Spatial-Aware Image Denoising through an Encoder-Decoder Framework

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Image denoising is a fundamental task in computer vision, aiming to recover clean images from noisy inputs while preserving structural integrity. This paper introduces an innovative adaptation of the Encoder-Decoder Network with Guided Transmission Map (EDN-GTM) [1], originally developed for image dehazing, to address image denoising. This adaptation is motivated by the conceptual parallels between dehazing and denoising, as both seek to remove unwanted visual artifacts (haze and noise, respectively) while retaining important image features. Notably, the transmission map in dehazing provides structural guidance, which can serve as a spatial attention mechanism. Leveraging this insight, we reinterpret the transmission map as a spatial guidance mechanism for a U-Net-based architecture [2] to enhance denoising performance. The proposed network, inspired by EDN-GTM, is redesigned to be more compact while still incorporating a Spatial Pyramid Pooling module and Swish activation to better preserve edges and textures. An overview of the proposed framework is shown in Figure 1. Experimental results on a synthetic dataset demonstrate that the proposed model achieves favorable denoising performance with high visual quality (see Figure 2), effectively balancing noise suppression and structural preservation, with an average inference time of only 31 ms per 512×512 image.

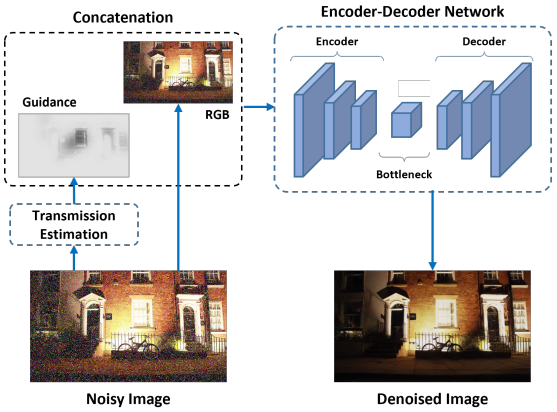

Figure 1. The proposed framework.

Figure 2. Denoising results.

References

[1] L.-A. Tran, S. Moon, and D.-C. Park, "A novel encoder-decoder network with guided transmission map for single image dehazing," *Procedia Computer Science*, vol. 204, pp. 682–689, 2022.

[2] L.-A. Tran and M.-H. Le, "Robust u-net-based road lane markings detection for autonomous driving," in *IEEE International Conference on System Science and Engineering (ICSSE)*, pp. 62–66, 2019.