

Underwater Image Enhancement Using Depth Estimation and a Transformer-GAN Model

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Abstract: Underwater imaging is important for diverse applications. However, the quality of underwater images is often diminished due to light absorption, scattering, noise, and uneven illumination. These issues result in colour distortion, reduced sharpness, and loss of detail, highlighting the need for effective underwater image enhancement (UIE) techniques. Although recent deep learning-based approaches have demonstrated remarkable performance, their effectiveness remains limited as they often neglect valuable depth information. This study addresses this limitation by incorporating depth cues into UIE using a deep learning framework. First, the depth map of an underwater image is estimated using a CNN-Transformer model. The depth map is then concatenated with the raw image as an additional channel to integrate depth information into the enhancement process. A Transformer-GAN architecture is subsequently employed to generate enhanced images with natural colours. Experimental results on the LUSI and UIE benchmark datasets validate the superiority of the proposed approach, achieving PSNR values of 25.74 and 23.45 and SSIM values of 0.90 and 0.89, respectively. These results show that the proposed method delivers better performance compared to existing Transformer and GAN-based approaches, marking a notable achievement in UIE.