and reconstruction tasks, which lead to small shifts in the input, that fell Lack of shift invariance. This DTCWT has added the characteristic of perfect reconstruction property.

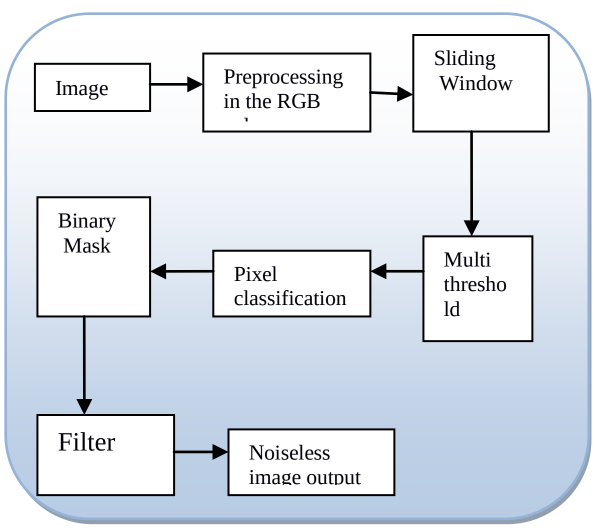

Fig 4: Block Diagram

The Existing system usually generates the output images in black and white format, since the input is also taken in the same manner. Thus the system does not work out to accept colored input images. Therefore Gaussian noise is removed and output is generated in black and white color format. However the projected system is helpful in obtaining the output images in grey color format, even if the input image taken is black and white in color. Thus the system works well to accept any kind of input and noise removal process is carried out with the perfect reconstruction property. This system is very much advantageous, since the salt and pepper noise is being removed using both the PDE and DTCWT techniques through the use of C#.Net language being linked with the MATLAB. DTCWT performance is high when compared to PDE implementation. This system produces sensible quality output by removing noise without altering the underlying structure of the image. Also, verified effective on compression and latent noise delivered to the surface by bar graph exploit. It is economical, very efficient and also provides security.

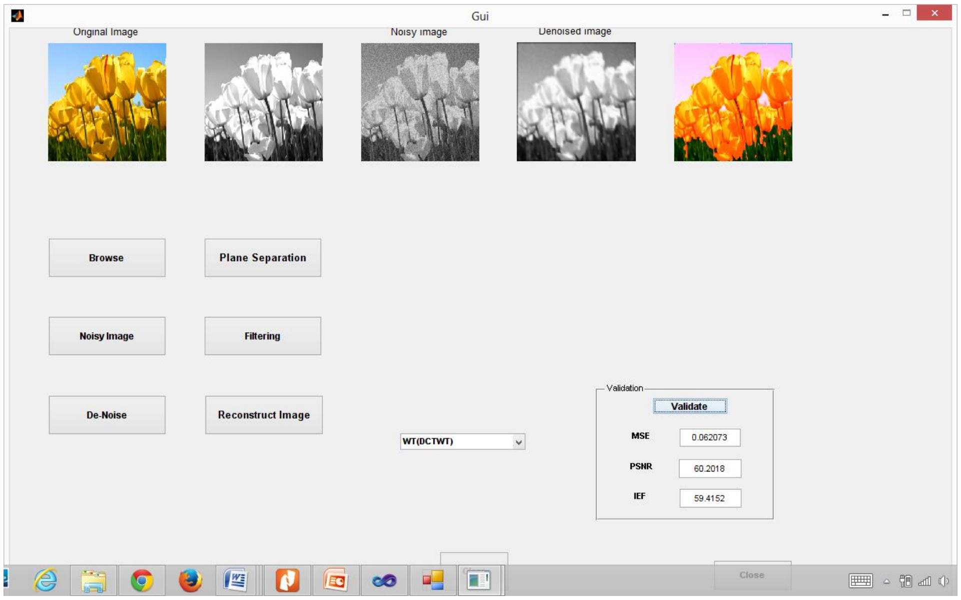

Fig 5: Design Page

	MSE	PSNR	IEF
PDE	11.644	37.47	0.9431
DTCWT	0.0486	61.267	51.957

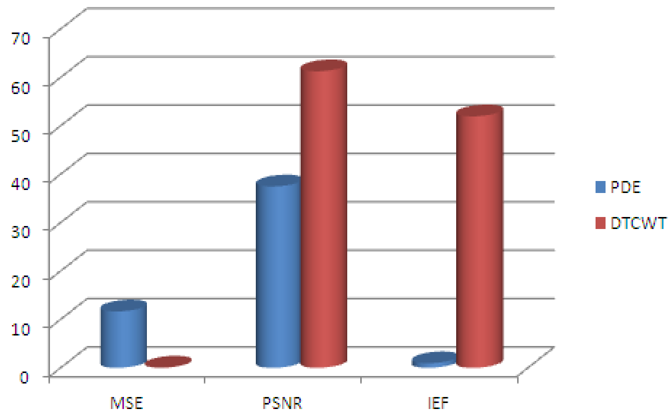

Fig 6: Graphical Representation of noise removal using both PDE&DTCWT

2. LITERATURE SURVEY

Dual-tree complex wavelet transform based denoising for random spray image enhancement methods

This work introduces a novel way of using the Random Spray sampling approach to reduce point-wise noise introduced or exacerbated by image enhancement methods. Due to the sampling structure used and the nature of the spray, output images for such methods tend to exhibit noise with unknown distribution. This proposed method of noise reduction is based on the assumption that the non-enhanced image is either free of noise or contaminated by various levels of noise. For both the non-enhanced and enhanced image the dual-tree complex wavelet transform is applied on the luma channel. The standard deviation of the energy for the non-enhanced image across the six orientations is computed and normalized. Thus to shrink the real coefficients of the enhanced image decomposition the obtained normalized map is used. A noise reduced version of the enhanced version can then be computed via the inverse transform. Therefore in order to confirm the validity of the proposed approach, a thorough numerical analysis of the results has been performed.

Random spray retinex: A new retinex implementation to investigate the local properties of the model

This work presents a new implementation, in order to investigate the local filtering behavior of the Retinex model. This implementation derives a method known as random spray Retinex, in which paths are replaced by 2-D pixel sprays. The way its parameters being controlled in order to perform spatial investigation is a peculiar feature of this implementation. The parameters' tuning is accomplished by an unsupervised method based on quantitative measures. Making use of user panel tests, this procedure has been validated. Furthermore, the spray approach is more efficient than the path-wise one. Further discussion is made, tests are carried out and results are presented.

A spatially variant white patch and gray-world method for color image enhancement driven by local contrast

Starting from the revolutionary Retinex by Land and McCann, further development has been made on several perceptually inspired color correction models, with different aims, e.g. enhancement of color images, reproduction of color sensation, robust features recognition. Such models have a differential, variant and non-linear nature. These can coarsely be distinguished between white-patch (WP) and gray-world (GW) algorithms. This paper shows that the combination of a pure WP algorithm (Random Spray Retinex (RSR) and an essentially GW one (Automatic Color Equalization (ACE)) leads to a more robust and better performing model (RACE). For both algorithms RSR and ACE the choice of these follows from the recent identification of a unified spatially-variant approach. Mathematically, differential mechanisms of RSR and ACE and the originally distinct non-linear and have been fused using the local average operations and the spray technique. The investigation of RACE allowed us to put in evidence a common drawback of corruption of uniform image areas, differential models. To overcome this intrinsic defect, a local and global contrast-based and image-driven regulation mechanism has been devised, which has a general applicability to perceptually inspired color correction algorithms. Further tests, comparisons and discussions are presented.

Spatio-temporal retinex-inspired envelope with stochastic sampling: A framework for spatial color algorithms

The authors present a new framework for algorithms for a wide range of image enhancement and reproduction applications, such as Stress Spatio Temporal Retinex-inspired Envelope with Stochastic Sampling. The working of the algorithms is done by recalculating each pixel for local upper and lower bounds in the image using envelopes. The envelopes are obtained can be interpreted as local reference maximum and minimum and sampling neighbor pixels. This approach is derived from a computational simplification of previous spatial color algorithms, such as ACE or Retinex. With the proposed method, various tasks such as high dynamic range image render, spatial color gamut mapping, local contrast stretching and color to gray scale conversion, automatic color correction can be performed with good results. With some aspects of the human visual system, the algorithm exhibits behaviors in line e.g., simultaneous contrast.

3. IMPLEMENTATION

MODULES DESCRIPTION

Image Capturing:

Here the image is introduced using image enhancement methods, Random spray method which produces two-dimensional collection of points with a given spatial distribution around the origin. The analysis can be limited to the luma channel of both the non-enhanced and enhanced image.

Converting Process:

In this step the plane separation process takes place. The proposed method first converts the image in a space where the chroma is separated from the luma and operates on the wavelet space of the luma channel. Making a choice to use only the luma channel does not lead to any visible color artifact. The input image is considered to be either free of noise or contaminated by various levels of noise. If such an assumption holds, the input image contains the information needed for successful noise reduction.

Image Identification:

After the plane separation process, the input image is identified by the type of noise. The image is considered to be contaminated by non perceivable level of noise. With the advantage of human visual system the content of noise in the image is easily identified. Thus noisy image is obtained on which further transformations techniques are applied.

Comparing Each Transform:

With the importance given to the directional content in human vision, an analysis is carried out through the dual-tree complex wavelet transform (DTCWT). Unlike the discrete wavelet transform, the DTCWT allows for distinction of data directionality in the transform space. For each level of the transform, a non-enhanced image is considered and the standard deviation of these non-enhanced image coefficients is computed across the six orientations of the DTCWT, and then it is normalized.

Coefficient Shrinkage:

Some of the most commonly used transforms for shrinkage-based noise reduction are the Wavelet Transform. This Produces map of the directional structures present in the non enhanced image. This map is then used to shrink the coefficients of the enhanced image. These shrunk coefficients and the coefficients from the non-enhanced image are then mixed according to data directionality.

Resulting Image:

The output image is then computed by inverting the Dual Tree Complex Wavelet transform and the color transform with complete reconstruction property.

4. CONCLUSION

This work presents a noise reduction method based on Dual Tree Complex Wavelet Transform coefficients shrinkage. The main point of uniqueness is represented by its application in post-processing on the output of an image enhancement method and the lack of assumptions on the statistical distribution of noise. To achieve pleasant denoising, the proposed method exploits the data orientation discriminating power of the Dual Tree Complex Wavelet Transform to shrink coefficients from the enhanced, noisy image. Always according to data directionality, the coefficients which are shrunk are mixed with those from the non-enhanced, noise-free image. The output image is then computed by inverting the Dual Tree Complex Wavelet Transform and the colour transform. Therefore in order to carry out a safe and secured data transmission process in a successful manner, this proposed method is very much advantageous. Thus information can be exchanged in the form of images in a very efficient and effective way without any change in the original structure of the image.

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BIOGRAPHY

Miss. Dhadbhanjan Rekha - is Pursuing **M.Tech (SE)** at **J.B. Institute of Engineering & Technology, Yenkalapally, Moinabad, Telangan**a. She has completed graduation (**B.Tech**) from **VMR** Institute of Technology and Management Sciences, Andhra Pradesh. Her current research interests include design and analysis of image processing, digital computing, multidimensional systems and Computer Networks.

Mr. CH Srinivasulu - is presently **Associate Professor in Information Technology** at **J.B. Institute of Engineering & Technology, Yenkalapally, Moinabad, Telangana.** He has nearly17 years of experience in industry as well as a faculty of Computer Science and Information Technology Departments. He is pursuing his PhD from JNTU kakinada. His areas of interests are: image Processing, Computer Architecture, Parallel Computing and Software Engineering,

Mr. P Prakash - is presently **Assistant Professor in Information Technology** at **J.B. Institute of Engineering & Technology, Yenkalapally, Moinabad, Telangana.** He has more than 4 years of experience in Teaching. His areas of interests are: image Processing. Nanotechnology, Artificial Intelligence and Cloud Computing.

