An Improved Histogram for Noisy Image Received by Satellite on Earth Station by Using Innovative Filters

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Abstract— In information age also known as computer age or digital age, visual knowledge and material is often transmitted in the form of digital images. Digital images plays very significant role in our daily routine like they are used in satellite television, Intelligent traffic monitoring, handwriting recognition on checks, signature validation, computer resonance imaging and in area of research and technology such as geographical information systems and astronomy. A digital image can be described as twodimensional image as a finite set of discrete values, known as picture elements or pixels. Pixel ideals typically represent grey levels, colors, heights, opacities etc. Image processing is any form of signal processing for which the input is an image, such as photographs or frames of video and the output of image processing can be either an image or a set of characteristics or parameters related to the image.

Keywords— Image Processing, Image Denoisng, Filter, Histogram

I. OVERVIEW OF IMAGE PROCESSING

In information age also known as computer age or digital age, visual knowledge and material is often transmitted in the form of digital images. Digital images plays very significant role in our daily routine like they are used in television, Intelligent traffic satellite monitoring, handwriting recognition on checks, signature validation, computer resonance imaging and in area of research and technology such as geographical information systems and astronomy. A digital image can be described as twodimensional image as a finite set of discrete values, known as picture elements or pixels. Pixel ideals typically represent grey levels, colors, heights, opacities etc. Image processing is any form of signal processing for which the input is an image, such as photographs or frames of video and the output of image processing can be either an image or a set of characteristics or parameters related to the image.

In image processing system depends on its ability to detect the presence of noisy pixels in the image. Image Processing is the analysis of a picture using different techniques that can identify relationships, shades and colors that cannot be perceived by the human eye. Image processing is a way to change an image into digital form and implement some operations on it, in order to get an image with increased quality or to obtain some useful information from it. Significant works have been done in both hardware and software to improve the signal-to-noise ratio for images. In software, a denoising filter is used to remove noise from an image. Each pixel is represented by three scalar values representing the red, green, and blue chromatic intensities. At each pixel studied, a filter takes into account the surrounding pixels to derive a more accurate version of this pixel. By taking neighboring pixels into consideration extreme "noisy" pixels can be replaced. However, outlier pixels may represent in corrupted fine details, which may be lost due to the smoothing process.

Blurring as well as noise generates degradation due to electronic and photometric sources. Blurring is a form of bandwidth reduction of the image caused by the imperfect image formation process such as relative motion between the camera and the original scene or by an optical system that is out of focus so there may be several reasons due to which an image can reduce its quality or get corrupted aremotion between camera and object, improper opening of the shutter, atmospheric disturbances, misfocusing etc. Noise is addition of undesired components in the image that degrades the visual quality of an image. This undesired constituent needs to be removed before the process of retrieving the original image is to be start. The digital image acquisition process converts an optical image taken with an optical device into a continuous stream of electronic signals that is later sampled in the primary process by which noise appears in digital images. In some case when the images are sent by the sender, images get corrupted with undesirable noise & unwanted elements after transmission.

When aerial photographs are produced for remote sensing purposes, blurs are introduced by atmospheric turbulence, aberrations in the optical system and relative motion between camera and ground. In addition to these blurring effects, the recorded image is corrupted by noises too. A noise is introduced in the transmission medium due to a noisy channel, errors during the measurement process and during quantization of the data for digital storage. Each element in the imaging chain such as lenses, film, digitizer, etc. contributes to the degradation. . In some cases noise gets intruded in the image at the time of acquisition. It is generally caused by malfunctioning of camera sensors, faulty memory locations in hardware or transmission in a noisy channel. Thereby receiver in many cases receives images with diminished quality. Therefore received images require processing before they can be used in various applications.

Processing of image is a science in itself which concerned with the generation, collection, duplication, analysis, modification, and visualization of image. In image processing input is an image like a photograph or video and output is an image or its related parameters. Image processing can be classified in various categories like digital image processing, analog image processing and optical image processing. But usually image processing refers to digital image processing. Basically digital image processing uses computer algorithms to perform image processing on a digital image. It can be called as a subcategory of digital signal processing. Digital image processing is advantageous then analog image processing because it allows a wide range of algorithms to be applied on data and avoids generation of noise during processing.

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Now we will focus on the fundamental concepts of image processing. We begin with certain basic definitions. An image defined in the "real world" is considered to be a function of two real variables, for example, a (x,y) with a as the amplitude (e.g. brightness) of the image at the real coordinate position (x,y). Most usually, image processing systems require that the images be available in digitized form, that is, arrays of finite length binary words. For digitization, the given Image is sampled on a discrete grid and each sample or pixel is quantized using a finite number of bits. The digitized image, it is first converted into analog signal, which is scanned onto a display.

II. PROBLEM IDENTIFICATION

It is essential to suppress noise from an image as far as possible. At the same time, its fine-details and edges are to be retained as much as practicable. The filtering with the Thresholding algorithms to be developed must be of low computational complexity so that they can filter noise in short time, and hence will find themselves suitable for online and real- time applications.

Thus, the problem taken for this thesis research work is to develop efficient filters with the Thresholding to suppress noise:

- With very high efficiency
- yielding extremely low distortion
- In wide range of noise densities
- With less computational complexity and low runtime overhead

- While retaining edges and fine details of an image The thesis research work focuses mainly on salt & pepper noise, Gaussian noise and random noise; in addition some methods are developed to suppress noises.

Therefore the following problem is taken.

Problem: To develop some novel efficient restoration algorithms for images corrupted with high density noises.

III. METHODOLOGY

Denoising techniques plays an increasingly important role in the signal analysis and image processing. Denoising analysis techniques has been applied to a wide of signals.

A. Denoising Technique

Image analysis is easy task after noise is filtered. An engineer working in signal processing has different meaning of the term filter which requires certain operations which tell us the area of interest in the image. Image filters may be used to highlight edges that is, parts of objects in images or boundaries between objects. Filters provide better visual interpretation of images, and can also be used as a predecessor to further digital processing, such as segmentation. Image Denoising is the process of obtaining the original image from the degraded image if value of the degrading factors is known. It is used to eliminate the noise from the corrupted image while retaining the edges and other major detail without hampering the visual information of image.

There are three most popular techniques for image denoising namely image filtering, wavelet analysis and

multifractal analysis. Each technique has their own advantages and disadvantages. Filtration can be done in either linear or non linear environment. Linear filter provides linear relationship between input and output, so we can plot a linear curve between input and output. For example mean filter, weiner filter etc. Nonlinear filters have quite different behavior compared to linear filters. For nonlinear filters, the filter output or response of the filter does not obey the principles outlined earlier, particularly scaling and shift invariance. Moreover, a nonlinear filter can produce results that vary in a non-intuitive manner.

In this thesis we will deal with different type of filters. Two types of filtering techniques are popular-linear and Nonlinear filtering techniques are discussed below:

- 1) Linear filters: The approach output values are linear function of the pixels in the original image. Linear methods are easy to analyze mathematically than the nonlinear Filters
- 2) Non-linear filters: These filters have accurate results because they are able to reduce noise levels without blurring the edges.



Fig. 4.1: Classification of image de-noising

IV. FILTERATION AND NEED OF FILTERATION

Filtering in image processing is a mainstay function that is used to accomplish many things, including interpolation, noise reduction, and resampling. The choice of filter is often determined by the nature of the task and the type and behavior of the data. Noise, dynamic range, color accuracy, optical artifacts, and many more details affect the outcome of filter functions in image processing. The following discussion will explore the differences between different nonlinear filters – as well as highlight image processing approaches that benefit from these filters and identify situations where one filter might be preferred or required over the other.

A. Regular Median Filters

Median Filter Median filter is a best order static, non-linear filter, whose response is based on the positioning of pixel values on basis of rank contained under the filter region. The Median Filter performs filtration by taking the magnitude of all of the vectors within a mask and sorted according to the magnitudes. The pixel with the median magnitude is then used to replace the pixel studied. The median of a set is more robust with respect to the presence of noise. The median filter is given by

Median filter($x_1...,x_N$) =Median ($||x_1||^2...,||x_N||^2$)

Median filter yields good result for salt and pepper noise. These filters are basically smoothers for image processing as well as in signal processing. The benefit of the median filter over linear filters is that the median filter can remove the effect of input noise values with huge magnitudes which means median filter can eliminate the effect of input noise values with extremely large magnitudes.

B. Adaptive Median Filters

Traditional median filter doesn't take into consideration for how image characteristics vary from one location to another. It replaces every point in the image by the median of the corresponding neighborhood. Adaptive filters are capable of denoising non-stationary images that is, images that have abrupt changes in intensity. Such filters are known for their ability in automatically tracking an unknown circumstance or when a signal is variable with little a priori knowledge about the signal to be processed. The Adaptive Median Filter performs processing to determine which pixels in an image have been affected by noise. It classifies pixels as noise by comparing each pixel in the image to its surrounding neighbor pixels. A pixel that is different from a majority of its neighbors, as well as being not structurally aligned with those pixels to which it is similar, is designated as impulse noise. These noisy pixels are then replaced by the median value of the pixels in the neighborhood that have passed the noise detection test. The output of the filter is a single value used to replace the value of the pixel at (x, y). Consider the following notation:

 $Z_{min} = minimum$ intensity value in S_{xy}

 Z_{max} = maximum intensity value in S_{xy}

 Z_{med} = median of the intensity values in S_{xy}

 Z_{xy} = intensity value at coordinates (x, y)

 S_{max} = maximum allowed size of $S_{xy.}$

C. Gaussian filters

Gaussian filter is windowed filter of linear class by its nature is weighted mean. It was named after a famous scientist Carl Gauss, because weights in the filter are calculated according to Gaussian distribution. The Gaussian filter is known as a 'smoothing' operator, as its convolution with an image averages the pixels in the image, affectively decreasing the difference in value between neighboring pixels. In addition to applications such as feature extraction, filters can be used for denoising signals and images. Many different filters can achieve this purpose and the optimal filter often depends on the particular requirements of the application. One such filter is called a Gaussian, so named because the filter's kernel is a discrete approximation of the Gaussian (normal) distribution. The Gaussian filter is known as a 'smoothing' operator, as its convolution with an image averages the pixels in the image, affectively decreasing the difference in value between neighboring pixels.

Gaussian distribution has surprising property. Look, its expression could be rewritten as:

$$G(\mathbf{x}, \mathbf{y}) = \frac{1}{2\pi\sigma^2} e^{\frac{-(x^2 + y^2)}{2\sigma^2}} = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-x^2}{2\sigma^2}} \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-y^2}{2\sigma^2}} \dots \dots \dots (3)$$

= G(x) G(y)(4)

The σ parameter in equation is equal to the standard deviation of the Gaussian, and can be adjusted according to the desired distribution.

D. Bilateral filters

Bilateral filtering is a technique to smooth images while preserving edges. It can be traced back to 1995 with the work of Aurich and Weule [4] on nonlinear Gaussian filters. It was later rediscovered by Smith and Brady as part of their SUSAN framework, and Tomasi and Manduchi who gave it its current name. Since then, the use of bilateral filtering has grown rapidly and is now ubiquitous in image processing applications. It has been used in various contexts such as denoising, texture editing. The bilateral filter has several qualities that explain its success:

- Its formulation is simple: each pixel is replaced by a weighted average of its neighbors. This aspect is important because it makes it easy to acquire intuition about its behavior, to adapt it to application-specific requirements, and to implement it.
- It depends only on two parameters that indicate the size and contrast of the features to preserve.
- It can be used in a non-iterative manner. This makes the parameters easy to set since their effect is not cumulative over several iterations.

V. THRESHOLDING

A. Proposed Thresholding Method

Finding an optimized value (λ) for threshold is a major problem. A small change in optimum threshold value destroys some important image details that may cause blur and artifacts. So, optimum threshold value should be found out, which is adaptive to different sub band characteristics. Here we proposed a new threshold estimation technique which gives an efficient threshold value for noise to get high value of PSNR as compared to previously explained methods.

B. Brute Force Thresholding

Threshold follows the same concept as in basic electronics, Brute force Threshold is given 5 times the maximum pixel intensity, which will be 127 in most of the images. Brute force thresholding always outclass other existing thresholding techniques in terms of better results. Algorithm for brute force thresholding is given.

Input wavelet sub band.

- Find maximum (max) and minimum (min) value of sub band coefficients.
- loop through (threshold=min to max) and execute desired algorithm
- save the results in array for each loop such that F= [threshold, result]
- When loop completed, select the (threshold) that gives best result.

VI. MEASURES OF IMAGE QUALITY

A. Mean Square Error (MSE)

In statistics and signal processing, a Mean square error (MSE) estimator describes the approach which minimizes the mean square error (MSE), which is a common measure of estimator quality.

The MSE estimator is then defined as the estimator achieving minimal MSE. In many cases, it is not possible to determine a closed form for the MMSE estimator. In these cases, one possibility is to seek the technique minimizing the MSE within a particular class, such as the class of linear estimators. The linear MSE estimator is the estimator achieving minimum MSE.

.....(5)

 $MSE = \frac{\Sigma[Is(r,c) - Id(r,c)]^2}{\frac{R*c}{R*c}}$ Where R*C is the size of image.

Is = original Image

Id = Despeckled Image

B. Root Mean Square Error (RMSE)

In mathematics, the root mean square (abbreviated RMS or rms), also known as the quadratic mean, is a statistical measure of the magnitude of a varying quantity. It is especially useful when variations are positive and negative, e.g., sinusoidal. RMS is used in various fields, including electrical engineering; one of the more prominent uses of RMS is in the field of signal amplifiers. It can be calculated for a series of discrete values or for a continuously varying function. The name comes from the fact that it is the square root of the mean of the squares of the values. It is a special case of the generalized mean with the exponent p = 2. The RMS value of a set of values (or a continuous-time waveform) is the square root of the arithmetic mean (average) of the squares of the original values (or the square of the function that defines the continuous waveform). The RMS over all time of a periodic function is equal to the RMS of one period of the function. The RMS value of a continuous function or signal can be approximated by taking the RMS of a series of equally spaced samples.

C. Peak to Signal Noise Ratio (PSNR)

The phrase peak signal-to-noise ratio, often abbreviated PSNR, is an engineering term for the ratio between the maximum possible power of a signal and the (or codec type) and same content. It is most easily defined via the mean square error (MSE) which for two m×n monochrome images I and K where one of the images is considered a noisy approximation of the other is defined as:

Here, MAX_I is the maximum possible pixel value of the image. When the pixels are represented using 8 bits per sample, this is 255.

VII. FLOW CHART FOR PROPOSED ALGORITHM



Fig. 4.2: Flow Chart for image denoising using brute force Thresholding Algorithm

For better and easy understanding, a complete flowchart of the discussed methodology has been shown above. The thesis, is as follows :main algorithm, followed in order to fulfill the aim of this

- Step 1:Read original standard image or SAR image (lena.bep, sar_image.jpg)
- Step 2:Add noise (salt & pepper noise, Gaussian noise, random noise) to the standard test image.
- Step 3:Make the noise image to undergo filtering (regular median filtering, adaptive median filtering, Gaussian filtering & bilateral filtering).
- Step 4:Apply the Proposed Thresholding technique i.e. brute force Thresholding
- Step 5:Then three parameters, PSNR (Peak to Signal noise ratio), MSE (mean square Error) RMSE (Root mean square Error) are calculated for all standard images with noise and denoised counterparts, respectively. Hence, we get a good amount of comparison between the noisy and denoised image keeping the set standard intact.
- Step 6:A usual way to de-noise is to find a processed image such that it minimizes MSE (mean square Error), RMSE (Root mean square Error) and increases the value of the PSNR (Peak Signal to noise ratio). Hence depending upon the values of above three parameters, we conclude that which filter with brute force Thresholding technique give best denoised result.

VIII. EXPERIMENTAL RESULT

This method has been implemented using Matlab as the simulation tool. The proposed filter is tested with Image' Lena.bmp' and SAR Image of size 512 x 512. The image is corrupted by salt and pepper noise, Gaussian noise, Random noise at various noise densities and performance is measured using the parameters such as Signal-to-Noise

Ratio (SNR), Peak-Signal-to-Noise Ratio (PSNR), Mean Absolute Error (MAE), Mean Square Error (MSE), and Universal Quality Index (UQI).The parameters used to define the performance are: Results from LENA image:





IX. CONCLUSIONS & FUTURE SCOPE

This chapter concludes the work in this thesis in terms of the various input and output parameters that have been considered while denosisng images using wavelet

transforms. It also provides with a look up in the future scope of our work area.

X. CONCLUSIONS

In this thesis, we have proposed a new threshold estimation technique in which a gray scale image in 'bmp' format is injected salt and pepper noise, Gaussian noise, Random noise. Further, the noised image is denoised by using different filtering and Thresholding techniques ("Brute Force Thresholding"). A particular algorithm is to be selected according to the noise present in the image. The proposed threshold mentioned in this thesis shows better performance over other techniques. Thus we can say that the proposed threshold may find applications in image recognition system, image compression, medical ultrasounds and a host of other applications.

XI. FUTURE SCOPE

The field of image processing has been growing at a very fast pace. The day to day emerging technology requires more and more revolution and evolution in the image processing field. The well known saying "A picture says a thousand words" can be taken as the main motive behind the need of image processing.

The work proposed in this thesis also portrays a small contribution in this regard. The proposed de noising technique can provide a good platform for further research work in this respect. The work presented in this thesis can be extended in several directions. Here sever of the research directions which might be followed for the further application in the segmentation and classification of real SAR image features. Moreover, for future work we can train our algorithm using various AI techniques like fuzzy logic or neural network, in order to attain the best output without performing calculations for each and every combination.

REFERENCES

- [1] Lopes A., Nezry E., Touzi R., Law H., "Maximum A Posteriori Speckle Filtering And First Order Texture Models In Sar Images" 10th Annual International Geoscience and Remote Sensing Symposium, 1990.
- [2] H. Guo, J. E. Udegard, M. Lung, R. A. Gopinath, I. W. Selesnick and C. S. Burrui, "Wavelet Based Speckle Reduction With Application To SAR Based Atd/R" IEEE International Conference on Image Processing, 1994.
- [3] M. Lmg, Member, IEEE, H. GUO, Student Member, IEEE, J. E. Odegard, Student Member, IEEE, C. S. Burrus, Fellow, IEEE, and R. 0. Wells, Jr. "Noise Redction Using An Undecimated Discrete Wavelet Transform" IEEE Signal Processing Letters, Vol. 3, No. 1, January 1996
- [4] Sang-il Park, Mark J. T. Smith and Russell M. Mersereau, "A New Directional Filter Bank For Image Analysis And Classification" IEEE International Conference on Acoustics, Speech, and Signal Processing, 1999. Proceedings., 1999
- [5] Vasily Strela, Peter Niels Heller, Member, IEEE, Gilbert Strang, Member, IEEE, Pankaj Topiwala, Member, IEEE, and Christopher Heil, "The Application

of Multiwavelet Filterbanks to Image Processing" IEEE Transactions On Image Processing, Vol. 8, No. 4, April 1999

- [6] Fabrizio Argenti, Member, IEEE, and Luciano Alparone, "Speckle Removal From SAR Images in the Undecimated Wavelet Domain" IEEE Transactions On Geoscience And Remote Sensing, Vol. 40, No. 11, November 2002
- [7] Alin Achim, Student Member, IEEE, Panagiotis Tsakalides, Member, IEEE, and Anastasios Bezerianos, Member, IEEE, "SAR Image Denoising via Bayesian Wavelet Shrinkage Based on Heavy-Tailed Modeling" IEEE Transactions On Geoscience And Remote Sensing, Vol. 41, No. 8, August 2003
- [8] of SAR Images" IEEE Transactions On Geoscience And Remote Sensing, Vol. 42, No. 4, April 2004 Stian Solbø and Torbjørn Eltoft, Member, IEEE, "Homomorphic Wavelet- Based Statistical Despeckling
- [9] Min Dai, Student Member, IEEE, Cheng Peng, Andrew K. Chan, Fellow, IEEE, and Dmitri Loguinov, Member, IEEE, "Bayesian Wavelet Shrinkage With Edge Detection for SAR Image Despeckling" IEEE Transactions On Geoscience And Remote Sensing, Vol. 42, No. 8, August 2004
- [10] Fabrizio Argenti, Member, IEEE, Tiziano Bianchi, Member, IEEE, and Luciano Alparone,
 "Multiresolution MAP Despeckling of SAR Images Based on Locally Adaptive Generalized Gaussian pdf Modeling" IEEE Transactions On Image Processing, Vol. 15, No. 11, November 2006
- [11] Michael Elad, Member, IEEE, "Why Simple Shrinkage Is Still Relevant for Redundant Representations?" IEEE Transactions On Information Theory, Vol. 52, No. 12, December 2006
- [12] Florian Luisier, Thierry Blu, Senior Member, IEEE, and Michael Unser, Fellow, IEEE, "A New SURE Approach to Image Denoising: Interscale Orthonormal Wavelet Thresholding" IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 16, NO. 3, MARCH 2007
- [13] Mario Mastriani, and Alberto E. Giraldez, "Kalman's Shrinkage for Wavelet- Based Despeckling of SAR Images", World Academy of Science, Engineering and Technology Vol:2 2008
- [14] Syed Musharaf Ali, Muhammad Younus Javed, Naveed Sarfraz Khattak, Athar Mohsin, and Umar Farooq, "Despeckling of Synthetic Aperture Radar Images Using Inner Product Spaces in Undecimated Wavelet Domain", World Academy of Science, Engineering and Technology. Vol:2 2008
- [15] Ruxin Wang and Qiang Li, "A Survey on SAR Image Despeckling", Huazhong University of Science and Technology. 2011.