JOURNAL OF INFORMATION, KNOWLEDGE AND RESEARCH IN
COMPUTER ENGINEERING

PROPOSED APPROACH FOR DE-SCATTERING AND CLASSIFICATION IN UNDERWATER IMAGE

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ABSTRACT : *There are two major issues called scattering and color change in underwater optical imaging. Many conventional methods aimed at improving visibility in low cloudy water. High cloudy underwater image enhancement is still an opening issue. To detect and recognize objects in underwater requires complex algorithms to operate in cloudy water. There is still an issue with high cloudy underwater image enhancement. In past few years researchers applied some algorithms for image de-scattering and color correction methods to enhance high cloudy water images. Here we propose some technique for underwater de-scattering. This enhanced method used to remove scatter in cloudy water image. We also use some machine learning techniques for classification of image such as support vector machine with histogram of oriented gradients features.*

Keywords— Image Processing, Underwater Imaging, HOG (Histogram of Oriented Gradients), SVM (Support Vector Machine), De-Scattering, Classification

I. INTRODUCTION

The objects in underwater images are not clearly visible due to scattering of light and contrast and the noise or dullness present in underwater image.

There are some de-scattering methods and color distortion methods used by researchers to remove scatter and color correction in image. SR method is used for recovering distorted image in high turbid water. This method overcome the artifacts in high turbid water[1-3]. There are numerous approaches for image enhancement and image restoration are available, but there are only few approaches for underwater images. These are summarized in paper[4].

A joint normalized filter to refine the coarse depth map that outperform convention methods. More comprehensive image quality assessment index that can measure the underwater image quality better than the traditional approaches [5].

Underwater images have poor visibility due to medium and scattering of light. Joint trilateral filter can remove the dark fields of underwater images by refining the transmission depth map through trilateral filtered source image and estimates depth. Simple prior based on difference in attenuation among the different color channels [6-8].

Underwater image color correction and de-scattering is major issue. The novel approach is given for underwater optical image. By estimating depth map through dark channels. And second considering the position of the lightning lamp, camera and imaging plane, they developed rational imaging model[9].

Contrast enhancement techniques and the quality assessment method for image in high turbid water. The major issue of scatter removal and color correction is covered in underwater image by using deep neural network[10].

Image restoration and color change in underwater image is

II. LITERATURE SURVEY

A. Underwater imaging model:

In the optical model, the acquired image can be modeled as being composed of two components. One is the direct transmission of light from the object, and the other is the transmission due to scattering by the particles of the medium (e.g. airlight). Mathematically, it can be written as,

$$I(x) = J(x)t(x) + (1 - t(x))A \qquad (1)$$

where I is the achieved image. J is the scene radiance or haze-free image, t is the transmission along the cone of vision, and t(x) = $e^{-\beta d(x)}$, b is the attenuation coefficient of the medium, d(x) is the distance between the camera and the object, A is the veiling color constant and x = (x,y) is a pixel. The optical model assumes linear correlation between the reflected light and the distance between the object and observer. The light propagation model of Eq. (1) is slightly different from the underwater environment. In the underwater optical imaging model, absorption plays an important role in image degradation. Furthermore, unlike scattering, the absorption coefficient is different for each color channel, being the highest for red and lowest for blue in seawater. These are expressed by the following simplified hazy image formation model based on Eq. (1):

$$\begin{aligned} I(x) &= J(x)\, e^{-(\beta s+\beta a)d(x)} + (1 - e^{-\beta s d(x)})A \\ &= J(x)\, e^{-\beta s d(x)} \cdot J(x)\, e^{-\beta a\, d(x)} + (1 - e^{-\beta s d(x)})A, \\ &= K \cdot J(x)\, e^{-\beta s d(x)} + (1 - e^{-\beta s d(x)})A \\ &= K \cdot J(x)\, t(x) + (1 - t(x))A \end{aligned}$$

(2)

where βs is the scattering coefficient, βa is the absorption coefficient of light, and K is a constant. In this paper, we simplify the model at a certain water depth, where the transmission t is defined only by the distance between the camera and scene (see Fig. 1), which is slightly modified by Schechner' underwater imaging model [11]. In addition, we assume the term for the absorption coefficient is constant. With these simplifications, Eq. (2) can be easily computed as well as Eq. (1).

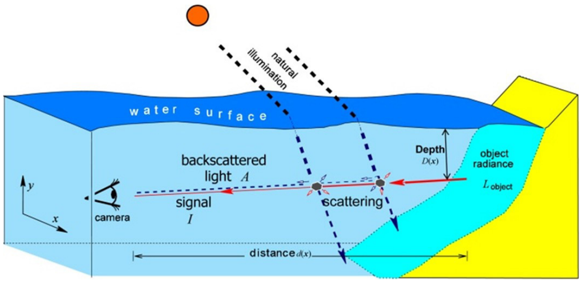


Fig. 1. Underwater optical imaging model (Y. Schechner et al.).

The modified method for underwater imaging model is as follows:

$$I^c(x) = J^c(x)e^{-\eta d(x)} + \rho(x) \cdot J^c(x)(1 - e^{-\eta d(x)}),\ c \in \{r, g, b\} \quad (3)$$

where $J^c(x)$ is the real scene at depth D, $\rho(x)$ is the normalized radiance of a scene point, $d(x)$ is the distance from the scene point to the camera, and η is the total nonlinear beam attenuation coefficient.

B. *Depth map and estimating transmission*[10]*:*

In the same depth, the natural illumination changes slightly according water quality. Take the maximum intensity of the red color channel to compare with the maximum intensity of the green and blue color channels. We define the dark channel $\tilde{d}(x)$ for the underwater image as,

$$\tilde{d}(x) = \min_{\Re(m,n)} \left(\min_{c\in\{r,b\}} \frac{I^c(x)}{\rho(x) \cdot J^c(x)} \right),\ c \in \{r, b\} \quad (4)$$

where $\Re$ is a square patch of size 5×5. For each pixel located at position (m, n) in the patch $\Re$, the pixel values from the red color channel and blue color channel are compared, and the lower value is selected. Then, the depth map is calculated by:

$$d(x) = 1 - \omega\tilde{d}(x), \quad (5)$$

where ω is chosen as 0.8 in most cases

Depth map contains ring artifacts and yields less accurate de-scattering results. Therefore, we have developed a joint guidance image filter to reduce such artifacts. The normalized image is obtained as follows:

$$I^c_f(x) = \begin{cases} \frac{I^c(x) - I^c_{\min}(x)}{I^c_{\max}(x) - I^c_{\min}(x)}, & if\ 0 < I^c(x) < 1 \\ 0, & if\ 0 > I^c(x) \\ 1, & if\ 1 < I^c(x) \end{cases},\ c \in \{r, g, b\}$$

(6)

C. *Color correction:*

After depth map and estimating transmission colors are distorted. The physical spectral characteristics based color correction method is used to adders this distortion.

We consider the effect of artificial lights. We take the chromatic transfer function (CTF) τ to weight the atmospheric light from the water surface to a given water depth of objects as follows:

$$\tau_\lambda = \frac{E_\lambda^{surface}}{E_\lambda^{object}} \quad (7)$$

where CTF τ at wavelength λ is derived from the irradiance of the water surface $E_\lambda^{surface}$ by the irradiance of the object E_λ^{object}. Next, we convert τ in different wavelength to the RGB domain as follows:

$$J^c_\lambda(x) = \nu_{RGB} \cdot \hat{J}^c_\lambda(x) \cdot \tau_{RGB} \quad (8)$$

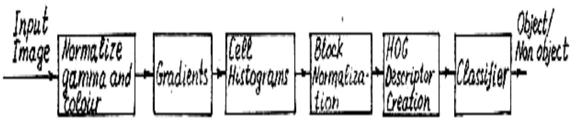
where the weighted RGB transfer function is τ RGB, and Cc(λ) is the underwater spectral characteristic function of the color band c, c∈{r,g,b}. Considering the spectral power distribution transfer function, the finally corrected image is gathered as follows:

$$\tau_{RGB} = \int_{400nm}^{725nm} \tau_\lambda \cdot C_c(\lambda) d\lambda,\ c \in \{r, g, b\} \quad (9)$$

where $J_\lambda^c(x)$ is the color corrected image and $\hat{J}_\lambda^c(x)$ is uncorrected images. ν_{RGB} is the spectral power distribution transfer function. It can be measured by spectrometer.

III. PROPOSED APPROACH

De-scattering and color distortion can be achieve by neural network approach as given above. Now we are working on with new approach. In which HOG(Histogram of Oriented Gradients) feature is used with SVM(Support Vector Machine) classifier. An algorithm is as follows:



This method is to detect an object and then remove scatter from image and color correction in underwater image. By applying HOG feature with SVM classifier we can get much more clarity in underwater image. Here SVM classifier is used and function as follow:

$$f(\vec{x}) \leftarrow sgn\left(\sum_{s_i \in support\ vectors} \alpha_i y_i \vec{s}_i \cdot \vec{x} + b \right), where\ sgn = \begin{cases} -1\ when\ x < 0, \\ 0\ when\ x = 0, \\ 1\ when\ x > 0. \end{cases}$$

(10)

Here, α_i is the Lagrange multiplier, y_i is the labels of the support vectors, $\vec{s}_i$ is the support vectors, and $\vec{x}$ is our input feature vector.

Conclusion

In this paper we summarized all available approaches for underwater image de-scattering and color distortion. We summarize methods for denoising underwater image. In this a joint guidance image filter for refining the coarse depth map[7]. We proposed new approach for de-scattering and classification for underwater image. For that we used SVM classifier with HOG feature for inhomogeneous scatter removal.

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