Radiance-Reflectance Combined Optimization and Structure-Guided $\mathcal{l}_0$-Norm for Single Image Dehazing

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Abstract— Outdoor images are subject to degradation regarding contrast and color because atmospheric particles scatter incoming light to a camera. Existing haze models that employ model-based dehazing methods cannot avoid the dehazing artifacts. These artifacts include color distortion and overenhancement around object boundaries because of the incorrect transmission estimation from a depth error in the skyline and the wrong haze information, especially in bright objects. To overcome this problem, we present a novel optimization-based dehazing algorithm that combines radiance and reflectance components with an additional refinement using a structure-guided l0-norm filter. More specifically, we first estimate a weak reflectance map and optimize the transmission map based on the estimated reflectance map. Next, we estimate the structure-guided l0 transmission map to remove the dehazing artifacts. The experimental results show that the proposed method outperforms state-of-the-art algorithms in terms of qualitative and quantitative measures compared with simulated image pairs. In addition, the real-world enhancement results demonstrate that the proposed method can provide a high-quality image without undesired artifacts. Furthermore, the guided l0- norm filter can remove textures while preserving edges for general image enhancement algorithms.