Analysis of underwater image for future requirement using Wavelet Transform analysis

Pratiksha Chafle[1], Prof.P.R.Badadapure[2]

[1]Student, ENTC Department, JSPM ICOER Wagholi ,Pune, Savitribai Phule University, Maharashtra, India.

[2]HOD, ENTC Department, JSPM ICOER Wagholi ,Pune, Savitribai Phule University, Maharashtra, India.

Email - pratuschafle@gmail.com, badadapurep@gmail.com

Abstract: Optical information is transmitted in the form of digital images is becoming a large method of communication in the modern age but still the images reach after transmission is often depraved with noises so the received images demand processing before it can be used in application. Our motive is that to eliminate the noise from images that is underwater images also improve the image , underwater images consist of different kinds of noises like random noise, speckle noise, Gaussian noise, salt and pepper noise, Brownian noise etc. Image De-noising is involved manipulation of images data to produce a visually high quality, images processing of improving the quality of images by enhancing its features. The underwater image processing area has accepted appreciable attention within the last decades so using some proper kind of filter it is possible. The filter we will employ is a bilateral filter for smoothing the images. It is required because of a lot researchers like forensic department, argeologiest geologist, and underwater marine lab and underwater inside hydro lab and so on, for their research activity. The underwater images have poor image condition. First it uses some preprocessing methodology which is to be complete before wavelet threshold de-nosing. Then it will use CLAHE method for image enhancement along with wavelet transform then we get some adaptive output and the images that we reborn are more enhanced as well as it reduce the noise level.

Key Words: Noise associated with underwater image, Image De-noising using adaptive wavelet transform, Image Enhancement using CLAHE method.

1. INTRODUCTION:

Digital Image Processing (DIP) involves the change of digital data for improving the image qualities with the aid of computer. The processing helps in maximizing clarity, sharpness and details of properties of interest towards data extraction and further analysis. Noise is a major issue while transferring images through all kinds of electronic communication. The most common noises in underwater images are random noise, speckle noise, Gaussian noise, salt and pepper noise, Brownian noise etc. are one of the common problems in image processing in water. Even a maximum resolution photo is bound to have some noise in it. For a maximum-resolution photo a simple box blur may be proportionate, because even a tiny property like eyelashes or cloth texture will be represented by a maximum number of group of pixels. In order to deal with underwater image processing, so first of all in the main physics of the light propagation in the water medium to be consider. Physical properties of the medium cause degradation reaction not present in normal underwater images taken in air.

Underwater images are significantly represent by their poor image visibility because light is statistical attenuated as it swing in the water and the scenes result poorly contradict and hazy. Light depletion end point the image visibility distance at about 20 meters in clear water and 5 meters in turbid water. The light attenuation performance is creator by absorption and scattering. The absorption and scattering method of the light in water influence the overall process of underwater imaging arrangement. Forward scattering leads to blurring of the image property. On the other hand, backward scattering generally end point the contrast of the images, generating a significantly shade that superimposes itself on the image and reserve the scene. Absorption and scattering property are due not only to the water itself but also to other constitute such as dissolved organic matter.

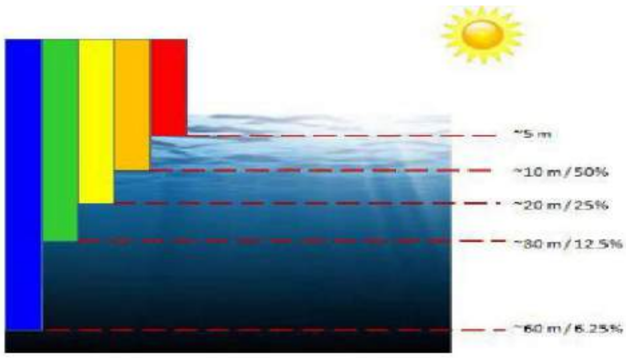


Fig: Water level in sea

The residence of the floating particles known as "marine snow" maximize absorption and scattering reaction. The visibility area can be maximized. With artificial lighting but these sources not only go through from the problem described before (scattering and absorption), but in inclusion tend to brighten the scene in a non-uniform fashion, generating a bright spot in the middle of the image with a poorly brightened area surrounding it. Lastly, as the amount of light is minimized when light is go wide, colors diminish one by one depending on their wavelengths. The blue color suffer the longest in the water due to its compressed wavelength, making the underwater images to be control necessarily by blue color.

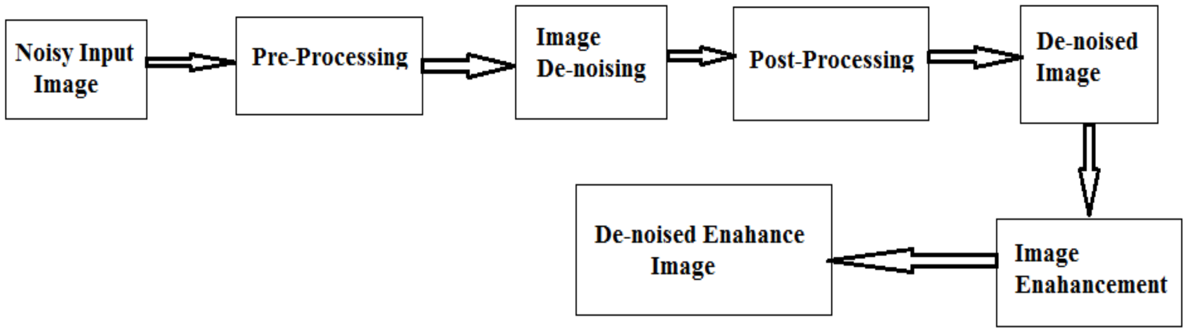


Fig.1:Block diagram

2. LITERATURE SURVEY:

R.Sathya,M.Bharathi,G.Dhivyasri[1] et al suggested in“Underwater Image Enhancement by Dark Channel Prior” in this paper, Light scattering and color change are two main difficulty in underwater images. Due to light scattering, incident light gets reflected and deflected multiple times by particles exist in the water. This degrades the image visibility and contrast of the underwater image. Dark channel prior is technique used for eliminating the haze exist in the underwater image. It is based on a key observation - most regional patches in haze-free underwater images contain some kind of pixels which have very low depth in at least one color channel. Using this prior with the haze imaging color model calculate the thickness of the haze and recover a maximum quality haze free image. This technique does not need images with various exposure values, and is entirely based on the attenuation experienced by point across multiple frames. Underwater image enhancement using Dark channel Prior is complete. Results shows that the performance of this technique is better compared to image enhancement using HE.

De-An Huang, Li-Wei Kang, Yu-Chiang Frank Wang, Chia-Wen Lin [2] et al suggested in “Self-Learning Based Image Decomposition with Applications to Single Image De-noising” in this paper, it has been presented a learning-based image decomposition framework for single image de-noising. The proposed framework first observes the dictionary atoms from the input image for image representation. Image components associated with various context information will be automatically learned from the grouping of the derived dictionary atoms, which does not necessary the prior information on the kind of images nor the collection of training image data. To address the task of image de-noising, our proposed technique is able to find image components which correspond to undesired noise patterns. Experiments on two kinds of single image de-noising tasks (with structured and unstructured noise) confirmed the use of our proposed technique, which was shown to quantitatively and qualitatively outperform present de-noising approaches.

Dr.G.Padmavathi, Dr.P.Subashini, Mr.M.Muthu Kumar and Suresh Kumar Thakur [3] et al suggested in "Comparison of Filters used for Underwater Image Pre-Processing" in this paper, underwater image pre-processing is absolutely needed due to the quality of images captured under water. Basically, under water images experience from quality degradation due to transmission of limited range of light, minimum contrast and blurred image due to quality of light and diminishing color. When an underwater image is captured, pre-processing is needed completed to correct and adjust the image for further study and processing. Various filtering method are available in the literature for pre-processing of underwater images. The filters used normally increase the image quality, compress the noise, preserves the edges in an image, enhance and smoothen the image. Therefore an experiment has been made to compare and calculate the performance of three popular filters namely, homomorphic filter, anisotropic diffusion and wavelet de-noising by average filter used for under water image pre-processing. Out of the three filters, wavelet de-noising by average filter find desirable results in terms of Mean Square Error and Peak Signal to Noise Ratio.

3. METHOD:

Image De-noising:

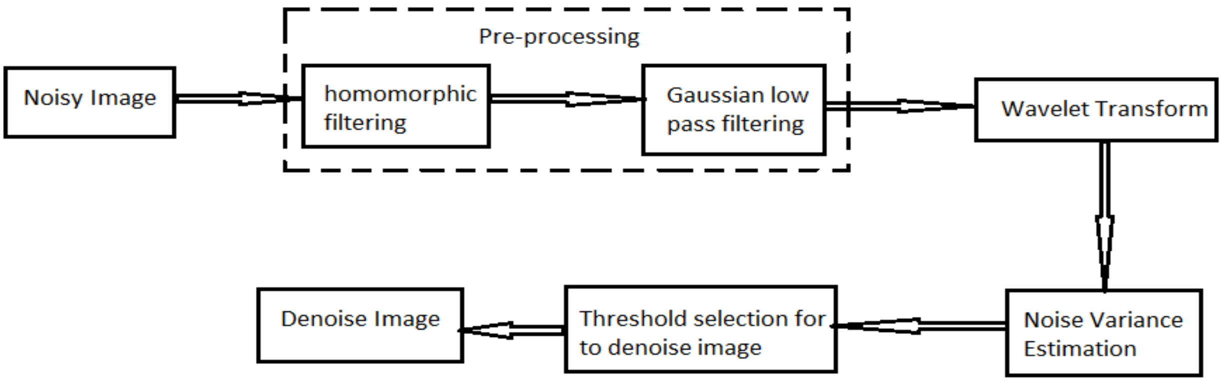


Fig 2 : The process of Image de-noising

In the existing System, the image processing is complete on the underwater images, which is ready for enhancement of the image, but they are not profitable to eliminate noise purely. Many significant property get diminished from the original image, which makes object difficult to identification a problematic task for us. The main Objective is to increase quality of underwater image by using de-noising method, the processing of underwater image is important because the quality. These image leads some severe difficulty when compared to images from a clearer surrounding. Numbers of system are there to recovery these underwater images by using various types of filtering method are also available in the literature for processing & enhancement of underwater images. Then the design method is also initiative to solve the difficulty.

The method is motivated from the literature survey of the wavelet transformation method. In this method pre-processing is completed on the underwater image using filtering method, which makes the image look more prominent .After pre-processing adaptive wavelet transformation is given. So that more accurate de-noised outputs is attempt. In order to achieve better de-noising effect, some pre-processing should be completed before wavelet threshold de-nosing method. The pre-processing consist two steps, the first step is to use Homomorphic filtering technology to remove the non-uniform brightening and balance contrast. This step can realize the purpose to minimize the brightening changes, sharpen the edge details, preserve details and eliminate the noise in the image.

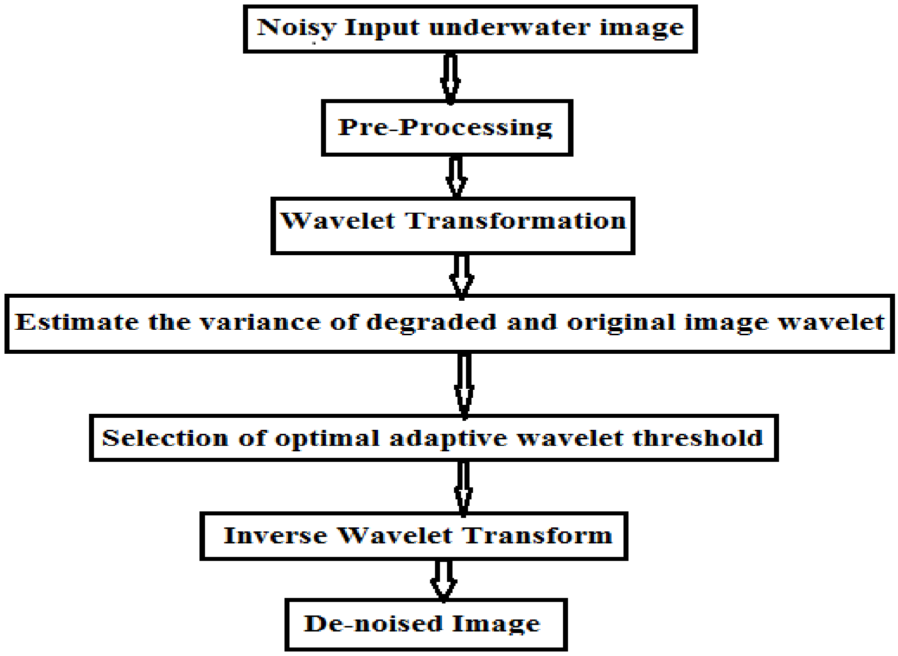


Fig.3: Flowchart of De-noising underwater images.

4. IMAGE ENHANCEMENT:

Histogram Equalization:
For a given image X, the probability density function (X k) is defined as by following term function.

$$p\ ([(X)])^{k} = \frac{n^k}{n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (1)$$

Let,For k = 0, 1……………, L – 1,

Where nk -number of times that the level ,Xk appears in the input image X and n - total number of samples in the input image.

Note that p (Xk) is combine with the histogram of the input image which represents the number of pixels that have a specific depth (intensity) Xk. In fact, a plot of nk vs. Xk is known histogram of X. Based on the probability density function, the cumulative density function is defined as

$$C(x)\sum_{j=0}^{k} p(X_j) \qquad \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where Xk = x, for k = 0, 1, L – 1. Note that c(XL-1) = 1 by definition. HE is a scheme that maps the input image into the entire dynamic range, (X0, XL-1), by using the cumulative density function as a transform function. Let's define a transform function f(x) based on the cumulative density function as

$$f(x) = X_0 + (X_{l-1} - X_0)c(x) \ldots\ldots\ldots\ldots.. (3)$$

Then the output image of the HE, Y = {Y(i, j)}, can be expressed As

$$Y = f(X) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (4)$$

$$= \{f(X(\ i\ ,j) / X(\ i,j) \epsilon X\} \ldots\ldots\ldots\ldots. (5)$$

The maximum achievement of the HE in enhancing the contrast of an image as a consequence of the dynamic range expansion, Besides, HE also flattens a histogram. Based on information theory, entropy of message source will get the high value when the message has uniform distribution features. As addressed previously, HE can introduce a important change in brightness of an image, which hesitates the direct application of HE method in consumer electronics.

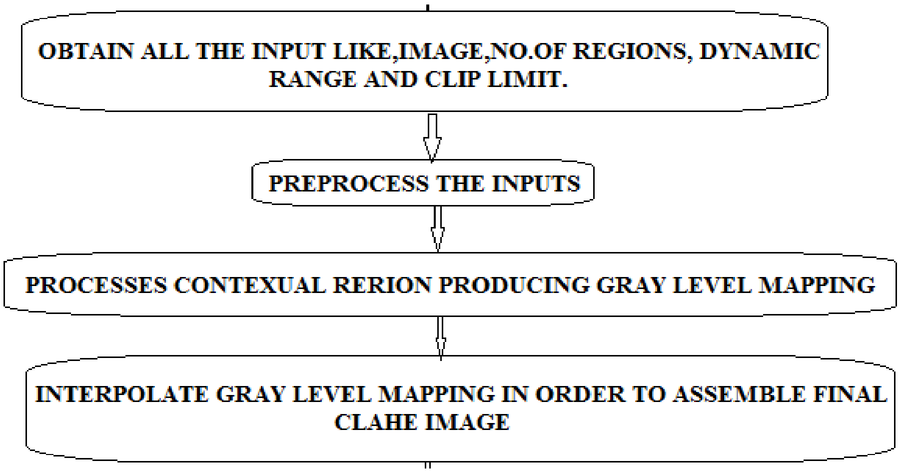


Fig. 4: Flow chart for CLAHE

5. DISCUSSION:

Here proposed work uses some pre-processing methodology. For restoring image from de-noising it use wavelet transform and for getting more enhanced image it make the use of law called CLAHE method. Here it will use MATLAB as simulation experiment tool.

Underwater Images:

Firstly we will use constructed underwater images. Then we will apply some preprocessing methodologies.

Preprocessing:

For getting better de-noising image some preprocessing should be done before wavelet threshold de-noising. The preprocessing is done by two ways. Very first we will use Homomorphic filtering technology to eliminate the non-uniform illumination and balance contrast. In the second case we will apply the Gaussian low pass filtering for smoothing the image.

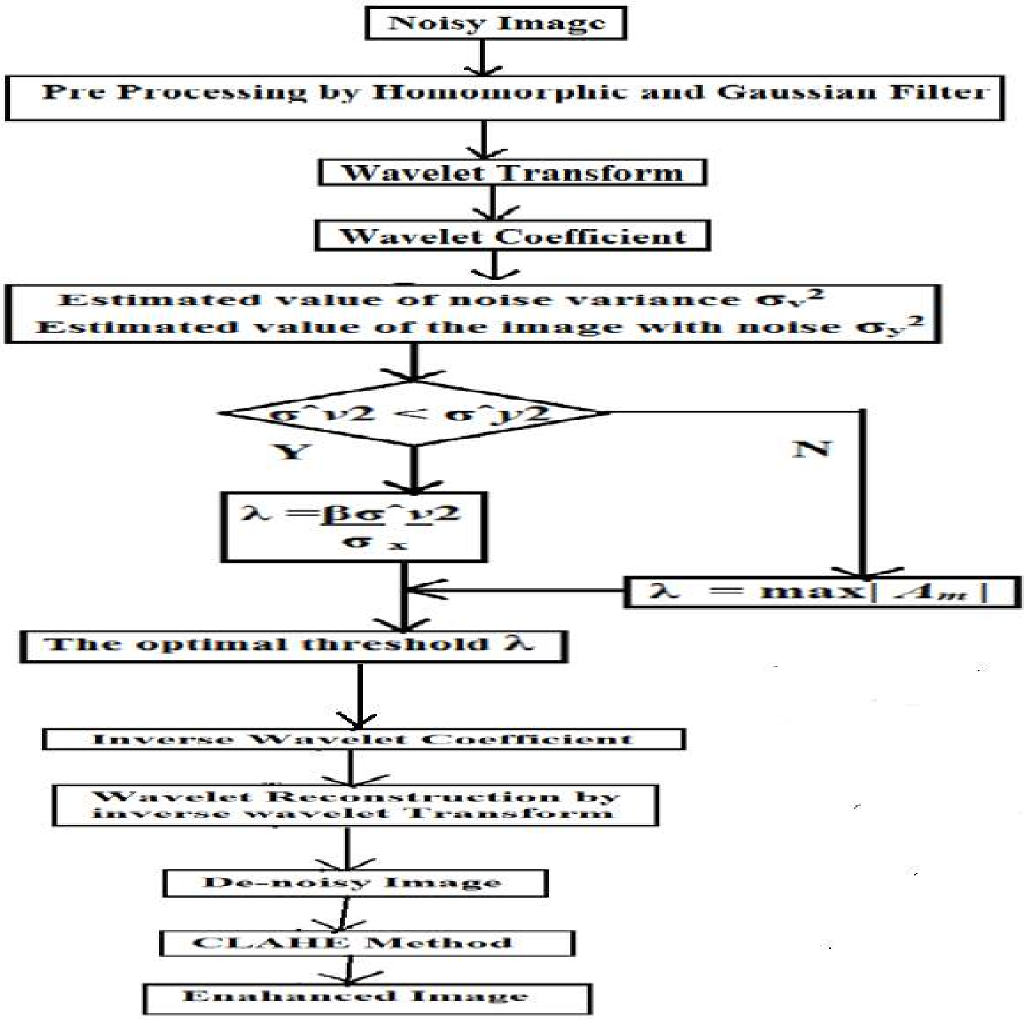


Fig (a) Flow Chart of proposed work

Wavelet Transform:

As proposed work uses Wavelet transforms which represent signals with a high degree of sparsity. This is the principle behind a non-linear wavelet based signal estimation technique known as wavelet de-noising. In this paper we explore wavelet de-noising of images. In this, a method to enhance contrast is proposed; the methodology consists in solving an optimization problem that maximizes the average local contrast of an image. The optimization formulation includes a perceptual constraint derived directly from human threshold contrast sensitivity function.

CLAHE :

Adaptive histogram equalization (AHE) is a computer image processing technique used to improve contrast in images. It differs from ordinary histogram equalization in the respect that the adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute the lightness values of the image. It is therefore suitable for improving the local contrast and enhancing the definitions of edges in each region of an image.

However, AHE has a tendency to over amplify noise in relatively homogeneous regions of an image. A variant of adaptive histogram equalization called contrast limited adaptive histogram equalization (CLAHE) prevents this by limiting the amplification.

Enhanced Image:

At the end we get enhanced image by the morphological operations that can first be defined on gray scale images where the source image is planar (single-channel). The definition can then be expanded to full-colour images.

Performance Metrics:

The four parameters are used for the performance evaluation of underwater images are as follows:

1. MSE: The Mean Square Error (MSE) represents the cumulative squared error between the compressed and the original image. The lower the value of MSE, the lower the error. The MSE is computed by using the following equation:

$$MSE = (\sum M,N - [I1(m,n) - I2(m,n)]2)/(M*N)$$

2.RMSE: The Root Mean Square Error (RMSE) (also called the root mean square deviation, RMSD) is a frequently used measure of the difference between values predicted by a model and the values actually observed from the environment that is being modelled. These individual differences are also called residuals, and the RMSE serves to aggregate them into a single measure of predictive power.

$$RMSE = \sqrt{(MSE(\emptyset))} = \sqrt{(E(\emptyset - \emptyset)2)}$$

3. PSNR: Compute peak signal-to-noise ratio (PSNR) between images. This ratio is often used as a quality measurement between the original and a compressed image. The higher the PSNR, the better the quality of the compressed, or reconstructed image.

$$PSNR = 10 \log 10 ((R^2)/MSE)$$

Where, R is the maximum fluctuation in the input image data type

4. Correlation: Compute the correlation coefficient between an image and filtered image. Digital image correlation is an optical method that employs tracking and image registration techniques for accurate 2D and 3D measurements of changes in images.

6. FINDINGS:

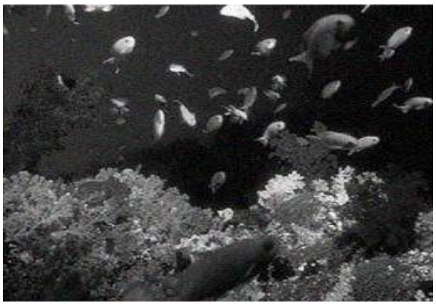
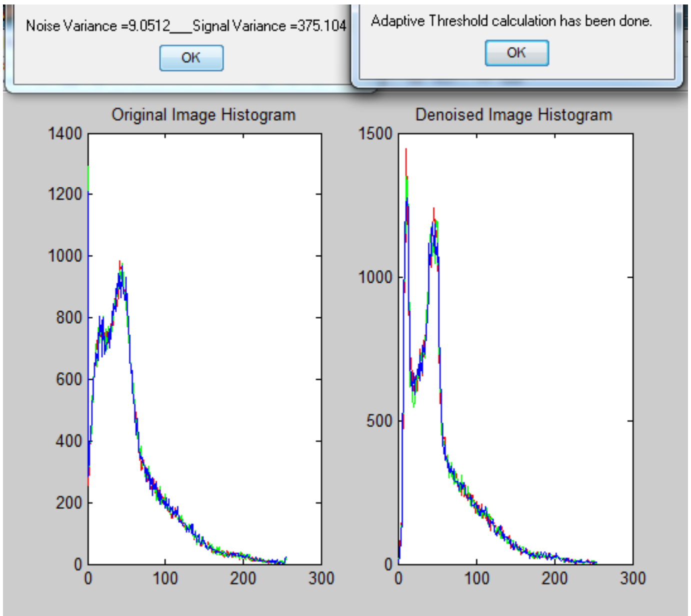
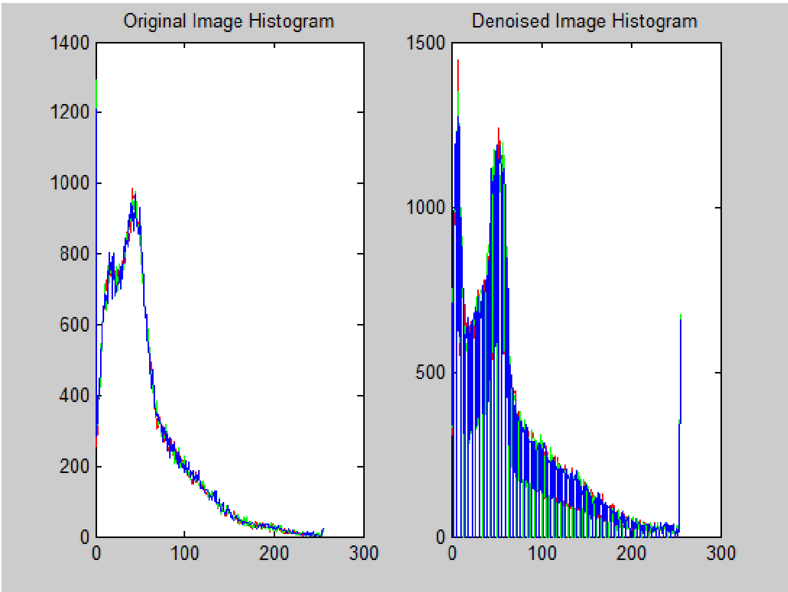


Image 1: Noisy Image

Image 2: Enhanced De-noised grey Image



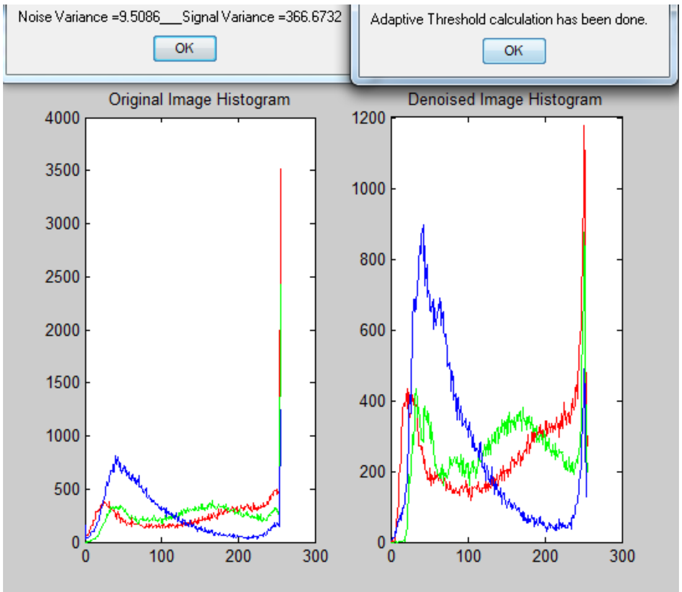
Graph 1: original image and de-noised image



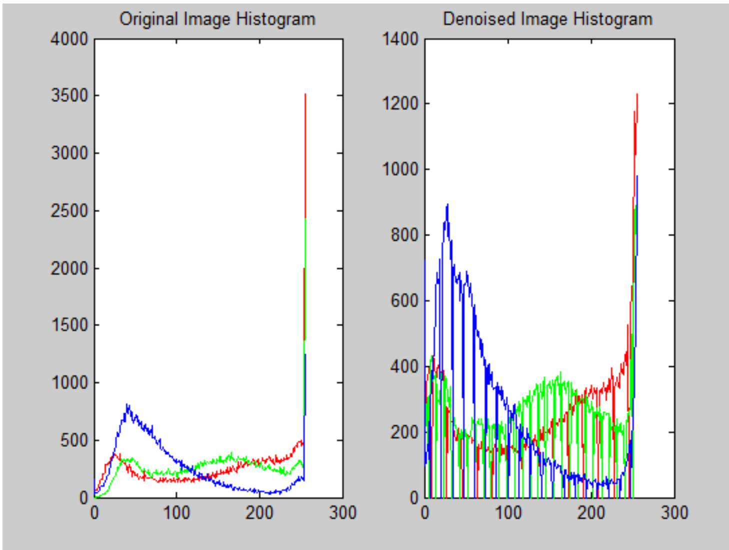
Graph 2: original image and Enhanced De-noised Image

Image 7: Noisy Image

Image 8: Enhanced De-noised colour Image



Graph 3: original image and de-noised image



Graph 4: original image and Enhanced De-noised Image

7. RESULT:

Paper	Parameter
new method proposed in the paper	PSNR-134.39 (Grey image) MSE-103.272 RMSE-4.8649e-005 Entropy-6.89601 Correlation-0.98566 PSNR- 140.484 (Colour image) MSE-6.24163 RMSE-2.41182e-005 Entropy-7.618 Correlation-0.995105

Table 1: Parameter for grey and colour image

8. CONCLUSION:

The obstacle correlate with finding image visibility of objects at long or short distance in underwater scenes presents a challenge to the image processing community. Nowadays, leading advancements in optical imaging technology and the use of cultivated sensing method is rapidly maximizing the ability to image objects in the sea. Above result we are conclude that input image into original wave light image and enhance image have much difference .There visibility much clear in enhance image.

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