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Quick Transformation and Recent Advance methods in Single Color Image De-Hazing

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Abstract

In real world scenario due to bad weather conditions the presence of fog and haze, the particles in the outdoor environment or atmosphere (e.g., droplets, smoke, sand, snow, mist, volcanic ash, liquid dust or solid dust) greatly reduces the visibility of the scene. As aconsequence, the clarity of an image would be seriously degraded, which may decrease the performance of many image processing applications. Image Dehazing methods try to alleviate these problems by estimating a haze free version of the given hazy image. Traditionally the task of image dehazing can be processed as recovering the scene radiance from a noisy hazy image by estimating the atmospheric light and transmission properties. In those kinds of techniques, it additionally needs some more information regarding the image such as scene depth, weather condition parameters and so on. But this is not suitable for real world scenario. We start with the popular Transformer and find that several of its key designs are unsuitable for image dehazing. To this end, we propose Dehaze Former, which consists of various improvements, such as the modified normalization layer, activation function, and spatial information aggregation scheme. We train multiple variants of DehazeFormer on various datasets to demonstrate its effectiveness. Specifically, on the most frequently used SOTS indoor set. Hence this research focus on recovering dehaze version of the input image by Image Quality Assessment (IQA). So that all methods are comes under the categories image enhancement, image fusion image restoration based on statistical and structural features of the hazed image.

Index Terms—Image Restoration, Features, Image Dehazing, Visibility Enhancement, IQA – Image Quality Assessment.

I INTRODUCTION

The Land, water, air, sky, fire are our main five resources surrounding in earth. The Earth is a watery place. About 71 percent of the Earth's surface is water-covered, and the oceans hold about 96.5 percent of all Earth's water. Water also exists in theair as water vapor, in rivers and lakes, in icecaps and glaciers, in the ground as soil moisture and in aquifers. We didn’t take photos every day in sea water. In casual life we take lot of photos in land only. Due to image destruction, socking up, disperse in the environment and the presence of haze in the atmosphere degrades the quality of images captured by visible camera sensors. The visibility of outdoor images [4] is often degraded due to the presence of haze, fog, sandstorms, and so on. Bad weather condition [8] such as haze, mist, fog and smoke degrade the quality of the outdoor scene. It diminishes the visibility of

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the scenes and it is a threat to the reliability of many applications [10] like outdoor surveillance, object detection, it also decreases the clarity of the satellite images and underwater images. For surveillance [10] we needcorrect reference images. So removing haze from images is an imperative and broadly demanded area in computer vision and computer graphics. Every person likes the clarity of images. To ameliorate or detach of haze, called "dehazing". The decision is taken by eyes only in major times. If vision is not clear, it will be diagnose by any method.

Therefore, it is necessary need for vision to improve the image. It is also called as "haze removal" or "defogging" [12]. Image dehazing methods try to alleviate the problems. From the light the object is getting reflected and getting disturbed for the observer. For example the observer is camera means the original image is getting disturbed by illuminationand the scattered particles. Fig. 1 Shows the original image and dehaze image.

Fig.1. (a) Haze Image (b) Dehaze Image

Fig. 1.Comparison of Haze image and Dehaze Image.

By preprocessing method many haze free scene is provided as input. The problem of haze formation has been extensively studied inatmospheric optics. The hazy image can be regarded as a convex combination of scene radiance and atmospheric light [5]. For single image dehazing withadditional information needed such as restore the scene structure from captured under different weather condition [11]. Due to weather and climate often a change in our real world scattering problem occurs. For clear clarity of that haze into haze free is needed. Dehazing problem decomposed into three sub problems. (i) Estimate the atmospheric light 'A', most of the problem is solved and cleared by estimating A, how much single image is affected by haze (ii) Predict the transmission't', it resolves the remaining (iii) Recover scene radiance J, original image is how far affected by haze is estimated means we get the exact method to haze free the same image. The formation of haze is explained in Fig. 2.

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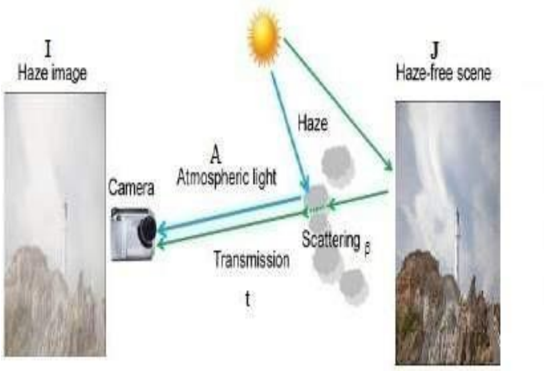

Fig.2. Formation of Haze Image

Light propagating through a scattering medium undergoes certain changes. Transformationof intensity is one of them. This change in intensity ismodelled using the following equation [10].

$I(x) = J(x)\, t(x) + (1 - t(x))\, A$

t(x) is the transmission of image where I(x) is the observed intensity, J(x) is the intensity of light coming from the scene objects and before gettingscattered, t(x) is the scene transmittance denoting the amount of light that reaches the observer after getting scattered and A denotes the global environmental illumination. The scene transmittance t(x) depends on the depth at position x and the scattering coefficient. This scattering coefficient depends on the size of the scattering particle and the wavelength of the light. So, in case of RGB images if we use this model of image formation, then for each colour channel t(x) needs to be different.

Fig.3. (a) Haze Image (b) DehazeImage

Fig.3. Fog affected image and clear Image.

Single image dehazing:

As single image dehazing is an ill-posed problem, various priors and hypotheses have been proposed to tackle this problem. Assume a constant air-light and estimate it via finding the minimum of a global cost function. It removes the haze layer based on the observations that clear images have more contrast and the transmission tends to be smooth. It assumes that the shading and transmission functions are locally statistically uncorrelated. Which is further develop the underwater dark channel prior for image enhancement. These investigate the dehazing effects on image and video coding. They further use locally adaptive Wiener filter to refine the estimated density of haze. It reduces the amplified noise in the dehazed result image restored from dense haze. By utilizes the color-lines prior in local image patch. Apply the color-lines prior to estimate an appropriate global constant atmospheric light vector. It propose amultiscale depth fusion (MDF) method with local Markov regularization to blend multi-level details of chromaticity priors .It propose a color attenuation prior and further apply a linear model for haze removal and a fast method based on linear transformation. For each prior, it can be applied to a range of hazy images; however, there are often images which may not meet it. To this end, this paperaims at automatically learning information from massive data. Recently, there are several learning- based image dehazing methods. Then train a regression model to estimate the transmission via incorporating four types of haze-relevant features. Two recent works also adopt CNN to perform image dehazing. First one, directly estimate the whole transmission map from an input image via multi-scale CNN under the FCN framework. Second one use a regression network to estimate the transmission ofeach pixel from its surrounding patch. However, these works mainly exploit existing hand-crafted features or classical CNNs. In contrast, we propose a novel Ranking-CNN to simultaneously capture statistical and structure attributes, which both are essential for single image dehazing.

Classification of algorithm Recently a machine learning technique allows more accurate and faster implementation of processing and computer vision task. There are four types in machine learning supervised, unsupervised, reinforcement, and evolutionary methods. In supervised learning, a training set of examples with the correct responses or target is provided and, based on this training set, the algorithm generalizes to respond correctly to all possible inputs. This is also called as learning from experience. In unsupervised, it doesn't provide correct response instead the algorithm tries to identify similarities between inputs. The statistical approach [19] is well known unsupervised learning for clustering and categorization. In reinforcement learning somewhat between supervised and unsupervised learning, it tellsonly the algorithm is correct or not telling the exact method or solution to rectify. In evolutionary learning, biological evolutionary can be seen as alearning process to improve the survival fates and chance of offspring in their environment. Offspring is the new generation development in the training set. Now deep learning is very famous for dehazing. This is the next step improvement in machine learning.

A. Image Enhancement methods

Image enhancement based methods [1] are notrequired to solve the physical model of image degradation, but rather directly enhance the image contrast and improve the image quality [9] from the perspective of human visual perception. These methods mainly include histogram equalization, the Retina method and frequency domain enhancement.

B. Fusion based methods

Image fusion is the process of combining relevant information from multiple source channels into a high quality image. Fusion strategies should maximize the extraction of information [2] from each channel in order to improve the utilization of image information. These methods have also been used in image dehazing in recent years.

C. Image restoration based methods

Image restoration based methods for dehazing arestudied to explore the reasons for the image degradation and analyze the imaging mechanism [13], then recover the scene by an inverse transformation. In this method, the physical model of the degraded images is the basis, and many researchers have used the following general model for image restoration.

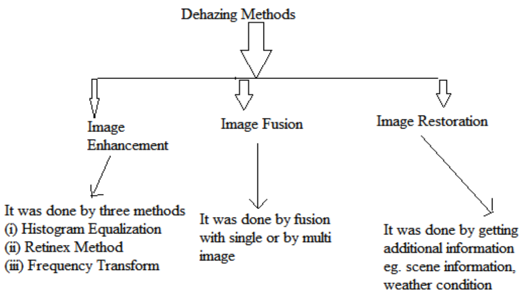

Fig.4. Methods of hazy free image classification

These methods are classified by structural andstatistical features, Statistical are the basic information like atmospheric light A, transmission t by dark channel prior method and in structural features calculating the pattern and texture in single image. So these methods only finding how much of original image is affected and how much to rectified the hazy image.

Dark Channel Prior:

The dark channel prior is a kind of statistics of outdoor haze-free images. It is based on a key observation most local patches in outdoor haze-free images contain some pixels whose intensity is very low in at least one color channel. Dark channel prior is used to remove haze from a single input image. The dark channel prior is a kind of statistics of the haze-free outdoor images. It is based on a key observation - most local patches in haze-free outdoor images contain some pixels which have very low intensities in at least one color channel. Using this prior with the haze imaging model, we can directly estimate the thickness of the haze and recover a high quality haze-free image. . We find that, in most of thelocal regions which do not cover the sky, it is very often that some pixels (called ”dark pixels”) havevery low intensity in at least one color (rgb) channel. In the haze image, the intensity of these dark pixels inthat channel is mainly contributed by the air light. Therefore, these dark pixels can directly provide accurate estimation of the haze’s transmission. Combining a haze imaging model and a soft matting interpolation method, we can recover a hi-quality haze-free image and produce a good depth map (up to a scale). Geometrically, the haze imaging Equation

(1) means that in RGB color space, vectors A, I(x), and J(x) are coplanar and their end points are collinear. The dark channel prior is based on the following observation on haze-free outdoor images:in most of the non-sky patches, at least one color channel has very low intensity at some pixels. In other words, the minimum intensity in such a patch should have a very low value. Formally, for an image**J**, we define

J^dark(**x**) = min (min (Jc(**y**))),

$c \in \{r, g, b\}$ $\mathbf{y} \in \Omega(\mathbf{x})$

where Jc is a color channel of **J** and Ω(**x**) is a local patch centred at **x**. Our observation says that except for the sky region, the intensity of J^dark is low and tends to be zero, if **J** is a haze-free outdoor image. We call J^dark the dark channel of **J**, and we call the above statistical observation or knowledge the dark channel prior.

1. **Estimation of atmospheric light A(x):**

In dark channel prior, the estimation of atmospheric light A(x) is very important part to recover the affected part so only we can find the depth of affected part. Basically dark channel prior mentioned the color channel in red, green, blue. Most of the images have very low intensity at some pixel. The major fault or low intensity are mainly due to three factors: (i) shadow (ii) more colourful objects or surface (iii) dark objects. We can find statistical features in channel wise and pixel wise is very good result correspondingly.

2. **Predict the transmission t(x):**

We have to find both A, t for haze removal. Now assume A is given and most of the paper t is constant. But estimation of t is also very useful to find depth in both channel wise and pixel wise or patch wise. Finally refined transmission map is used to capture the sharp edge discontinuities and outline of the object.

3. **Recover scene radiance J(x):**

With the terms of transmission map, we can recover the scene radiance J(x). We can increase the J(x) for more bright display.

CNN (Convolutional Neural Network) :

Today, we will create an Image dehazingof our own use, which can distinguish whether a given image is of affected **or** something else depending upon your fed data. To achieve our goal, we will use one of the famous machine learning algorithms out there which is used for Image Classification i.e. Convolutional Neural Network (or CNN). As we know it's a machine learning algorithm for machines to understand the features of the image with foresight and remember the features to guess whether the name of the new image fed to the machine. The actual dataset (100 percentages) is classified into two types, train dataset (75 percentages), test dataset (25 percentages). Now after getting the data set, weneed to pre-process the data a bit and provide results to each of the image given there during training the data set. A CNN have some layers, they are Convolutional layers, Activation or ReLU layers, Pooling layers, a fully connected layer. The convolutional layer is used to filter or resize into small size of the images. ReLU (Rectified Linear Unit), in this layer it takes only positive values only other non positive values are changed into 0. In Pooling it takes only maximum values in the matrix. In fully connected layer they specify the number of typesof data. By,

Input ->Convolution ->ReLU ->Convolution ->ReLU

->Pooling ->

ReLU ->Convolution ->ReLU ->Pooling ->Fully Connected.

I. Image Quality Assessment(IQA)

Image quality assessment (IQA) [18] is animportant step in image dehazing. The three types areFull Reference Image Quality Assessment, Reduce Image Quality Assessment, No Reference Image Quality Assessment. It need for pleasant view of clearance. Generally, the assessment of image quality includes two main aspects: image fidelity and image readability which can be classified as the subjective assessment and the objective assessment.

A. Subjective Assessment

The subjective assessment method uses observers to make the quality assessment using a set of assessment criteria according to their visualopinion of the processed image. The results are summarized to compare the performance of the algorithm [6]. The score was divided into 5 grades. The assessment required that there were more than 20assessors and that some people have experience in image processing while others should have no knowledge of image processing. The final quality score, called the Mean Opinion Score (MOS), is computed to obtain the overall assessment score by averaging the subjective scores from all assessors. The assessment criteria are shown in Table I.

TABLE I

THE CRITERIA OF SUBJECTIVEASSESSMENT

Image Assessment grade	Image Quality criteria	Mean Opinion Score
very hazy	The worst very hazy in the group	1
hazy	Worse hazy than average	2
moderate	Average moderate in the group	3
clear	Better clear than average	4
very clear	The best very clear in the group	5
cloudy	Not used for enhancement	6

Although this method is simple and can reflect the visual quality of the image, it lacks stability and is often subject to experimental conditions, the knowledge of the observers, their emotions, is to manually present several images in bad visibility alongside their corresponding enhanced images [3] which have been processed by different algorithms, and then enlarge some regions with key details for subjective comparison. This method lacks consistency from different assessors, and is difficultto use in engineering applications [7].

B. Objective Assessment

The objective assessment method evaluates the image with qualitative data according to objective criteria. In general, there are three major categories of quantitative metrics depending on the availability of an original image: full-reference methods, reduced- reference methods [15] and no-reference methods, with the first two categories needing to use a reference image. However, for image dehazing, the reference image of the same scene without haze is usually very difficult to obtain, so there is no ideal image to be used as a reference. Therefore, the no reference evaluation method [13] is often used or a dehazed image is used as the reference image to evaluate the performance of the algorithms.

Conclusion and Expectation

There are three types of dehazing methods seen in current research: image enhancement based methods, image fusion based methods and image restoration based methods. All of these methods have advantages and disadvantages. (i) Image enhancement based methods [20] improve the image contrast from the perspective of subjective vision, motivation, and many other factors [17]. In the current literature, the most common existing solution using a colour correction which conforms to theperception of human visual system [16] on a colour scene by estimating airlight refinement. The early methods are mature and reliable, but these methods result in unpredictable distortion, especially where there is complex depth in the field image. (ii) Image fusion based methods maximize the beneficial information from multiple sources to finally form a high quality image. (iii) Image restoration based methods are related to the image degradation mechanism, and are suitable for image dehazing with different depth of fields. However, optimal tools are required to find the solution and these methods may be time-consuming. Image restoration based methods are better than the other two types of methods for real scene dehazing and is now the current research hotspot dehazing systems. At present, the research on quality assessment of dehazed images still requires further development, and the evaluation indexes are mainly concentrated on image clarity, contrast, colourand structural information, while lacking comprehensive scientific criteria. The no-reference IQA method based on feature cognition can better fit human visual characteristics, which can be combined with an image analysis model, a statistical model, a visual information model and machine learningtheory to evaluate the image dehazing objectively,and will be a very important research direction. In summary, image dehazing techniques started relatively late due to the random nature and complexity of weather conditions, and there is only approximately a decade of research. At present, as a research hotspot in the field of machine vision, imagedehazing techniques are developing rapidly, and alarge number of new methods continue to appear.Although some research works have shown outstanding results under certain conditions, thesemethods still need further improvement. Exploiting image dehazing methods with universality, robustness and real-time performance will be a challenging task and usage of this in abounds in the future.

References

[1] H. Halmaoui, A. Cord, and N. Hautiere, “Contrastrestoration of road images taken in foggy weather,” in *Proc. 2011 IEEE Int. Conf. Computer Vision Workshops*, Barcelona, Spain, 2011, pp. 205-2063.

[2] Yuanyuan Goa, Hai-Miao hu, Bo Li, Qiang Guo, and Shiliang Pu, “Detail Preserved Single Image De-Hazing Algorithm Bsed on Airlight Refinement” in *IEEE Trans.on Multimedia*, 2018.

[3] Hai-Miao Hu, Qiang Guo, Jjin Zheng, Hanzi Wang, and Bo Li “Single Image Defogging Based on

Illumination Decomposition for Visual MaritimeSurveillance," *IEEE Trans. On Image Processing*, 2019.

[4] S. C. Huang, B. H. Chen, and Y. J. Cheng, "An efficient visibility enhancement algorithm for roadscenes captured by intelligent transportation systems," *IEEE Trans. Intell. Transp. Syst.*, vol. 15, no. 5, pp. 2321-2332, Oct. 2014.

[5] S. C. Huang, "An advanced motion detection algorithm with video quality analysis for video surveillance systems," *IEEE Trans. Circuits Syst. Video Technol.*, vol. 21, no. 1, pp. 1-14, Jan. 2011.

[6] B. Xie, F. Guo, and Z. X. Cai, "Universal strategyfor surveillance video defogging," *Opt. Eng.*, vol. 51, no. 10, pp. 101703, May 2012.

[7] Z. Jia, H. C. Wang, R. E. Caballero, Z. Y. Xiong,

J. W. Zhao, and A. Finn, "A two-step approach to see-through bad weather for surveillance videoquality enhancement," *Mach. Vis. Appl.*, vol. 23, no. 6, pp. 1059-1082, Nov. 2012.

[8] I. Yoon, S. Kim, D. Kim, M. H. Hayes, and J. Paik, "Adaptive defogging with color correction in the HSV color space for consumer surveillance system," *IEEE Trans. Consum. Electron.*, vol. 58, no.1, pp. 111-116, Feb. 2012.

[9] K. B. Gibson, D. T. Vo, and T. Q. Nguyen, "An investigation of dehazing effects on image and video coding," *IEEE Trans. Image Proc.*, vol. 21, no. 2, pp. 662-673, Feb. 2012.

[10] M. Chacon-Murguia and S. Gonzalez-Duarte,"An adaptive neuralfuzzy approach for object detection in dynamic backgrounds for surveillance systems," *IEEE Trans. on Industr. Electron.*, vol. 59, no. 8, pp. 3286-3298, Aug. 2012.

[11] S. Y. Tao, H. J. Feng, Z. H. Xu, and Q. Li, "Image degradation and recovery based on multiple scattering in remote sensing and bad weather condition," *Opt. Express*, vol. 20, no. 15, pp. 16584- 16595, Jul. 2012.

[12] J. Long, Z. W. Shi, W. Tang, and C. S. Zhang, "Single remote sensing image dehazing," *IEEEGeosci. Remote Sens. Lett.*, vol. 11, no. 1, pp. 59-63, Jan. 2014.

[13] A. Makarau, R. Richter, R. Muller, and P. Reinartz, "Haze detection and removal in remotely sensed multispectral imagery," *IEEE Trans. Geosci. Remote Sens.*, vol. 52, no. 9, pp. 5895-5905, Sep. 2014.

[14] J. Liu, X. Wang, M. Chen, S. G. Liu, X. R. Zhou, Z. F. Shao, and P. Liu, "Thin cloud removal from single satellite images," *Opt. Express*, vol. 22, no. 1, pp. 618-632, Jan. 2014.

[15] H. F. Li, L. P. Zhang, and H. F. Shen, "A principal component based haze masking method for visible images," *IEEE Geosci. Remote Sens. Lett.*,vol. 11, no. 5, pp. 975-979, May 2014.

[16] X. X. Pan, F. Y. Xie, Z. G. Jiang, and J. H. Yin, "Haze removal for a single remote sensing imagebased on deformed haze imaging model," *IEEE Signal Process. Lett.*, vol. 22, no. 10, pp. 1806-1810, Oct. 2015.

[17] L. X. Wang, W. X. Xie, and J. H. Pei, "Patch- based dark channel prior dehazing for RS multi- spectral image," *Chin. J. Electron.*, vol. 24, no. 3, pp. 573-578, Jul. 2015.

[18] R. Spinneker, C. Koch, S. B. Park, and J. J. Yoon, "Fast fog detection for camera based advanceddriver assistance systems," in *Proc. IEEE 17th Int. Conf. Intelligent Transportation Systems*, Qingdao,China, 2014, pp. 1369-1374.

[19] S. H. Sun, S. P. Fan, and Y. C. F. Wang, "Exploiting image structural similarity for single image rain

removal," in *Proc. 2014 IEEE Int. Conf. Image Processing*, Paris, France, 2014, pp. 4482- 4486.

[20] G. Yadav, S. Maheshwari, and A. Agarwal, "Foggy image enhancement using contrast limited adaptive histogram equalization of digitally filtered image: Performance improvement," in *Proc. 2014 Int. Conf. Advances in Computing, Communications and Informatics*, New Delhi, India, 2014, pp. 2225- 2231.