

Review Article

Comparative Analysis of Various Underwater Image De-Noising Methods

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Abstract

Under Water Images are used for studying water life, for research work, for archeological surveys, etc. Due to bad environmental condition or due to improper acquisition process, such images may have noise in them. Image de-noising is used to remove the additive noise while retaining possible the important signal features. Object identification becomes a typical task, due to noise in it. Because of all these reasons, In this paper we introduced various image De-noising method and review the details of different systems developed so far. Here we attempted to analysis various De-noising method and classify them based on different factors, which leads to a better understanding on their operation. We also discuss the implementation details of these methods including the tools used by various authors and the metrics used to measure their performance.

Keywords: The Image De-noising, Underwater Images, PSNR, Wavelet Transformation.

1. Introduction

Currently, underwater image are gathered for studying underwater life, for some archaeological surveys and for research work, but under the influence of underwater special environment, the gathered images have different degrees of distortion and misrepresentation. Absorption and scattering are the two basic process of the light propagation in the water. The process of the light in water can influence the overall performance of underwater imaging system. Forward scattering generally leads to blurring of the image feathers and backscattering generally limits the contrast of the images. On the other hand, water and other plankton also make the light scattering serious. The above characteristics lead to uneven illumination, low contrast and poor quality of the image. Therefore, it is necessary to deal with such underwater images. A digital image is generally encoded as a matrix of grey-level or color values. The need for efficient image restoration methods has grown with the massive production of digital images and movies of all kinds, often taken in poor conditions. No matter how good cameras are, an image improvement is always desirable to extend their range of action.

Many researchers have developed techniques to de-noise and enhance underwater image, here, Section II presents literature concerning underwater images and work done till date, and Section III explains the

problem statement and related discussion. Section IV shows the comparative analysis of de-noising techniques and V concludes the paper.

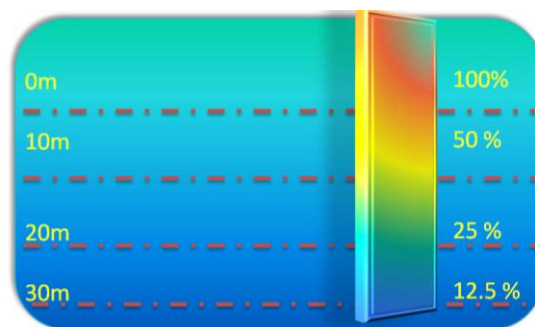


Figure1 Color Appearance and Visibility in underwater

2. Literature Survey

This section presents related literature concerning underwater image processing techniques.

LeiFei and Wang Yingying has proposed a paper “The Research of Underwater Image De-noising Method Based on Adaptive Wavelet Transform”, they have proposed a method based on adaptive wavelet combining adaptive threshold selection with adaptive output of the threshold function. The method proposed in this paper try to improve the results, by removing the noise, improve the contrast, by maintaining the quality of image (LeiFei and Wang Yingying, 2014).

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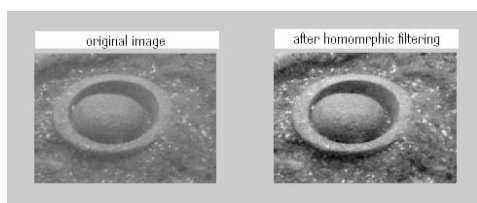
(a) Original image (b) Gaussian Filtered Image

Figure 2 Application of filtering method

In order to achieve better de-noising effect, authors have suggested doing some pre-processing before wavelet threshold de-noising. The pre-processing contains two steps, the first step, use of Homomorphic filtering technology to eliminate the non-uniform illumination and balance contrast. This step reduces the illumination changes, sharpen the edge details, preserve details and minimize the noise in the image. The second step, apply Gaussian low-pass filtering for smoothing image. It is used to smooth textures and reduce artifact by deleting small image features amplified by Homomorphic filtering. The image after adaptive wavelet transformation method is compared with hard threshold and soft threshold, but the method adaptive threshold with adaptive output of the threshold function yields a better result than hard/soft threshold.

Dr.G.Padmavathi, Dr.P.Subashini, Mr.M.Muthu Kumar and Suresh Kumar Thakur did a comparative study and proposed a paper "Comparison of Filters used for Underwater Image Pre-Processing", they have suggested that pre-processing should be necessarily done to correct and adjust the image for further study and processing. Recently, pre-processing is done only for correcting the non-uniform lights or color and intensity adjustment.

The authors have suggested the use of filters, the filters normally improve the image quality, suppress the noise, preserves the edges in an image, enhance and smoothen the image. They have posited three famous 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 is the best method, which gives desirable results in terms of Mean Square Error and Peak Signal to Noise Ratio.



(a) Original image (b) Filtered Image

Figure 3 Application of homomorphic filtering

Amine Mahiddine, Julien Seinturier, Jean-Marc Boi, Pierre Drap, Djamel Merad, has presented a paper on "Preprocessing Techniques on the Repeatability of SIFT and SURF Descriptors", The authors has explained the phenomena of light condition, both inside the water and outside water, Based on the study of light condition, they have proposed a preprocessing technique.

The underwater image pre-processing can be addressed from two different point i.e. image restoration or image enhancement methods, Image restoration techniques need some parameters such as attenuation coefficients, scattering coefficients and depth estimation of the object in a scene. For this reason in their works, the preprocessing of underwater image is devoted to image enhancement methods, which do not require a prior knowledge of the environment.

The proposed pre-processing technique works like, firstly each disturbance is corrected sequentially, then apply homomorphic filter for uniformity of illumination and to enhance the contrast in the image. Regarding the acquisition noise, which is often present in images, they applied wavelet de-noising followed by anisotropic filtering to eliminate unwanted oscillations. To finalize the processing chain a dynamic expansion is applied to increase contrast and equalizing the average colors in the image is being implemented to mitigate the dominant color.

J.N.Ellinas,T,Mandaelis, A.Tzortzis,L. Aslanoglou Has stated a paper "image de-noising using wavelets", they have proposed a adaptive method of image de-noising in wavelet sub band domain. This approach is based on threshold estimation for each sub band of the wavelet decomposition of noise-contaminated image, by considering that the sub band coefficients have a generalized Gaussian distribution.

The proposed de-noising algorithm is like, a four level DWT transforms the noise-corrupted image, then Estimate the noise standard deviation by employing a thresholding criterion. After this, For each sub band apply hard or soft threshold to the sub band coefficients and then Reconstruct the image by employing the inverse DWT (J.N.Ellinas,T,Mandaelis, A.Tzortzis,L. Aslanoglou,2003).

3. Proposed Work

This review paper covers the image de-noising techniques and the image quality enhancement using filters.

The atmospheric light is a major difficulty to process underwater images which comes from the poor visibility conditions under the water, scattering of light and light attenuation due to all the reasons the underwater images suffers a lot and affect their visibility and the contrast which they contain actually. Light attenuation limits the visible distance, at about 20 meters in clear water and 5 meters or less in turbid or less muddy water (Huimin Lu, Seiichi Serikawa, 2014). In this paper, we try to figure out, a common

better framework, which ensures a proper noise removal of underwater images.

Various Existing System are able to manage color and light consistency but are not able to remove noise correctly. Many important image features get diminished in the image. To overcome this problem, pre-processing is suggested to prepare the underwater images for further processing, using different filtering methods, which will strengthen the capture quality. Then apply adaptive wavelet transformation to the resultant image after preprocessing, should be done. This process will remove noise by retaining light and color consistency. Therefore, proper preprocessing along with adaptive wavelet transformation will help increases the peak signal to noise ratio (PSNR) of the image and obtain better de-noising effect (LeiFei, Wang Yingying, 2014).

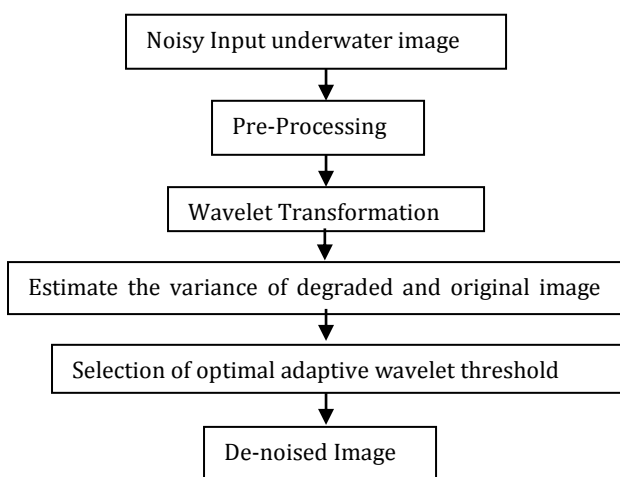


Figure 4 Proposed Work approach

Simple De-noising algorithms that use the wavelet transformation consist of three steps:

- Calculate the wavelet transform of the noisy signal,
- Modify the noisy wavelet coefficient according to some rule,
- Compute the inverse transform using the modified coefficients.

Wavelet Domain Advantages

Why we prefer De-noising in wavelet domain, because it has many advantage, like:

- Wavelet based de-noising provides multi resolution hierarchical characteristics. Hence an image can be de-noised at different levels of resolution and can be sequentially processed from low resolution to high resolution.
- High robustness as compared to common signal processing.

Conclusions

In this paper we explored and successfully reviewed various under water image de-noising methods, we

also studied some preprocessing methods whose purpose was to improve color and contrast of underwater images. This research has shown that it is in fact possible to remove noise effectively with the help of proper de-noising architecture.

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Authors brief Introduction

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References

- LeiFei, Wang Yingying(2014),The Research of Underwater Image De-noising Method Based on Adaptive Wavelet Transform,*IEEE Image Proceedings*.
- Huimin Lu, Seiichi Serikawa(2014), A Novel Underwater Scene Reconstruction Method, *International Symposium on Computer, Consumer and Control*.
- Miao Yang, Member, Arcot Sowmya(2014),New Image Quality Evaluation Metric for Underwater Video, *IEEE Signal processing*,Vol. 21.
- Huimin Lu, Seiichi Serikawa(2014) ,Underwater Scene Enhancement Using Weighted Guided Median Filter.
- Shiwam Thakare, Amit Sahu(2014), Comparative Analysis of various Underwater Image Enhancement Techniques,*IJCSMC*.
- Lixin Liu, Hongyu Bian(2013),An Effective Wavelet-based Scheme for Multifocus, Image Fusion,*IEEE proceedings*.
- Akira Yamawaki, Shiyuan Yang, Seiichi Serikawa (2013), Underwater Optical Image Dehazing Using Guided Trigonometric Bilateral Filtering, *IEEE proceedings*.
- Muhammad Suzuri Hitam, Ezmahamrul Afreen Awalludin(2013),Mixture Contrast Limited Adaptive Histogram Equalization for Underwater Image Enhancement, *IEEE proceedings*.
- Huimin Lu, Yujie Li, Seiichi Serikawa(2013),Underwater Image Enhancement Using Guided Trigonometric Bilateral Filter And Fast Automatic color correction,*IEEE proceedings*.
- Amine Mahiddine, Julien Seinturier, Jean-Marc Boi, Pierre Drap, Djamel Merad(2012), Performances Analysis of Underwater Image Preprocessing Techniques on the Repeatability of SIFT and SURF Descriptors,*IEEE proceedings*.
- Amit Sahu, Vijaya K. Shandilya(2012),Infrared Image Enhancement Using Wavelet Transform,*IJERA*, Vol. 2, Issue 2, pp.026-031.
- Dr.G.Padmavathi, Dr.P.Subashini, Mr.M.Muthu Kumar and Suresh Kumar Thakur(2010),Comparison of Filters used for Underwater Image Pre-Processing, *IJCSNS International Journal of Computer Science and Network Security*, VOL.10 No.1.
- A. Buade, B. Coll, And J. M. Morel, A Review Of Image Denoising Algorithms(2005), With A New One , *Society For Industrial And Applied Mathematics*.
- J. N. Ellinas, T. Mandadelis, A. Tzortzis, L. Aslanoglou (2003), "Image de-noising using wavelets",
- Lakhwinder Kaur , Savita Gupta(2003), Image Denoising using Wavelet Thresholding
- J.N.Ellinas,T. Mandadelis(2003),Image de-noising using wavelet.