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IMAGE DEHAZING THROUGH SCENE PRIORS OPTIMAL TRANSMISSION MAP

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ABSTRACT

The challenge of single-image dehazing mainly comes from double uncertainty of scene radiance and scene transmission. Most existing methods focus on restoring the visibility of hazy images and tend to derive a rough estimate of scene transmission. Unlike previous work, in this paper we advocate the significance of accurate transmission estimation and recast our problem as deriving the optimal transmission map directly from the haze model under two scene priors. We introduce theoretic and heuristic bounds of scene transmission to guide the optimum and show that the proposed theoretic bound happens to justify the well-known dark channel prior of haze-free images. With the constraints on the solution space, we then incorporate two scene priors, including locally consistent scene radiance and context-aware scene transmission, to formulate a constrained minimization problem and solve it by quadratic programming. The global optimality is guaranteed. Simulations on synthetic data set quantitatively verify the accuracy and show that the transmission map successfully captures finegrained depth boundaries. Experimental results on color/gray level images demonstrate that our method outperforms most state of the arts in terms of both accurate transmission maps and realistic haze-free images.

Index Terms—Constrained minimization problem, dark channel prior, optimal transmission, single-image dehazing.

I. INTRODUCTION

Stationary atmospheric effects caused by suspended particles usually lead to poor visibility in bad weather conditions, e.g., Haze and fog. These particles absorb and scatter light before it is received by cameras, and thus degrade the visual quality of images captured in an outdoor scene. Degraded images may greatly decrease the performance of many computer vision tasks, such as scene analysis, video surveillance, remote sensing, and target identification. Direct attenuation exponentially degrades the scene radiance in proportional to the

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scene depth; air light is a white atmospheric veil reducing the visibility. Because $L\infty$ is usually determined empirically, the major difficulty in image dehazing comes from the double uncertainty of scene depth (or scene transmission) and scene radiance. To make the ill-posed problem tractable, existing methods either utilized the depth information measured from multiple images [2]–[4] or imposed suitable priors on a single image [6]–[12]. In this paper, we focus on the more practical scenario—single-image dehazing, because multiple hazy images captured in the same scene are usually not available. Different priors, either on scene radiance [8] or on scene depth [9], [10], have been introduced to facilitate single-image dehazing. Christo Ananth et al. [5] proposed a system in which OWT extracts wavelet features which give a good separation of different patterns. Moreover the proposed algorithm uses morphological operators for effective segmentation. From the qualitative and quantitative results, it is concluded that our proposed method has improved segmentation quality and it is reliable, fast and can be used with reduced computational complexity than direct applications of Histogram Clustering. The main advantage of this method is the use of single parameter and also very faster. While comparing with five color spaces, segmentation scheme produces results noticeably better in RGB color space compared to all other color spaces. Few methods consider both the scene radiance and depth as two statistically uncorrelated [11] or independent [12] layers. However, because these methods [8]–[11] usually rely on general hypotheses (such as statistical distribution or empirical observation), they tend to obtain a rough estimate on scene depth (or scene transmission). For example, one of the most popular hypotheses is the dark channel prior, which was based on observation of haze-free images and was empirically verified from 5000 natural images [9]. Although many follow up methods [13]–[15] were proposed to boost the performance, there seems to be no significant improvement on the estimate of scene transmission. In addition, because many methods include a post processing step to refine their rough estimate, this post process may further compromise the accuracy of the final results in the original haze model. In this paper, we argue that an accurate transmission map $\alpha(x, y)$ is the key to successful single-image dehazing. Note that our goal is to recover the underlying scene radiance rather than to maximize the visibility. Given an observed hazy image $E(x, y)$ and the empirically determined $L\infty$, once we have the optimal transmission $\hat{\alpha}(x, y)$, then the haze-free image $R(x, y)$,

$$R(x, y) = E(x, y) - L\infty\,\hat{\alpha}(x, y) + L\infty$$

Should be the most realistic result, though it may not have the best visibility. To this end, we propose to derive the optimal transmission map directly from the haze model [i.e., (1)]. In Section III we first discuss the bounds of $\alpha(x, y)$, both theoretically and heuristically. In addition, we will show that the dark channel prior [9]

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corresponds with a lower bound inherently existing in the haze model and that this lower bound alone can only serve as a rough estimate on transmission map. With the analysis, we then recast the problem as finding the optimal *α(x, y)* under scene priors within the bounded range. In Section IV we formulate two scene priors, under the assumption of locally consistent radiance *R(x, y)* and content-aware transmission *α(x, y)*, to characterize the desired optimal transmission. Inspired by the derivation in image matting [16], we also adopt the locally consistent assumption and successfully derive a detailed transmission map even in fine-grained scale. In addition, we introduce a content-aware assumption to preserve consistent transmission for the same object. When combining the lower bounds under the two assumptions, we show that finding the optimal transmission *α(x, y)* is equal to solving a constrained minimization problem by quadratic programming (QP).

Because the global optimum of QP can be readily obtained, our method can guarantee the optimal transmission map. In our preliminary work . we have proposed an optimization framework to derive the transmission map. Here, two major contributions are further presented: 1) we thoroughly investigate the theoretic bound of the scene transmission directly from the haze model and 2) we further propose the context-aware objective to better characterize the scene transmission in structural regions. We believe our discussion on the range of transmission may explain the success of dark channel prior in recent publication. Starting from the theoretic bound, we give a new perspective for image dehazing: finding the optimal transmission under scene priors in the feasible range. We will also show that the new context-aware objective indeed improves the estimate of transmission map and also the quality of recovered images in our experiments.

II.DEHAZING METHODOLOGY

The challenge of single-image dehazing mainly comes from double uncertainty of scene radiance and scene transmission. Most existing methods focus on restoring the visibility of hazy images and tend to derive a rough estimate of scene transmission. It is advocated that the significance of accurate transmission estimation and as deriving the optimal transmission map directly from the haze model under two scene priors. It introduces theoretic and heuristic bounds of scene transmission to guide the optimum and show that the proposed theoretic bound happens to justify the well-known dark channel prior of haze-free images. With the constraints on the solution space, it has two scene priors, including locally consistent scene radiance and context-aware scene transmission, to formulate a constrained minimization problem and solve it by quadratic programming. The global optimality is guaranteed. Simulations on synthetic data set quantitatively verify the accuracy and

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show that the transmission map successfully captures fine grained depth boundaries.

Theoretic Bounds: It is first point out three basic properties in the haze model of

1) the scene radiance is nonnegative.

2) the scene transmission ranges from zero to one.

3) the scene transmission only relates to the location rather than different color channels.

The connection between the dark channel prior and the theoretic bound, where the former comes from the empirical prior observed in haze-free outdoor images, and the latter is grounded on the inherent nature of hazy images, i.e., the underlying haze model. In addition, it also shows an lower bound for the scene transmission.

Heuristic Bounds

It helps to derive the underestimated transmission. Hence, because of numerical errors, the theoretic bounds derived in may become unreliable or useless for nearly black, white, or very saturated objects. To better characterize the scene transmission, it is needed to include other scene information to determine the bounds. Transmission map measures the scene depth by calculating the distance between a manually labeled vanish point and the other image points. Although the rough estimate of scene depth is insufficient to remove haze effects, it may provide a reasonable bound for the transmission in planar images with horizon.

It simply assumes that hazy images are captured by orthographic projection of scenes and that the scene depth depends only on the third coordinates of the scene. The ground area in an outdoor scene has increasing depth (or exponentially decreasing transmission) along the vanishing lines. However, because the depth information of the scene is unknown, it is assumed that the transmission of the ground area depends only on its vertical distance from the horizon.

Under this criteria, the ideal transmission map, which the transmission heuristic, for the sky and ground areas in image. Also for each object in the scene, its transmission value should be consistent and is thus determined by its lowest part connecting to the ground. In other words, the optimal transmission must be always larger than the transmission heuristic because objects in a scene are closer to the camera than the background area.

Locally Consistent Scene Radiance

Locally Consistent Scene Radiance which achieves fine grained foreground and background decomposition; it is adopted the prior that the scene radiance is locally consistent and thus it remains same throughout the images in the scene.

Context-Aware Scene Transmission

The main advantage of is its accuracy on estimating fine grained

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transmission within a small window. However, if the size of some object is much larger than the window, then may fail to preserve a consistent transmission over

Gray-Level Images

The optimal transmission map with and obtains a higher contrast result but may look unrealistic. The dehazed result of still remains little hazy (especially in the farther road). By contrast method effectively removes the haze from gray-level image.

III.BLOCK DIAGRAM

The method is based on four major steps that has been described

- Transmission mapping process
- Canny edge detection
- Vanishing point detection
- Combining process

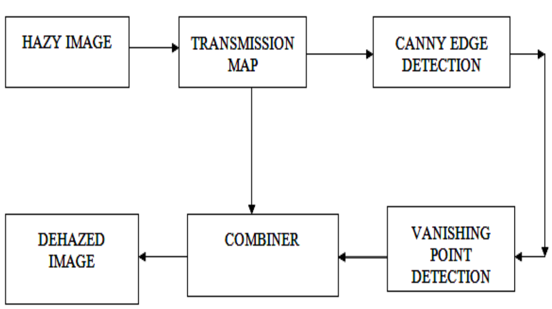

Fig:1 Block diagram to dehaze the image

Input hazy image

Haze degrade the visual quality of images captured in an outdoor scene. Degraded images may greatly decrease the performance of many computer vision tasks. Single-image dehazing is considered, because multiple hazy images captured in the same scene are usually not available

Transmission mapping process

Two major contributions are further presented with the high resolution

1) Investigation of the theoretic bound of the scene transmission directly from the haze model

2) The context-aware objective to better characterize the scene transmission in structural regions is proposed

Canny edge detection

It provides optimal detection with no spurious responses. It aims to reduce the response to noise and maintains accuracy of the images. It eliminates the multiple responses to the single edge. It can be used for the horizontal and the vertical edges of the scene radiance.

Vanishing point detection

Vanishing pixels are considered from the required pixels of the above step. The lowered intensity values are eliminated. The background images are viewed with brighter value than the edge points. The blurred pixel values are eliminated and the required pixel values are taken for processing.

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Combining process

Transmission mapping process image output is combined with the vanishing point detection image output. The output of the combiner produces the dehazed image with the optimal scene radiance. The dehazed image can be used for the scene analysis, video surveillance, remote sensing, and target identification etc.,.

IV. RELATED WORK

A. Multi-image-Based Dehazing

Earlier previous work utilized multiple images, captured in the same scene but under different weathers or equipments, to measure the scene depth for image dehazing. As noted in [2] and [3], because air light is partially polarized, haziness can be partially reduced by polarizing filters. Therefore, the authors used different angles of polarizing filters to capture two images in the same scene. Then, the scene depth was measured from the difference between the two images[4] and [6].

B. Single-Image Dehazing With User Interaction/Device

Rather than using multiple images, some methods tackle the single-image dehazing using depth information obtained via user-intervention or specific device. Narasimhan and Nayar [6] assumed that the scene depth is inversely related to the image distances between any point and the vanishing point. Therefore, they roughly measured the depth map using a manually marked vanishing point. In [7], given the geo-referenced digital terrain and urban models, Kopf *et al.* [7] proposed to enhance outdoor photos and showed excellent haze-free results by using the available scene depth. However, the dehazing performance of these two methods highly depends on the accuracy of their given depth maps first detected the depth boundary from multiple images captured under different atmospheric or weather conditions. Based on the depth information, the authors proposed to derive a haze-free image. Although these methods work well when multiple images (captured in the same scene) are available, acquisition of these images is not always possible in real-world applications and the multi-image assumption is impractical for processing existing hazy images.

C. Single-Image Dehazing With Priors

To solve the ill-posed problem, recent methods imposed different priors on scene to tackle the single-image dehazing. A high-contrast prior on the haze-free image was proposed in [8] to maximize the number of edges in the dehazed image. Although the method significantly enhances the visibility of hazy images, it usually leads to unrealistic color. He *et al.* [9] proposed the dark channel prior to estimate the transmission. The authors observe that most local patches in outdoor haze-free images contain some pixels whose intensity is nearly zero in at least one color channel. Similar to [9], Tarel and Hautiere [10] proposed the concept of

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whiteness as the upper bound of atmospheric veil. They assumed that the atmospheric veil changes smoothly and thus applied statistical adjustment on local patches to improve the bound

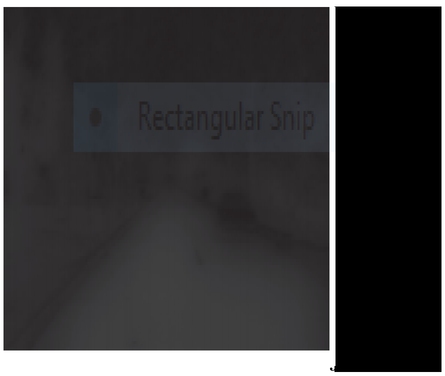

Fig:a)Haze image

- Haze degrade the visual quality of images captured in an outdoor scene
- Degraded images may greatly decrease the performance of many computer vision tasks
- Single-image dehazing is considered, because multiple hazy images captured in the same scene are usually not available

Fig:b)Transmission map derived by no extra boundary

TRANSMISSION MAPPING PROCESS

Two major contributions are further presented:

1)Investigation of the theoretic bound of the scene transmission directly from the haze model

2)The context-aware objective to better characterize the scene transmission in structural regions in proposed.

Fig:c)The proposed using therortic bound

Three basic properties the three scene radianceR(x,y)non negative the scene transmission $\alpha(x,y)=e^{-\beta d(x,y)}$ranges from zero to one the scene transmission α

Fig:d)the proposed using heuristic bound

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Fig:e)Vanishing point horizon detection

Fig:f)Result of cany edge detection

V.CONCLUSION

The proposed system recast the problem of single-image dehazing as finding the optimal scene transmission and it proposes both theoretic and heuristic bounds to restrict solution space, and then propose two objectives for scene priors, including locally consistent radiance and context aware transmission, to derive the optimal transmission map. The problem as a constrained minimization problem and is solved by quadratic programming with global optimum. The results demonstrate that it outperforms most state of the arts in terms of both accurate transmission and realistic haze-free images.

REFERENCES

[1]Buades.A, Coll.B, and Morel.J.M, (2008) "Nonlocal image and movie denoising," Int. J. Comput. Vis., vol. 76, no. 2, pp. 123–139.

[2]Fattal.R, (2008) "Single image dehazing," ACM Trans. Graph., vol. 27, no. 3, p. 72,

[3]He.K, Sun.J, and Tang.X, (2010) "Single image haze removal using dark channel prior," IEEE Trans. Pattern Anal. Mach. Intell., vol. 33, no. 12, pp. 2341–2353,

[4]He.K, Sun.J, and Tang.X, (2013). "Guided image filtering," IEEE Trans. Pattern Anal. Mach. Intell., vol. 35, no. 6, pp. 1397–1409.

[5] Christo Ananth, A.S.Senthilkani, Praghash.K, Chakka Raja.M., Jerrin John, I.Annadurai, "Overlap Wavelet Transform for Image Segmentation", International Journal of Electronics Communication and Computer Technology (IJECCT), Volume 4, Issue 3 (May 2014), pp-656-658

[6]Kopf et al.J, (2008) "Deep photo: Model-based photograph enhancement and viewing," ACM Trans. Graph., vol. 27, no. 5, pp. 116-1–116-10,

[7]Koschmider.H, "Theorie der horizontalen sichtweite," in Proc. Beiträge zur Phys. der Freien Atmos.(1924), pp. 171–181.

[8]Lai.Y.S, Chen.Y.L, and Hsu.C.T, (2012) "Single image dehazing with optimal

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transmission map," in Proc. IEEE Int. Conf. Pattern Recognit., pp. 388–391.

[9]Lee.P and Wu.Y, (2011) "Nonlocal matting," in Proc. IEEE Conf. Comput. Vis., pp. 2193–2200.

[10]Levin.A, Lischinski.D, and Weiss.Y, (2006) "A closed form solution to natural image matting," in Proc. IEEE Conf. Comput. Vis. Pattern Recognit., pp. 61–68.