

SINGLE IMAGE DEFOGGING USING A DEPTH- AND EDGE-AWARE MODIFIED CYCLEGAN

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Visibility in outdoor imagery is frequently compromised by adverse atmospheric conditions, with fog representing one of the most common and challenging phenomena. Effective single-image defogging is critical for a wide range of applications, including autonomous navigation and traffic surveillance systems. In recent years, approaches based on Generative Adversarial Networks (GANs) have demonstrated notable improvements in defogging performance. Despite these advancements, such methods often exhibit limitations, particularly in their insufficient utilisation of scene depth information and their difficulty in preserving fine structural details throughout the enhancement process. To address these limitations, this study proposes a novel approach that incorporates both depth maps and edge maps, alongside raw degraded images, into a CycleGAN-based model. This integration aims to generate realistic defogged images while effectively preserving structural and geometric details. The depth and edge maps are derived from the raw degraded images during both the training and testing phases. In the proposed generator and discriminator architectures, features extracted from the depth and edge maps are concatenated with those from the raw images to enrich the input representation. Furthermore, a depth attention block is integrated into both the generator and discriminator to enhance spatial feature learning through attention mechanisms. The proposed approach is trained and evaluated using the publicly available RESIDE and Haze-1K datasets. Experimental results on the test sets demonstrate that the method outperforms existing approaches, achieving an average PSNR of 24.80 and an average SSIM of 0.927 on the RESIDE dataset, and a PSNR of 23.28 with an SSIM of 0.923 on the Haze-1K dataset. The findings of this study clearly highlight the importance of incorporating depth and edge cues in single-image defogging, as they contribute significantly to preserving spatial and structural details.

Keywords: CycleGAN, Depth Map, Edge Map, Single image defogging