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A RAPID FILTERING AND THRESHOLD TECHNIQUES FOR THE ENHANCEMENT AND SEGMENTATION OF REMOTE SENSING IMAGES USING ADAPTIVE THRESHOLD

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ABSTRACT
An image is an artifact that depicts or records visual perception. Image refers to digital data that is suitable for processing using digital computers. In this paper remote sensing image has been used. The original color image is processed without any conversion. The Gaussian noise is implemented to the color image and removed using the spatial correlation filter which works well for the RGB images. Again the bilateral filter is used for noise reduction and various enhancement operations are performed to enhance the quality of the image. One of the morphological operations is used for the extraction of the image process. Segmentation plays a vital role in the image partitioning where one of the thresholding technique is performed in this paper which works well.

Key words – *Remote sensing images, spatial correlation filter, Bilateral filter, Thresholding technique.*

I. INTRODUCTION

Remote sensing can be defined as any process whereby information is gathered about an object, area or phenomenon without being in contact with it. Remote sensing can be broadly defined as the collection and interpretation of information about an object, area, or even without being in physical contact with the object [3]. Remote sensing is the measurement of object properties on Earth's surface using data acquired from aircraft and satellites [2]. Remote sensing can be defined as any process whereby information is gathered about an object, area or phenomenon without being in contact with it.

Traditionally, there are two types of remote sensing. They are passive remote sensing and active remote sensing which are used for various purposes. Noise represents unwanted information which deteriorates image quality. Noise is defined as a process which affects the acquired image and is not part of the scene. Using the additive noise model.

The noise can also be referred as error which occurs in an image. There are various types of noise which are introduced in an image. As the same there are various types of filters to reduce the noise. The spatial correlation filter [9] is used to remove the noise from color image which is simple and powerful method of smoothing image. For the Gaussian noise, this spatial correlation filter is the suitable one to reduce the noise. Once again to transform

Pixel intensity values to reveal certain image characteristics the bilateral filter are used. Finally, the segmentation process is proposed where one of the threshold techniques is used.

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2. METHODOLOGY

Image processing is the main use of computers to process on the images or torrent of images which is available to it through relevant Input. After processing the Image, different kinds of outputs can be generated depending on the users needs. Basically Noise is the main Problem in Image. Noise removal is one of the important techniques in image processing. Here, the system architecture of our proposed work shown in the fig-1.

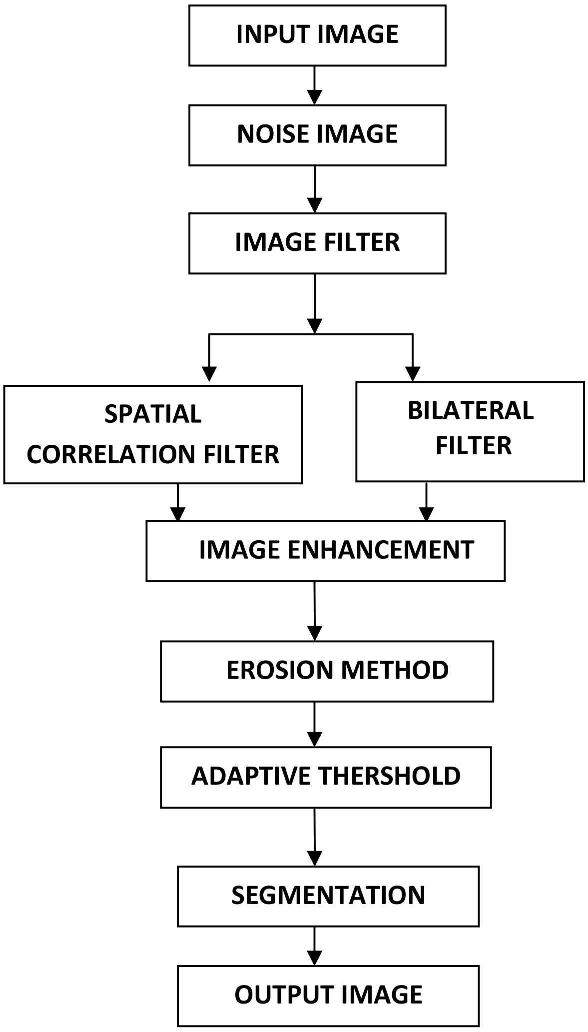

Fig-1 System Architecture

2.1 IMAGE NOISE

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Noise may be modeled either by a histogram or a probability density function which is superimposed on the probability density function of the original image. The models for the most common types of noise can be presented as salt and pepper noise, speckle noise and Gaussian noise.

2.1.1 GAUSSIAN NOISE

The Gaussian noise is also called the normal noise is randomly occurs as white intensity values. The Gaussian noise affects both the dark and light areas of the image. The Gaussian distribution is given as

$$P(z) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{(z-m)^2}{2\sigma^2}} \qquad \text{Equ (1)}$$

When P(x) is the Gaussian distribution noise in image, μ and σ is the mean and standard deviation respectively. In this paper only the gaussian noise in implemented in order to get better enhancement results as outcome.

2.2 BILATERAL FILTER

A bilateral filter is non-linear, edge-preserving and noise-reducing smoothing filter [1]. The intensity value at each pixel in an image is replaced by a weighted average of intensity values from nearby pixels. This weight can be based on a Gaussian distribution. Crucially, the weights depend not only on Euclidean distance of pixels, but also on the radiometric differences [13]. For example, the range difference such as color intensity, depth distance, etc. This preserves sharp edges by systematically looping through each pixel and adjusting weights to the adjacent pixels accordingly.

The bilateral filter is defined as:

$$I^{\text{filtered}}(x) = \sum_{x_i \in \Omega} I(x_i) f_r(\|I(x_i) - I(x)\|) g_s(\|x_i - x\|) \qquad \text{Equ (2)}$$

Where I^{filtered} is the filtered image, I is the original input image to be filtered, x are the coordinates of the current pixel to be filtered, Ω is the window centered in x, f_r is the range kernel for smoothing differences in intensities. This function can be a Gaussian function, g_s is the spatial kernel for smoothing differences in coordinates. This function can be a Gaussian function.

2.3 IMAGE ENHANCEMENT

Image enhancement is the process of enhancing the quality of a given image for analysis. Image enhancement is a subjective process, in which its procedure is very simple [6]. Image enhancement starts with the concept of image quality. While there are many factors that are responsible for image quality, some of the essential factors are contrast [10], brightness, spatial resolution and noise. One of the commands is used to map the old intensity range in the image to a new intensity range to improve the visual quality of the image.

2.4 EROSION OPERATION

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Image morphology is one of the important tools in image processing [4] [5]. Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation [5], the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. Erosion is one of the important operations in morphology. The objective of this operator is to make an object smaller by removing its outer layer of pixel. The output of the erosion operation is

$$g(x_0,y_0)=\begin{cases} 1 \text{ for } z=k \\ 0 \text{ for } z<k \end{cases} \qquad \text{Equ. (3)}$$

Let the number of pixels in the structuring element be k. let the number of pixels of value in the input image be z. let the pixel coordinate beneath the origin of the structuring element be (x_0, y_0).

2.5 SEGMENTATION

Segmentation is the process of partitioning a digital image into multiple regions and extracting meaningful regions known as regions of interest (ROI) for the future image analysis [8]. Image segmentation has emerged as an important phase in image-based applications [7]. Thresholding is a very important technique for image processing. It produces uniform regions based on the threshold criterion T. The thresholding operation [14] can be thought of as an operation, such as

$$T=T\{x,y,A(x,y),f(x,y)\} \qquad \text{Equ. (4)}$$

III. QUALITY MEASURES

3.1 MEAN SQUARE ERROR

The simplest of image quality measurement is Mean Square Error (MSE) [11]. The large value of MSE means that image is poor quality. MSE is defined as follow

$$MSE = \frac{1}{MN}\sum_{j=1}^{M}\sum_{k=1}^{N}\left(x_{j,k} - x'_{j,k}\right)^2 \qquad \text{Equ. (5)}$$

3.2 PEAK SIGNAL TO NOISE RATIO (PSNR)

The small value of Peak Signal to Noise Ratio (PSNR) [12] means that image is poor quality. In general, a good reconstructed image is one with low MSE and high PSNR [12].PSNR is PSNR defined as follow

$$PSNR = 10\log\frac{(2^n-1)^2}{MSE} = 10\log\frac{255^2}{MSE} \qquad \text{Equ. (6)}$$

3.3 MAXIMUM DIFFERENCE (MD)

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The large value of Maximum Difference (MD) [12] means that image is poor quality. The Maximum Difference (MD) is defined as follow

$$MD = Max\left(\left|x_{j,k} - x'_{j,k}\right|\right) \qquad \text{Equ. (7)}$$

3.4 CORRELATION

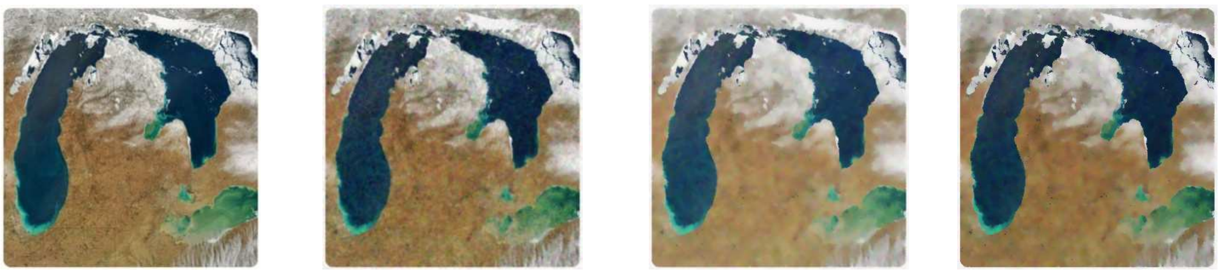
Correlation coefficient quantifies the closeness between two images. The correlation coefficient is computed by using the following equation [13].

$$NK = \sum_{j=1}^{M}\sum_{k=1}^{N} x_{j,k}\cdot x'_{j,k} \Big/ \sum_{j=1}^{M}\sum_{k=1}^{N} x^2_{j,k} \qquad \text{Equ. (8)}$$

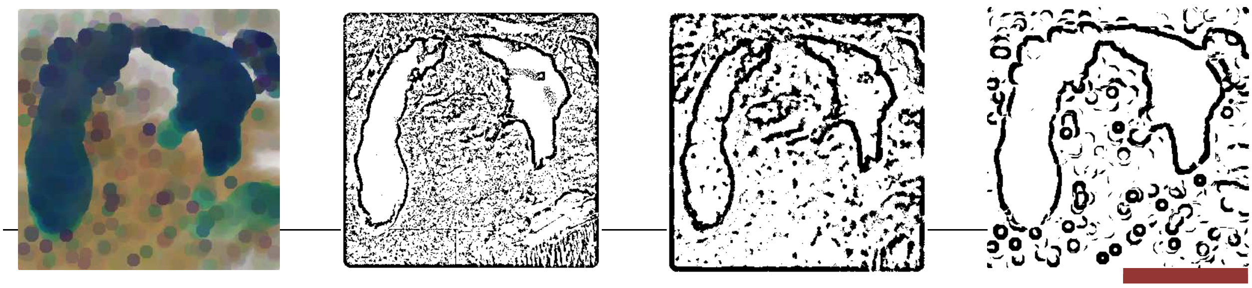
A correlation is a number between -1 and +1 that measures the1 degree of association between two variables (call them X and Y). A positive value for the correlation implies a positive association (large values of X tend to be associated with large values of Y and small values of X tend to be associated with small values of Y). A negative value for the correlation implies a negative or inverse association (large values of X with small values of Y and vice versa).

IV. RESULT

The following figure shows the experimental results of the proposed work. The Remote Sensing image is taken as the input image. This proposed work is done using MATLAB.2010 version.



(A) Remote Sensing Image (B) Correlation Filter Image (C) Bilateral Filter Image (D) Enhanced Image



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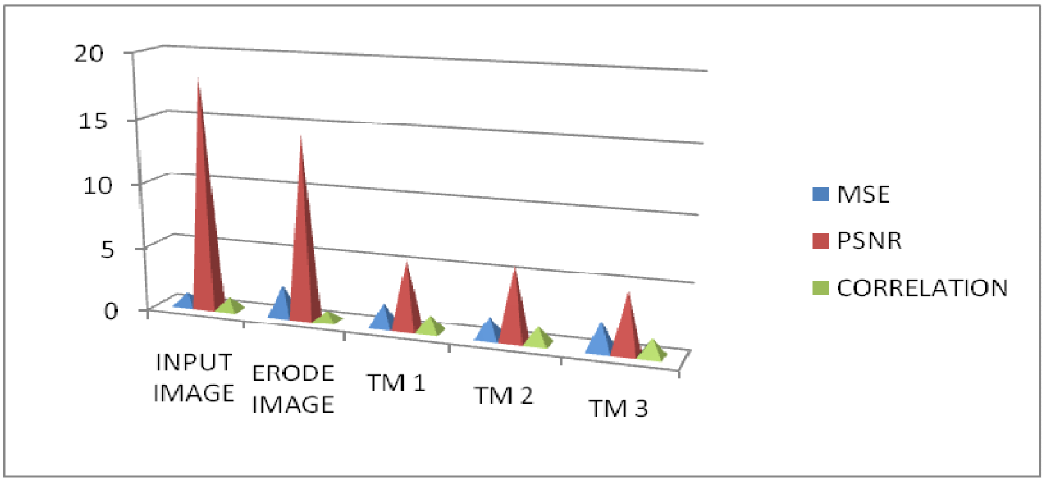
(E) Erode Image (F) Threshold Image 1 (G) Threshold Image 2 (F) Threshold Image 3

TABEL-1: Result of MSE, PSNR, MD AND CORRELATION for the images.

IMAGES	MEAN SQUARE ERROR	PSNR	MAXIMUN DIFFERENCE	CORRELATION
INPUT IMAGE	1.0162	18.0611	228	0.9980
ERODED IMAGE	2.4078	14.3147	215	0.7674
IMAGE 1	1.8746	5.4017	252	1.2865
IMAGE 2	1.7102	5.8004	248	1.3389
IMAGE 3	2.2392	4.6300	255	1.1291

Fig -2. Comparison of MSE, PSNR and CORRELATION for the images



V. CONCLUSION

In this paper remote sensing images has been used in order to get better quality results. The spatial correlation filter and bilateral filter is used to remove the noise from the RGB image. In this paper one of the segmentation techniques has been used for the partitioning of the images into various regions. All the images are compared using the image quality measures and finally the result shows that filtered image segmentation is better than the original image segmentation.

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