Underwater Image Enhancement and Recovery

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Abstract

In recent years, as the necessity for underwater environmental sensing has expanded, underwater picture color technology has been rapidly developed and widely used in underwater robotic surveys, marine biomonitoring, and naval applications. As a result of light absorption and dispersion, underwater pictures usually suffer from low contrast, detail blurring, and color distortion. At greater depths, this is especially true. Due to the natural occurrence of light deterioration in waterWe compare two of the more popular methods nowadays, image recovery and image enhancement. To train and test our model, we will use open-source datasets. We also run many qualitative and quantitative tests, such as PSNR and SSIM, to see if the proposed model can learn to improve underwater image quality. Finally we create a GUI that shows the difference by interacting with the audience.

1 Background

The undersea environment has steadily transformed into a new world center, owing to increased resource scarcity and the ongoing expansion of the global economy and international relations in recent years. One of the most crucial components for the sustainability of human civilization is the underwater environment, which contains innumerable biological resources and large amounts of untapped energy. People regularly use video or images to gather important information when researching the undersea environment. The challenges of underwater optical imaging are far greater than those of air optical imaging. Standard underwater optical imaging cannot guarantee high performance since light traveling underwater suffers from substantial absorption, scattering, color distortion, and noise caused by artificial light sources. The majority of light energy is absorbed by water particles, resulting in images that are dull and blurry. By causing a series of light direction changes interacting with particles in the water, the scattering process creates a hazy effect (e.g., sand, plankton, etc). This ailment is similar to how foggy weather impairs outdoor vision. This optical degradation substantially hinders the research of the deep world. As a result, if we want to continue exploring the oceans, we'll need to take steps to restore the color of the underwater images.

2 Dataset

Any code that may be referenced is open source and available for public use for any purpose (including commercial purposes) or modification of its original design. The dataset I want to use is open source and we can download form the official website.For the project, I want to use a mixed datadset such like the EUVP (Enhancing Underwater Visual Perception) dataset, which contains separate sets of paired and unpaired image samples of poor and good perceptual quality to facilitate supervised training of underwater image enhancement models [1], UIEB [2], and so on.

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3 Project tasks

3.1 Tasks Introduction

As a result of light absorption and dispersion, underwater pictures usually suffer from low contrast, detail blurring, and color distortion. This is especially true at greater depths, where red light fades out completely by 5 m and green light fades out completely by 40 m.

There are many ways to implement underwater color recovery, and so we classify them into two categoriesenhancement methods and recovery methods. The recovery methods target the cause of image degradation and rely on specific models. Underwater image degradation is caused by the medium, which is similar to images taken on foggy days, both of which show foggy blur due to medium scattering, so many scholars have applied defogging methods to underwater image restoration. Image enhancement-based methods focus on adjusting image pixel values to produce subjective and visually appealing images. Deep learning based approaches, relying on rich training data, are able to improve the image quality in different underwater scenes. Therefore, a new multi scale dense generative adversarial network (GAN) for enhancing underwater images has been recently proposed.

We will analyze the typical of these two methods nowadays and perform an analytical comparison to illustrate the advantages and disadvantages of these two methods as well as the applicable scenarios. We will use PSNR, SSIM, etc. for evaluation. Finally we will show the difference in the form of GUI and audience interaction.

3.2 Steps of tasks

. Review relevant papers and setup environment

. Implement the recovery-based algorithms

. Implement the regenerate-based algorithms

. Improve the training model used for the network based algorithm

. Compare the performance of different implementations (quality and performance)

. Create a GUI

. Finish report

References

[1]Islam, Md Jahidul, Youya Xia, and Junaed Sattar. "Fast underwater image enhancement for improved visual perception." IEEE Robotics and Automation Letters 5.2 (2020): 3227-3234.

[2]Li, Chongyi, et al. "An underwater image enhancement benchmark dataset and beyond." IEEE Transactions on Image Processing 29 (2019): 4376-4389.