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Image Defogging Based On Dark Channel Prior (Dcp)

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ABSTRACT

The presence of fog in the atmosphere degrades the quality of images captured by visible camera sensors. The removal of fog, called defogging, is typically performed under the physical degradation model, which necessitates a solution of an ill-posed inverse problem. To relieve the difficulty of the inverse problem, a novel prior called dark channel prior (DCP) was recently proposed and has received a great deal of attention. Based on the DCP, the defogging is accomplished through four major steps: atmospheric light estimation, transmission map estimation, transmission map refinement, and image reconstruction.

KEYWORDS - *Image processing, image defogging, dark channel prior.*

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I. INTRODUCTION

Due to absorption and scattering by atmospheric particles in haze, outdoor images have poor visibility under inclement. Weather Poor visibility negatively impacts not only consumer photography but also computer vision applications for outdoor environments, such as object detection and video surveillance. Fog removal, which is referred to as defogging, is considered an important process because haze-free images are visually pleasing and can significantly improve the performance of computer vision tasks. Methods presented in earlier studies had required multiple images to perform defogging. Dark channel prior (DCP) based image defogging is based on 'dark pixels', which has very low intensity in at least one color channel, except for sky region.

Haze is an atmospheric phenomenon which occurred due to the presence of dust, smoke and other dry particles reduces the clarity of the sky. By obtaining a distinctive gray hue in the captured images, for distant regions haze reduces the visibility. Fog is a dense cloud of water droplets, or cloud. Fog normally found near to ground. It is formed when the night is cold and is obtained by releasing the heat of the ground which is absorbed during day.

II. LITERATURE SURVEY

J.-P. Tarel et al. in [1] proposed a novel algorithm and variants for visibility restoration from a single image. The main advantage of the proposed algorithm compared with other is its speed: its complexity is a linear function of the number of image pixels only. This speed allows visibility restoration to be applied for the first time within real-time processing applications such as sign, lane-marking and obstacle detection from an in-vehicle camera.

S. G. Narashiman and S. K. Nayar in [2] proposed an automatic method based on physical model and maximum entropy to remove weather effects using only a single image. First, segment the sky region by optimal estimated normal distribution and select the lowest point of the sky region as the vanishing point. Then, exploit the physics-based model to remove weather effects from the image. At last, to overcome the defect of a single image lacking exact atmospheric information, an algorithm is proposed based on maximum entropy to select the optimal scattering coefficient of the atmosphere.

S.G. Narasimhan et al. in [3] proposed a fast algorithm to restore scene contrast. The methods described in this paper are effective under a wide range of weather conditions including haze, mist, fog, and conditions arising due to other aerosols. Further, the methods can be applied to gray scale, RGB colour, multispectral and even IR images.

Zhou Pei, Zhu Hong, Qian Xueming in [4] proposed a wavelet fusion method. Wavelet transform, histogram equalization and non-linear operator are used to process synthetically fog-degraded Image based on the existent image enhancement method. Histogram equalization is processed fog-degraded image firstly, then wavelet transform is used to decompose the image, nonlinear operator is used to enhance high-frequency part of the decomposition image lastly.

III. DEGRADATION MODEL WITH DCP

A foggy image formed as shown in Fig.1 can be mathematically modeled as follows,

$$I(x) = J(x)e^{-\beta d(x)} + A(1 - e^{-\beta d(x)}) \ldots (1),\; t(x) = e^{-\beta d(x)}$$

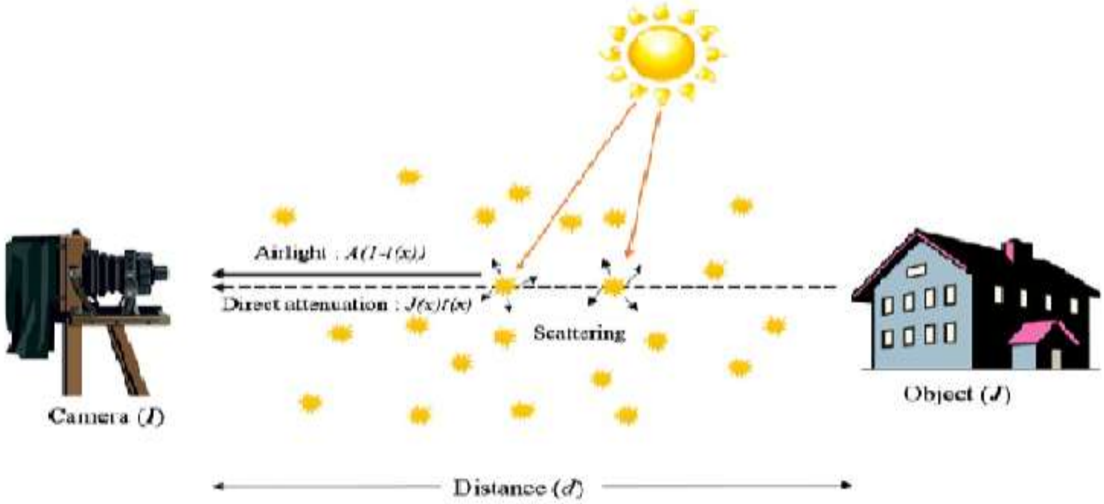


Fig.1 Degradation Model

Where x represents the image coordinates, I is the observed hazy image, J is the haze-free image, A is the global atmospheric light, β is the scattering coefficient of the atmosphere, and d is the scene depth. The first term of Eq. (1), J(x)t(x) (the direct attenuation), decreases as the scene depth increases. In contrast, the second term of Eq. (1), A (1 − t(x)) (the air light), increases as the scene depth increases. Since the goal of image defogging is to recover J from I, once A and t are estimated from I, J can be arithmetically obtained as,

$$J(x) = \frac{I(x) - A}{t(x)} + A \ldots\ldots\ldots\ldots (2)$$

2.2 Dark channel prior (DCP)

He et al. [9] performed an empirical investigation of the characteristic of haze-free outdoor images. They found that there are dark pixels whose intensity values are very close to zero for at least one color channel within an image patch. Based on this observation, a dark channel is defined as follows:

$$J^{Dark} = \min_{y \varepsilon \Omega(x)} (\min J^{c(y)}) \ldots\ldots\ldots (4),\quad J^{dark} \approx 0$$

Where, Jc is an intensity for a color channel c ∈ {r, g, b} of the RGB image and Ω(x) is a local patch cantered at pixel x. According to Eq. (4), the minimum value among the three color channels and all pixels in Ω(x) is chosen as the dark channel J dark(x). The pixel value is approximately zero.

2.3 DCP-based image defogging

In the DCP-based defogging algorithm, the dark channel is first constructed from the input image as in Eq. (4). The atmospheric light and the transmission map are then obtained from the dark channel. The transmission map is further refined, and the haze-free image is finally reconstructed as Eq. (3). More specifically, given the degradation model of the minimum intensity in the local patch of each color channel is taken after dividing both sides of Eq. (6) by Ac as follows:

$$I(x) = J(x)t(x) + A(1 - t(x)) \qquad \ldots\ldots\ldots (6)$$

$$\min_{y \varepsilon \Omega(x)} (\min_c \frac{I^{c(y)}}{A^c}) = \hat{t}(x) \min_{y \varepsilon \Omega(x)} (\min_c \frac{J^{c(y)}}{A^c}) + (1 - \hat{t}(x)) \qquad \ldots\ldots\ldots (7)$$

Here the transmission in the local patch Ω(x) is assumed to be constant and is represented as $\hat{t}(x)$. Then, the min operator of the three color channels can be applied to Eq. (7) as follows:

$$\hat{t}(x) = 1 - \min_{y\varepsilon\Omega(x)}\left(\min_{c} \frac{I^{c}(y)}{A^{c}}\right) \quad \text{.........(8)}$$

Here, the atmospheric light A needs to be estimated in order to obtain the transmission map t Most of the previous single image based defogging methods estimate A from the most haze-opaque pixels. The pixel value of the dark channel is highly correlated with haze density. Therefore, the top 0.1 % of the brightest pixels in the dark channel is first selected, and the color with the highest intensity value among the selected pixels is then used as the value for A.

$$\min_{y\varepsilon\Omega(x)}\left(\min_{c} \frac{I(x)}{A^{c}}\right) \approx 1 \quad \hat{t}(x) = 0 \quad \text{.........(9)}$$

Therefore, the sky does not need special treatment for estimating the transmission map. Given A, ~t, and I, the defogged image is obtained as,

$$J(x) = \frac{I(x) - A}{\max(\hat{t}(x), t_0)} + A \quad \text{.........(10)}$$

Where, t_0 is used as a lower bound for the transmission map.

2.5 Analysis of DCP-based defogging algorithms

We reviewed the original DCP-based defogging algorithm. The follow-up methods are based on the basic structure presented in but differ in each step of the defogging procedure. Instead of analyzing each method individually, we classify all the methods in accordance with the four steps of image defogging and then perform a step-by-step analysis. As shown in fig 2.

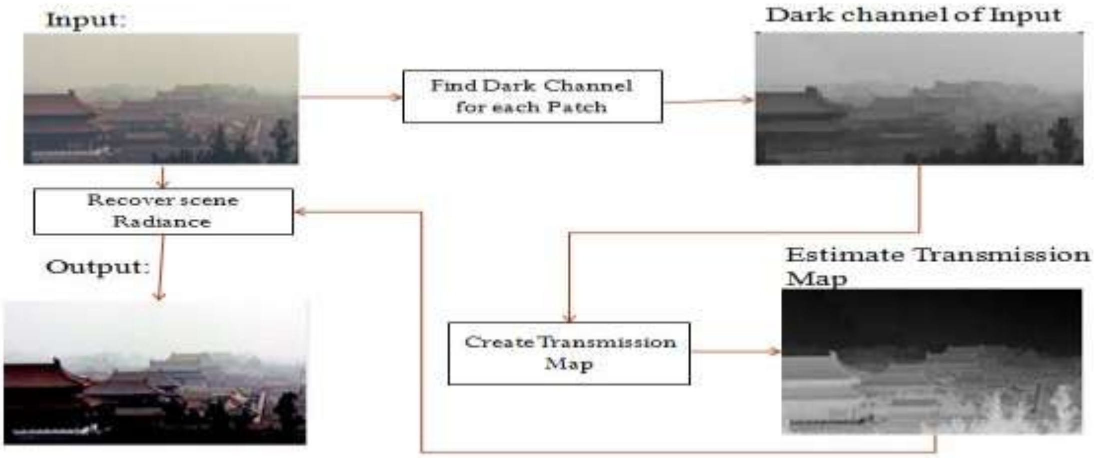


Fig.2 Flow process of dark channel algorithm, DCP Algorithm

IV. DARK CHANNEL CONSTRUCTION

Most conventional DCP-based defogging methods estimate the dark channel from the input hazy image I. The size of the local patch Ω(x) is the only parameter that needs to be determined. Although the effect of the size of the local patch is significant, most conventional methods simply use a local patch with a fixed size.

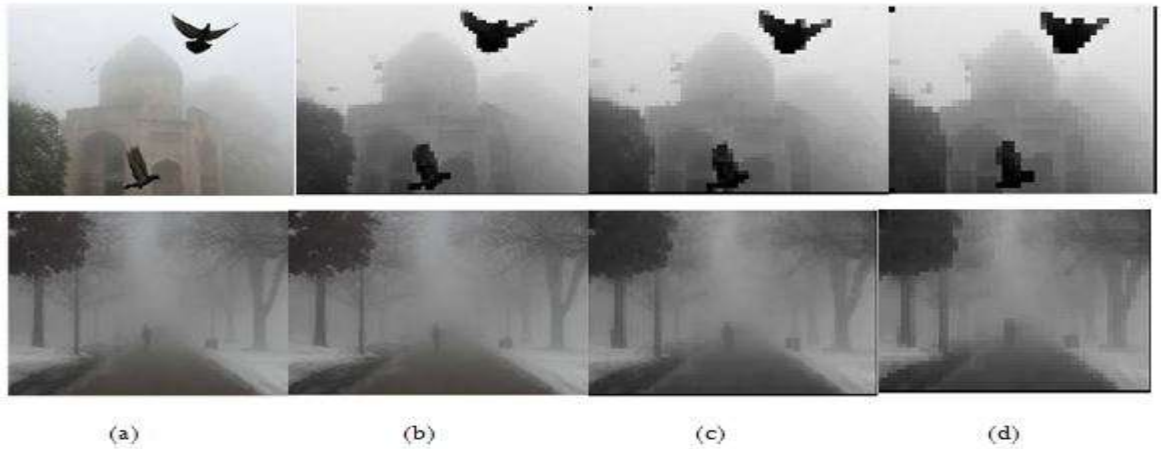


Fig.3 Dark Channel of Various size (a)Hazy Image Dark channel prior with patch size of (b)3*3 (c)7*7(d)11*11

1.1Aatmospheric light estimation

The majority of conventional DCP-based defogging methods estimate A as described in Section 1.2.3. However, the above method can incorrectly select the pixel when the scene contains bright objects. Instead, pixels with a top p% dark channel values are selected as the most haze-opaque pixels, and the one with the highest intensity is used to estimate A.

Fig.4 Atmospheric light estimation (a) Foggy image the pixel in dark channel are used to estimate the Atmospheric light when size of (b) 3*3 (c) 15*15

1.2 Transmission map estimation

The transmission map fined in Eq. (9) is obtained from the DCP. If the DCP is not exploited, Eq. (9) can be rewritten as,

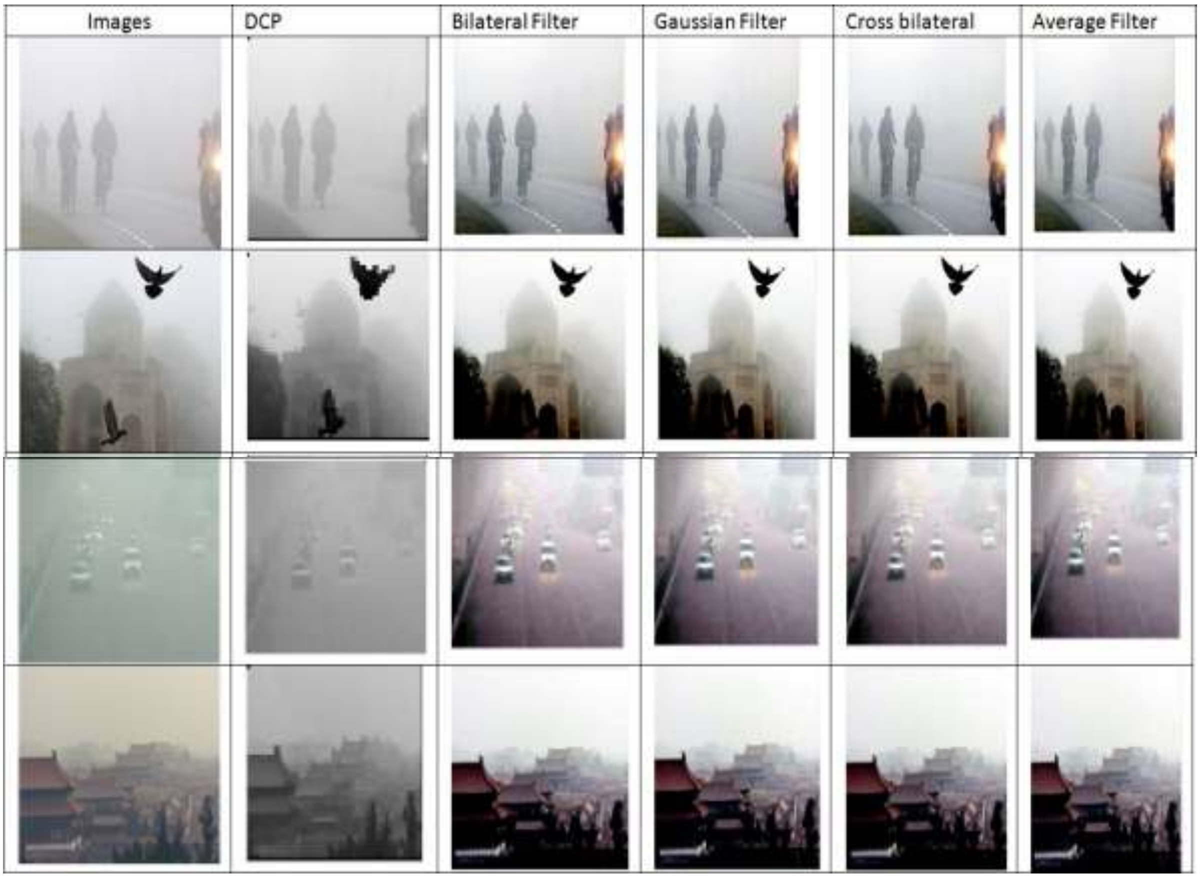
$$\hat{t}(x) = 1 - \min_{y \in \Omega(x)}(\min_{c} \frac{I^{c}(y)}{A^{c}}) + \hat{t}(x) . \min_{y \in \Omega(x)}(\min_{c} \frac{J^{c}(y)}{A^{c}}) \quad \text{.........(11)}$$

1.3 Transmission map refinement

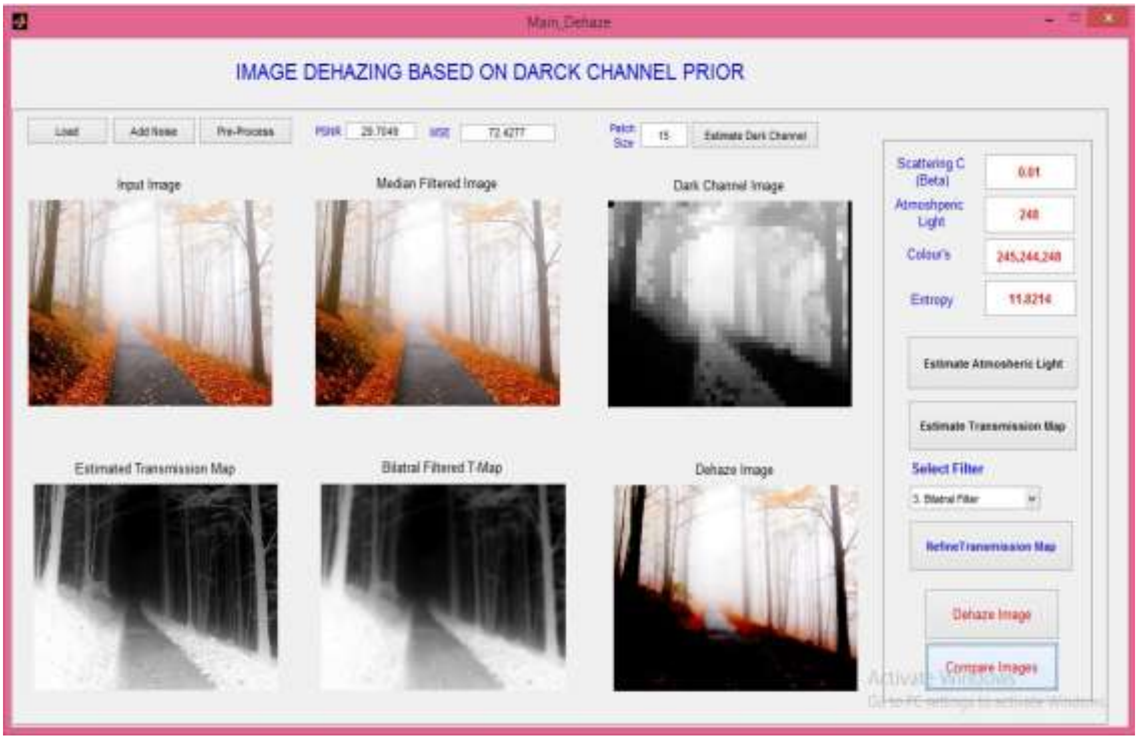
Incorrect estimation for the transmission map can lead to some problems such as false textures and blocking artefact decreases the apparent resolution of the dark channel, resulting in blurry transmission maps. It is especially mentioned that many defogging methods differ in the way of smoothing the transmission map. Some filtering methods, such as the Gaussian and bilateral filters, use only transmission maps, whereas the other methods, such as cross-bilateral filter, and average filter.

V. PERFORMANCE AND ANALYSIS

The performance of transmission map refinement is improved when a hazy image is used as a bilateral filter image, the cross-bilateral filters show the second-best accuracy. The Gaussian and average filters perform best in terms of the computational complexity.



The proposed method has been tested for a large data set which has haze as well as fog to check the robustness of the method. It is implemented by using MATLAB 2013.some results on MATLAB are as:



VI. CONCLUSION

Fog removal is very essential in the field of image processing. And there are different techniques are proposed for fog removal. The dark channel prior is used to improve the visual quality of foggy image and this produced the good results. DCP using Gaussian filter and bilateral filter gives better results as compare to cross bilateral filter and average filter. Since Fog removal is highly desired in computer vision applications, it is necessary to make a further effort to put the proposed method into real-time applications, such as the video-surveillance systems.

REFERENCES

[1]. R. Sharma and V. Chopra, ``A review on different image dehazing methods,'' Int. J. Comput. Eng. Appl., vol. 6, no. 3, pp. 7787, Jun. 2014.
[2]. N. Hautière, J.-P. Tarel, and D. Aubert, ``Towards fog-free in-vehicle vision systems through contrast restoration," in Proc. IEEE Conf. Comput. Vis. Pattern Recognit. (CVPR), Jun. 2007, pp. 18.
[3]. S. G. Narasimhan, C. Wang, and S. K. Nayar, ``All the images of an outdoor scene," in Computer Vision (Lecture Notes in Computer Science), vol. 2352. Heidelberg, Germany: Springer, 2002, pp. 148162.
[4]. S. G. Narasimhan and S. K. Nayar, ``Vision and the atmosphere," Int. J. Comput. Vis., vol. 48, no. 3, pp. 233254, 2002.
[5]. S. G. Narasimhan and S. K. Nayar, ``Removing weather effects from monochrome images," in Proc. IEEE Comput. Soc. Conf. Comput. Vis. Pattern Recognit. (CVPR), vol. 2. Dec. 2001, pp. II-186II-193.
[6]. J. John and M. Wilscy, ``Enhancement of weather degraded video sequences using wavelet fusion," in Proc. 7th IEEE Int. Conf. Cybern. Intell. Syst., Sep. 2008, pp. 16.
[7]. C. Ramya and D. S. S. Rani, ``Contrast enhancement for fog degraded video sequences using BPDFHE," Int. J. Comput. Sci. Inf. Technol., vol. 3, no. 2, pp. 34633468, 2012.
[8]. Z. Xu, X. Liu, and X. Chen, ``Fog removal from video sequences using contrast limited adaptive histogram equalization," in Proc. IEEE Int. Conf. Comput. Intell. Softw. Eng., Dec. 2009, pp. 14.

BIOGRAPHIES AND PHOTOGRAPHS

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