

# **Natural-based underwater image color enhancement through fusion of swarm-intelligence algorithm**

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## **ABSTRACT**

Underwater imagery suffers from severe effects due to selective attenuation and scattering effects when light travels through water medium. Such damages limit the ability of vision tasks and reduce image quality. There are a lot of enhancement methods to improve the quality of underwater image. However, most of the methods produce distortion effects in the output images. The proposed natural-based underwater image color enhancement (NUCE) method consists of four steps. The first step introduces a new approach to neutralize underwater color cast. The inferior color channels are enhanced based on gain factors, which are calculated by considering the differences between the superior and inferior color channels. In the second step, the dual-intensity images fusion based on average of mean and median values is proposed to produce lower-stretched and upper-stretched histograms. The composition between these histograms improves the image contrast significantly. Next, the swarm-intelligence based mean equalization is proposed to improve the naturalness of the output image. Through the fusion of swarm intelligence algorithm, the mean values of inferior color channels are adjusted to be closed to the mean value of superior color channel. Lastly, the unsharp masking technique is applied to sharpen the overall image. Experiments on underwater images that are captured under various conditions indicate that the proposed NUCE method produces better output image quality, while significantly overcoming other state-of-the-art methods.

## **KEYWORDS**

Color correction; Underwater color cast; Contrast stretching; Swarm-intelligence algorithm

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