



Analysis Of Underwater Image De-Hazing Approaches: A Perspective View

Priya Jha¹, Keerti Gupta²

¹Assistant Professor, ²PG Scholar
ECE, MIT, Bhopal, Madhya Pradesh, India

ABSTRACT

Image de-hazing is one of the pre-processing steps in various computer vision applications. It is the process of improving the quality of image without any information loss. Usually the images are affected by various facts. Especially in underwater imagery, the haze and hue variations are greatly affected. This paper discusses the issues in underwater images and compares the existing image enhancement techniques for underwater images.

Keywords: Underwater images, Enhancement, Contrast stretching, Histogram Equalization, Color correction

I. INTRODUCTION

Underwater images are corrupted due to scatters and amalgamation, resulting in low contrast and color distortion. Captured underwater images suffer from poor visibility. It is hard to acquire visible agreeable images at long or short distances due to the absorptive and dispersion nature of sea water. Noises diminish the details that could contain significant information. Thus, super-resolving underwater speckled images are important for ocean observation. These images frequently suffer from color distortion and low contrast due to the propagated light reduction with distance from the camera, mainly resulting from absorption and scattering effects. Even though there are many image enhancing techniques developed, such as white balance, color correction, histogram equalization, and fusion-based methods [1], they are not based on a physical model underwater, and thus are not applicable for underwater images with different physical properties. It is challenging to restore underwater images because of the deviation of physical properties. Light reduction underwater [2] leads to different degrees of color change, depending

on wavelength, dissolved organic compounds, water salinity, and concentration of phytoplankton [3].

II. LITERATURE SURVEY

Various image enhancement techniques are proposed in the literature. Haze in underwater image is reduced by dark channel. Hue variations are minimized by wavelength compensation [4]. Underwater images have low deceivability, small divergence and lessening hues [5]. A new scheme for enhancing ocean optical images whereas light traveling in the water, lights is distorted based on the wavelength [6]. Improve the nature of underwater images that has been debased due to various twists [7]. John Y. Chiang and Ying - Ching Chen.[8] proposed an algorithm that uses WCID which helps in efficiently restoring image color balance and remove haze. Naim and Isa [9] proposed a method called pixel distribution shifting color correction (PDSCC) for digital color image to correct the white reference point and ensure that the white reference point is achromatic.

Rizzi et al.[10] proposed unsupervised digital image color equalization with simultaneous global and local effects. Schechner and Karpel[11,12] analyzed the physical effects of visibility degradation and devised an image recovery algorithm based on several images taken through a polarizer at different orientations. Trucco and Olmos-Antillon[13] proposed a self-tuning image restoration filter that simplifies Jaffe[14] and McGlamery[15]. Shelda Mohan and T.R. Mahesh, 2013[16] has presented Particle Swarm Optimization (PSO) for tuning the enhancement parameter of Contrast Limited Adaptive Histogram Equalization relied on Local Contrast Modification (LCM). ICM [17] and UCM [18] are the popular

techniques that use the histogram modification technique to increase the quality of underwater image. ICM and UCM methods give a better result of underwater image in terms of contrast. Objects in the image are recognized from the original image efficiently. The main disadvantage is that it does not drastically improve the image contrast as more blue-green illumination retains in the output image. Unsupervised Color Correction Method (UCM), which can powerfully remove bluish color cast, increase the low red and low illumination problem in order to achieve high quality images for scientific purpose. There are three stages: equalize the RGB, contrast correction of RGB and then contrast correction of HSI. These three stages are applied to every pixel of the image to produce the correct value for the pixel.

Garcia et al. [19] gave an analysis and comparison of various techniques for dealing with the problems of underwater images which are deal with no uniform illumination, low contrast in underwater images.

Tarel et al. [20, 21] propose an algorithm to preprocess underwater images. It reduces underwater perturbations and improves image quality. It is composed of several successive independent processing steps which correct non uniform illumination (homographic filtering), suppress noise (wavelet de-noising), enhance edges (anisotropic filtering) and adjust colors (equalizing RGB channels to suppress predominant color). The algorithm is automatic and requires no parameter adjustment.

III. IMAGE DEHAZING TECHNIQUES FOR UNDERWATER IMAGE

Image intensification is a process of improving the quality of image by improving its features. There are three methods for image intensification for underwater images: Contrast stretching, Histogram equalization and Contrast limited adaptive histogram equalization. A number of contrast measures were proposed for complex images as underwater images. Contrast stretching is a straightforward image enhancement method that is used to improve, enhance the image contrast by 'stretching' the series of intensity values.

A measure of image's dynamic range or the "broaden" of image's histogram is the contrast of an image. Whole range of intensity values present within the image, or in a easier way, the minimum pixel value

subtracted from the maximum pixel value is called dynamic range of image. It differs from the more complicated histogram equalization in a way that it can only concern a linear scaling function to the image pixel values. There are many applications; there is a need for flat histogram. This cannot be achieved by histogram stretching. So Histogram Equalization can be used here. A perfect image has equal number of pixels in all its grey levels. Hence to get a perfect image, the objective is not only to spread the dynamic range, but also to have has equal number of pixels in all its grey levels. This technique is known as Histogram Equalization (HE). Histogram equalization maps grey levels r of an image into grey levels s of an image in such a way that grey levels s are uniform.

This expands the range of grey levels (contrast) that are near the histogram maxima, and compresses the range of grey levels that are near the histogram minima. For most images, the contrast is usually expanded for most pixels, improving many image features. Contrast Limited Adaptive Histogram Equalization (CLAHE) was originally developed for medical imaging and has proven to be successful for enhancement of low-contrast images such as portal films. The CLAHE algorithm partitions the images into contextual regions and applies the histogram equalization to each one. This evens out the distribution of used grey values and thus makes hidden features of the image more visible. The full grey spectrum is used to express the image.

IV. CONCLUSION

This review paper discuss the image enhancement techniques for underwater images and issues in it. Obtaining visibility of objects at long or short distance in underwater scenes is very difficult and is challenging task. The atmospheric light is a major difficulty to process underwater images 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. The enhanced images provide more interpretability, visibility and are better in terms of color and clarity. Further improvement a color correction quality is employed to enhance the color contrast of the object in underwater and remove different noise particles. The presented strategies have ignored the methods to lessen the noise issue, which is available in the resultant pictures of the current image

improvement procedures. This is the further directions of the research.

V. TOOLS RELATED TO IMAGE DEHAZING

Image dehazing technique can be implements with MATLAB R2013 version which is described below.

MATLAB is a high-performance, efficient and interactive language for technical computing environment. It integrates Computation, visualization, graphical, processing and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical syntactic notation and graphical form. Typical uses include mathematical matrix form and other computation algorithm development Data acquisition Modeling, image processing, Data processing, simulation, and prototyping Data analysis, exploration, and visualization Scientific and engineering drawing and graphics Application development, including graphical user interface building MATLAB(A Technical Computing Tool) is an interactive programming tool whose basic data element is an array (Matrix form) in different dimensional scheme, that does not require to specify dimensioning. This allows you to solve many technical computing problems in different format, especially those with matrix and vector formulations, in a small fraction of the time it would take to write a program in a specific scalar non interactive language like as C or FORTRAN. The name MATLAB is stands for matrix laboratory. MATLAB is used in every facet of computational mathematics. Following are some commonly used mathematical calculations where it is used most commonly: Dealing with Matrices and Arrays, 2-D and 3-D Plotting and graphics, Linear Algebra, Algebraic Equations, Non-linear Functions, Statistics, Data Analysis, Calculus and Differential Equations, Numerical Calculations, Integration, Transforms, Curve Fitting, Various other special functions.

MATLAB has evolved over many periods of years with different input from many more users. In university research environments, it is the standard and efficient instructional tool for introductory and advanced courses in mathematics, engineering, and medical science. In engineering industry, MATLAB is the tool of choice for better high-productivity research, development, proactive and analysis. MATLAB provide basic features a family of add-on

application-specific solutions called toolboxes. Very most important to most and licensed users of MATLAB, toolboxes allow you to learn and apply specialized computing technology. The basic features of MATLAB are as follows:

1. It is a high-level language for numerical computation, visualization and application development.
2. It also provides an interactive environment for iterative exploration, design and problem solving.
3. It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.
4. It provides built-in graphics for visualizing data and tools for creating custom plots.
5. MATLAB's programming interface gives development tools for improving code quality and maintainability and maximizing performance.
6. It provides tools for building applications with custom graphical interfaces.
7. It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and Microsoft Excel.

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams. It is used in a range of applications including: Signal Processing and Communications, Image and Video Processing, Control Systems, Test and Measurement, Computational Finance, Computational Biology.

VI. REFERENCES

1. Codruta O. Ancuti, Cosmin Ancuti, Christophe De Vleeschouwer and Philippe Bekaert, "Color Balance and Fusion for Underwater Image Enhancement", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 27, NO. 1, JANUARY 2018.
2. Nan Wang, Haiyong Zheng and Bing Zheng, "Underwater Image Restoration via Maximum Attenuation Identification", IEEE Access Journal, 2017.
3. Huimin Lu, Yujie Li, Shota Nakashima, Hyongseop Kim, Seiichi Serikawa, "Underwater Image Super-resolution by Descattering and Fusion", IEEE Access Journal, 2017.
4. Shu Zhang, Ting Wang, Junyu Dong, Hui Yu, "Underwater image enhancement via extended

- multi-scale Retinex”, *International Journal of Signal Processing*, homepage: www.elsevier.com/locate/neucom, 2017.
5. Kanisetty Venkata Swathi, CH. Hima Bindu, “Modified Approach of Multimodal Medical Image Fusion Using Daubechies Wavelet Transform”, *International Journal of Advanced Research in Computer and Communication Engineering* Vol. 2, Issue 11, November 2013.
 6. Oliver Rockinger, “Image Sequence Fusion Using a Shift-Invariant Wavelet Transform”, *Systems Technology Research, Intelligent Systems Group*.
 7. Parul Shah, Shabbir N. Merchant, Uday B. Desai, “An Efficient Adaptive Fusion Scheme for Multifocus Images in Wavelet Domain Using Statistical Properties of Neighborhood”, 14th International Conference on Information Fusion Chicago, Illinois, USA, July 5-8, 2011.
 8. G Geetha, S. Raja Mohammad, Dr. Y. S. S. R. Murthy, “Multifocus Image Fusion Using Multi resolution Approach with Bilateral Gradient Based Sharpness Criterion”, *CS & IT-CSCP* 2012.
 9. M. Xu, H. Chen, and P. Varshney, “An image fusion approach based on markov random fields,” *IEEE Trans. Geosci. Remote Sens.*, vol. 49, no. 12, pp. 5116–5127, Dec. 2011.
 10. K. He, J. Sun, and X. Tang, “Guided image filtering,” in *Proc. Eur. Conf. Comput. Vis.*, Heraklion, Greece, Sep. 2010, pp. 1–14.
 11. Z. Farbman, R. Fattal, D. Lischinski, and R. Szeliski, “Edge-preserving decompositions for multi-scale tone and detail manipulation,” *ACM Trans. Graph.*, vol. 27, no. 3, pp. 67-1–67-10, Aug. 2008.
 12. B. L. McGlamery, “A computer model for underwater camera systems,” *Proc. SPIE*, vol. 208, pp. 221–231, Oct. 1979.
 13. J. S. Jaffe, “Computer modeling and the design of optimal underwater imaging systems,” *IEEE J. Ocean. Eng.*, vol. 15, no. 2, pp. 101–111, Apr. 1990.
 14. H. Koschmieder, “Theorie der horizontalen sichtweite,” *Beitrage Phys. Freien Atmos.*, vol. 12, pp. 171–181, 1924.
 15. M. Levoy, B. Chen, V. Vaish, M. Horowitz, I. McDowall, and M. Bolas, “Synthetic aperture confocal imaging,” in *Proc. ACM SIGGRAPH*, Aug. 2004, pp. 825–834.
 16. S. K. Nayar and S. G. Narasimhan, “Vision in bad weather,” in *Proc. IEEE ICCV*, Sep. 1999, pp. 820–827.
 17. J. Kopf *et al.*, “Deep photo: Model-based photograph enhancement and viewing,” *ACM Trans. Graph.*, vol. 27, Dec. 2008, Art. no. 116.
 18. R. Fattal, “Single image dehazing,” in *Proc. ACM SIGGRAPH*, Aug. 2008, Art. no. 72.
 19. K. He, J. Sun, and X. Tang, “Single image haze removal using dark channel prior,” in *Proc. IEEE CVPR*, Jun. 2009, pp. 1956–1963.
 20. J.-P. Tarel and N. Hautiere, “Fast visibility restoration from a single color or gray level image,” in *Proc. IEEE ICCV*, Sep. 2009, pp. 2201–2208.
 21. J.-P. Tarel, N. Hautiere, L. Caraffa, A. Cord, H. Halmaoui, and D. Gruyer, “Vision enhancement in homogeneous and heterogeneous fog,” *IEEE Intell. Transp. Syst. Mag.*, vol. 4, no. 2, pp. 6–20, Aug. 2012.
 22. L. Kratz and K. Nishino, “Factorizing scene albedo and depth from a single foggy image,” in *Proc. IEEE ICCV*, Sep. 2009, pp. 1701–1708.
 23. C. O. Ancuti and C. Ancuti, “Single image dehazing by multi-scale fusion,” *IEEE Trans. Image Process.*, vol. 22, no. 8, pp. 3271–3282, Aug. 2013.
 24. H. Horvath, “On the applicability of the koschmieder visibility formula,” *Atmos. Environ.*, vol. 5, no. 3, pp. 177–184, Mar. 1971.
 25. C. Ancuti, C. O. Ancuti, C. De Vleeschouwer, and A. Bovik, “Night-time dehazing by fusion,” in *Proc. IEEE ICIP*, Sep. 2016, pp. 2256–2260.