ANALYSIS OF VARIOUS CONTRAST IMPROVEMENT TECHNIQUES FOR DEHAZING AN IMAGE

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Abstract

Haze removal also known as contrast improvement mention unique procedures that focus to minimize or eliminate the degradation that have arises while the digital image was captured. The degradation may be owing to different factors like respective target-camera motion, blur becouse of camera miss-focus, respective atmospheric instability and others. This paper has concentrated on the variety of contrast improvement techniques. Since haze depends on the informaion of scene depth which is unknown factor so dehazing is dificult task. Efficacy of fog is the function of distance between the camera and target. Thus, air light map estimation is needed to haze removal. The present dehazing techniques can be classified as: image enhancement and image restoration Although, the image enhancement does not consolidate the cause of fog degrade the class of image.

Keywords: Fog removal, image enhancement, visibility restoration, camera motion, atmospheric instability.

1. INTRODUCTION

Images of open air scenes recorded in bad weather suffer from destitute in contrast [1]. Under poor weather conditions, the light extends to a camera is severely scattered by the airspace. So the image is getting highly cheapen due to additive light. Additive light are form from disperse of light by tiny pieces of fog. Additive light is generated by mixing the perceptual light that is emitted from different light heads. This additive light is called air light. Air light is not uniformly dispenced in the image.

Bad weather reduces airspace visibility. Poor visibility cheapens the perceptual image quality and outcome of the computer vision algorithms such as surveillance, tracking, and navigation [1]. Thus, it is very vital to make these vision algorithms resilient to weather changes. From the aairspace point of view, climate conditions differ mostly in the types and dimensions of the particles present in the airspace. A great attempt has gone into measuring the dimension of these particles. Based on the type of the visual effects, bad climate conditions are widely organized into two categories, steady and dynamic. In steady bad climate, constituent droplets are very compact and steadily levitate in the air. The examples of steady climate are fog, mist, and haze. In dynamic bad climate, constituent droplets are 1000 times sizeable than those of the steady climate. Rain and snow represent dynamic climate states.

There have been some remarkable efforts to reimpose images devalued by fog. The most common method known to magnify devalued images is histogram equalization. However, even though exhuastive histogram equalization is straightforward and rapid, it is not worthy because the fog's out-turn on an image is a function of the gap between the camera and the entity. Another effective method is to restore degraded images [10] is scene depth method but here required two images which are taken under different climate condition for balance the image quality. When using the wavelet method also demands several images to attain the enhancement. In all previous work consider the air light is uniformly distributed in the image. But originally the air light [5] is not equally distributed. Another method is atmospheric model. This methods use physical models to divine the pattern of image devalued and then reimpose image contrast with appropriate compensations.

Fig. 1.1: Enhancement of Degraded Image[2]

They supply better image execution but usually entail extra information about the imaging system or the imaging environment.

The deriving rot in disparity varies across the scene and exponential in the depths of scene points. Therefore, customary volume invariant image processing techniques are not sufficient to remove weather effects from images. Here suggested a simple correction method of contrast loss in foggy images, in order to estimate the air light from a color image, a cost function is used for the RGB channel. However, it assumes that air light is uniform over the whole image. In this, existing method is improved to make it applicable even when the air light distribution is not uniform over the image [5]. In order to estimate the air light, a cost function that is based on the human visual model is used in the luminance image. The luminance image can be estimated by an appropriate fusion of the R, G, and B components. Also, the air light map is estimated using least squares fitting, which models the correspondance between topical air light and the coordinates of the image pixels.

1.2 PROBLEM DEFINITION

Taking an image in foggy climate state that images become devalued due to the existence of air light. It is known that under fog weather conditions, the disparity and color credibility of the images are drastically devalued. Clear day images have more contrast than foggy images. Hence, a fog removal algorithm should enhance the scene contrast. Enhancement of foggy image is a provocation due to the convolution in recovering luminance and chrominance while maintaining the color fidelity. During intencification of foggy images, it should be kept in sense that over intencification leads to saturation of pixel value. Thus, intencification should be vault by some limitaion to avoid saturation of image and preserve appropriate color fidelity.

1.3 OBJECTIVE

To compare different methods to remove fog and find the research gap. Removal of fog is important for the tracking and navigation applications, consumer electronics, and entertainment industries. Fog devalued the perceptual image standard, thus the efficacy of computer vision algorithms based on small trait or high frequencies [16]. Removal of fog from images as a preprocessing expends the exactness of these computer vision algorithms. A feature point detector can unsuccessful if images have short visibility. If fog is separated and image is enhanced, then feature point detector can work with higher accuracy.

2. Related Work

Bad climate such as fog, mist and haze reduce atmospheric visibility. Poor visibility degrades perceptual image quality and performance of the computer vision algorithms such as surveillance, tracking and navigation. Thus, it is very vital to make these vision algorithms resilient to climate changes. Optically, poor visibility in bad climate is due to the considerable existence of water droplets. These droplets have significant dimension (1–10 mm) [1] and distribution in the participating medium. Light from the airspace and light reflected from an entity are scattered by these droplets, resulting the visibility of the scene to be degraded. Two fundamental phenomena that are consequence of scattering are ‘attenuation’ and ‘airlight’. Light shaft coming from a scene point, gets attenuated because of scattering by airspace particles. This phenomenon is termed as attenuation which reduces contrast in the scene. Light coming from the source is scattered towards camera and adds whiteness in the scene. This phenomenon is termed as airlight. It is noted that attenuation and airlight are function of the distance between camera and object. Hence removal of fog requires estimation of depth map or airlight map. As a consequence, methods based on the use of multiple images are proposed. In [2] Schechner et al. suggested a method based on the use of images with different polarising filters. This requirement of filters is a big constrain for image acquisition and cannot be applied on the existing image databases. In past few years many methods [3–11] have been suggested for the removal of fog using single image. In [4] Fattal suggested a method based on ICA. This algorithm is computationally intensive and deeply based on colour information and thus cannot be applied for grey image. This method fails when images are degraded by dense fog because the foggy image is colourless. In [5] Tan removed fog by maximising local contrast of image but restored image looks over saturated. This method has advantage of easier application on many kinds of images. Kopf et al. [6] suggested a method based on the use of three-dimensional (3D) model of the scene. This method is application dependent and needs input from an expert. He et al. [7] suggested a method based on dark channel prior and soft matting. Here airlight map is estimated using dark channel prior and refined by soft matting. But when scene objects are bright similar to atmospheric light, underlying assumptions of this method are not valid. Tarel and Hautiere [3] suggested a method based on linear operations but this method requires many parameters for adjustment. In [10] Fang et al. suggested a method based on the graph-based segmentation. Initial transmission map is estimated according to black body theory and refined by bilateral filter. It is noted that for the foggy image choice of control parameters of segmentation is difficult. In [11] Zhang et al. suggested a local albedo insensitive image dehazing method. This method is based on iterative bilateral filter. This algorithm gives good results. Owing to the use of iterative bilateral filter this technique is computationally intensive and requires choice of number of parameters (viz. spatial and intensity kernels of bilateral filter and number of colour groups) for optimal results. Values of these parameters vary from image to image.

3. Comparison of Various Contrast Improvement Techniques for fog Removal

Here is the comparison of various contrast improvement techniques of last decade given in the tabular form. Mostly worked on color and gray image to rectify problem of fog. During the comparision of differenr methods there is gap found in the study which is giving in the next section.

Authors	**Bit of input image(s)**	**Belifes**	**Types of image**
Oakley (1998)	Multiple	Understanding of scene depth	Gray
Schenchner (2001)	Multiple	Light disseminate by tiny pieces of airspace is partially polarized	Color & gray
Narasimhan (2002)	Multiple	Uniform poor climate state	Color & gray
Narasimhan (2003)	Single	Interactive	Color & gray
Oakley (2007)	Single	Airlight is unchanged every portion in the image	Color & gray
Kim (2008)	Single	Cost function based on human visual model	Color
Kopf (2008)	Single	Interactive	Color & gray
Fattal (2008)	Single	Shading and transmission functions are locally discountinuous	Color
Tan (2008)	Single	Based on spatial regularization and scalation of local contrast	Color & gray
He (2009)	Single	Based on dark channel prior	Color & gray
Tarel (2009)	Single	Based on airlight as a percentage between local standard deviation and local mean of whiteness	Color & gray

Zhang . (2010)	Single	Under the assumption that large-scale chromaticity inequalities are because of transmission while small scale luminance variations are because of scene Albedo	Color & gray
Fang (2010)	Single	Based on blackbody theory and graph based image segmentation	Color & gray
A.Tripathi (2012)	Single	HE and anisotropic diffusion	Color & gray

4. GAPS IN RELATED WORK

Fog removal algorithms become more beneficial for numerous vision applications. It has been originated that the most of the existing research have mistreated numerous subjects. Following are the various research gaps concluded using the related work:-

(a) The presented methods have neglected the techniques to reduce the noise matter, which is given out in the output images of the existing fog removal algorithms.

(b) Not much attempt has concentrated on the united approach of the CLAHE and Dark channel prior.

(c) The problem of the uneven illuminate is also neglected by the most of the researchers.

5. CONCLUSION AND FUTURE WORK

Fog removal algorithms have become more applicable formany vision approach. It is confirmed that majority of the existing researchers have neglected many issues; i.e. no technique is precise for different kind of set of condition. The existing methods have neglected the use of histogram stretching and Gabor filter to reduce the noise problem which will be presented in the output image of the existing fog removal algorithms. To defeat the problems of existing research a new united algorithm will be proposed in near future. New algorithm will unite the dark channel prior, CLAHE and histogram stretching to improve the results further. The Gabor filtering is also done as a pre-processing step to remove the nosie form the input image.

6. References

[1]Garg, K., Nayar, S.K.: 'Vision and rain', Int. J. Comput. Vis., 2007, 75,(1), pp. 3–27.

[2] Schechner, Y.Y., Narasimhan, S.G., Nayar, S.K.: 'Instant dehazing of images using polarization'. IEEE Computer Society Conf. onComputer Vision and Pattern Recognition, 2001, pp. 325–332.

[3] Tarel, J.P., Hautiere, N.: 'Fast visibility restoration from a single color or gray level image'. IEEE Int. Conf. on Computer Vision, 2009, pp. 2201–2208

[4] Fattal, R.: 'Single image dehazing'. Int. Conf. on Computer Graphics and Interactive Techniques archive ACM SIGGRAPH, 2008, pp. 1–9

[5] Tan, R.T.: 'Visibility in bad weather from a single image'. IEEE Conf. on Computer Vision and Pattern Recognition, 2008, pp. 1–8

[6] Kopf, J., Neubert, B., Chen, B., et al.: 'Deep photo: model-based photograph enhancement and viewing', ACM Trans. Graph., 2008, 27, (5), p. 116:1–116:10

[7] He, K., Sun, J., Tang, X.: 'Single image haze removal using dark channel prior'. IEEE Int. Conf. on Computer Vision and Pattern Recognition, 2009, pp. 1956–1963.

[8] Kim, D., Jeon, C., Kang, B., Ko, H.: 'Enhancement of image degraded by fog using cost function based on human visual model'. IEEE Int. Conf. on Multisensor Fusion and Integration for Intelligent Systems, 2008, pp. 163–171.

[9] Yu, J., Xiao, C., Li, D.: 'Physics-based fast single image fog removal'. IEEE Int. Conf. on Signal Processing (ICSP), 2010, pp. 1048–1052.

[10] Fang, S., Zhan, J., Cao, Y., Rao, R.: 'Improved single image dehazing using segmentation'. IEEE Int. Conf. on Image Processing (ICIP), 2010, pp. 3589–3592

[11] Zhang, J., Li, L., Yang, G., Zhang, Y., Sun, J.: 'Local albedo-insensitive single image dehazing', Vis. Comput., 2010, 26, (6–8), pp. 761–768.

[12] Narasimhan, S.G., Nayar, S.K.: 'Chromatic framework for vision in bad weather'. IEEE Conf. on Computer Vision and Pattern Recognition, 2000, vol. 1, pp. 598–605.

[13] Gonzaless, R.C., Woods, R.E.: ‘Digital image processing’ (Addison- Wesley, Reading, MA, 1992, 2nd edn.)

[14] Perona, P., Malik, J.: ‘Scale space and edge detection using anisotropic diffusion’, IEEE Trans. Pattern Anal. Mach. Intell., 1990, 12, (7), pp. 629–639

[15] Economopoulosa, T.L., Asvestasa, P.A., Matsopoulos, G.K.: ‘Contrast enhancement of images using partitioned iterated function systems’, Image Vis. Comput., 2010, 28, (1), pp. 45–54

[16] Hautiere, N., Tarel, J.P., Aubert, D., Dumont, E.: ‘Blind contrast enhancement assessment by gradient ratioing at visible edges’, J. Image Anal. Stereology, 2008, 27, (2), pp. 87–95

[17] AK Tripathi and S Mukhopadhyay,”Single Image Fog Removal using anisotropic Diffusion ” ,IET Image Processing, 2102 Vol. 6, Iss. 7,pp. 966-975