Algorithm to improve underwater object recognition using ROV

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1. Introduction

In the past few years, research on image improvement methods has been conducted, but research on image improvement methods for underwater images is difficult due to environmental characteristics such as light distortion and scattering in the underwater environment.[1)]

Many prior studies have already been conducted on the fog removal technique, and the dark channel dictionary technique focusing on the fact that all RGB component values of white fog distributed in the air are large is a representative example.[2)] However, unlike aerial fog images, underwater images deteriorate in quality such as color distortion and sharpness due to attenuation according to the wavelength of light.

In the imaging, Gaussian noise is removed effectively by low-pass filtering and blurring, but the impulse noise is not almost giving an influence. In this paper, the impulse noises are dealing with the method of Hybrid Median Filter based on mask that is used in the field of imaging.[3)] Also, the method of data acquisition is dealing with in order to apply the Hybrid median filter.

2. Problems of Underwater Imaging

In this chapter, the light changes according to the unique environment of the sea, and there are several problems with underwater images that affect the color of the image. Because seawater is 800 times more dense than air, when light travels from air to water, only part of light enters the water by reflection, and the light decreases as the depth of the water increases.[4)] Therefore, as the depth of the sea increases, the amount of light decreases and it becomes darker.[5,6)]

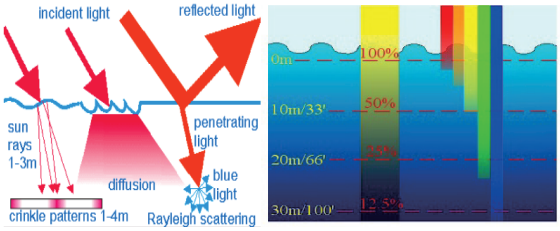

Fig. 1 Water surface effect by light and Light transmittance according to depth vs Raman-Nath parameter.

3. Extreme Condition Test

As described in the previous chapter, image processing has been performed through the process of reducing blurring, color distortion, and contrast, which are characteristics of underwater image quality. The ROV used in this experiment that an Interesting Water Drone (IWD) manufactured by CiLab, which records 1080 full HD images.

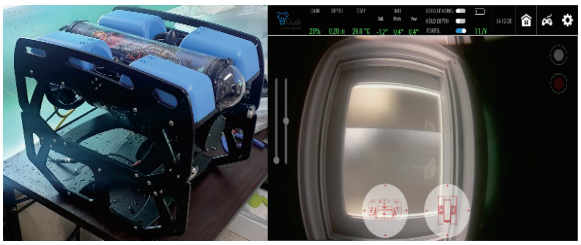

Fig. 2 ROV platform used underwater photograph.

3.1 Dark Channel Prior Algorithm

The blurring phenomenon refers to the reduction of image clarity as light reflected from an object is forward scattered and then projected onto the camera. The blurring phenomenon has been solved using the Dark Channel Prior algorithm.

3.2 Gray world color distortion restoration

The light attenuation according to the wavelength of light in water restored color distortion through the gray world algorithm. This paper assumes that the average value of all colors in the observed image is gray because various objects are evenly distributed in the colors observed in the underwater image.

Figure. 4(b) is an image to which the gray world algorithm has been applied, and brightness compensation has been performed after obtaining the average of the brightness values of each color channel. In addition, the brightness value of each channel was scaled to be 127.5 to maintain the appropriate level of brightness of the underwater image.

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3.3 Hybrid median filter

Hybrid median filter is used as the algorithm focused on border conservation. However, this algorithm has a limit to the removal of Gaussian noise. The concept of filtering in this algorithm is extraction of mask, odd by odd number, from images. From the mask extracted, each group of diagonals, reverse diagonal, central vertical and central horizon are obtained. After sorting each group, the median value of each group is obtained. And the median value of mask and the median value of each group are sorted and the median value is obtained. The median value is inserted into the image pixels in order to eliminate the impulse noise. In this paper, 5 by 5 image mask is used to eliminate impulse noise.

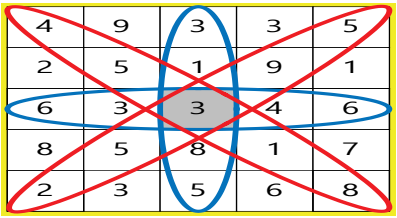
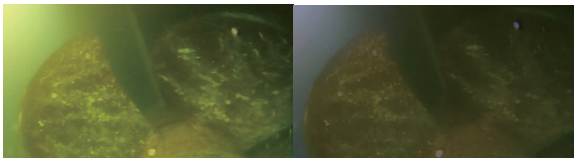


Fig. 3 Hybrid median mask.

The PSNR is an objective picture quality measurement method for maximum signal-to-noise ratio, primarily used to evaluate the information loss of quality images or videos loss compression. About the power of the signal without taking into account the maximum signal-to-noise ratio can be calculated using the mean squared error. Calculation is the equation.[1)]

$$PSNR = 10 \times \log_{10}\left(\frac{255^2}{MSE}\right) \quad (1)$$

From equation (1), 8bit sample images, as the maximum value of 255 can be obtained by subtracting the minimum value from the maximum value of the corresponding channel. If the loss is small, the PSNR has a high value.



(a) original image (b) Gray world algorithm applied image

Fig. 4 Image applied hybrid median filtering.

Table I. Peak Signal-to-noise ratio.

Filter type	PSNR (dB)
Block type median filter	8.0986
Diamond type median filter	8.3340
Applied hybrid median filter	19.6254

Figure 4 is the result of applying the three algorithms mentioned above in combination, and is an image in which light scattering has been removed and light attenuation has been restored to increase sharpness.

4. Conclusion

In this paper, by using the camera mounted on the ROV, the noise of the underwater image, the illuminance and clarity of the image have been improved, and the result has been obtained to increase the visibility distance of the underwater image and the recognition rate of the object. Based on these results, we plan to conduct a research on underwater mapping for a distance estimation method using visual odometry. Hybrid Median Filter for Autonomous Navigation for the ROV so that it can be used for real-time systems is expected to implement.

Acknowledgment

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