

A Survey on Visibility Restoration of Hazy Images

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ABSTRACT: Visibility restoration plays a dominant role in many image processing applications. The visibility of outdoor images is often degraded due to the presence of haze, fog, sandstorms, and so on. Poor visibility caused by atmospheric phenomena causes failure in image processing applications. Fog removal also known as visibility restoration refers to different methods that aim to reduce or remove the degradation that have occurred while the digital image was being obtained. This paper has focused on the various fog removal techniques. In order to solve this problem visibility restoration (VR) techniques have been developed and plays an important role in many image processing applications that operate in various weather conditions. In this paper various visibility restoration techniques are compared.

KEYWORDS: Dehazing, Visibility Restoration, Dark channel prior.

I. INTRODUCTION

Visibility restoration refers to different methods that aims to enhance the visibility of an image. The degradation may be due to various factors like relative object camera motion, blur due to camera misfocus, relative atmospheric turbulence and others. The image quality of outdoor scene in the fog and haze weather condition is usually degraded by the scattering of a light before reaching the camera due to large quantities of suspended particles (e.g. fog, haze, smoke, impurities) in the atmosphere. This phenomenon effects the normal work of automatic monitoring system, outdoor recognition system and intelligent transportation system. Scattering is caused by two fundamental phenomena such as attenuation and air light. By the usage of effective haze removal of image the stability and robustness of the visual system can be improved. Haze removal is a tough task because fog depends on the unknown scene depth information.



Fig.1.1 a) Hazy Image



b) Visibility restored Image

Fog effect is the function of distance between camera and object. Hence removal of fog requires the estimation of air light map or depth map. The current haze removal method can be divided into two categories: image enhancement and image restoration. Image enhancement does not include reasons of fog degrading image quality. This method can improve the contrast of haze image but loses some of the information regarding image. Image restoration firstly studies the physical process of image imaging in foggy weather. After observing that degradation model of fog image will be established. At last, the degradation process is inverted to generate the fog free image without the degradation.

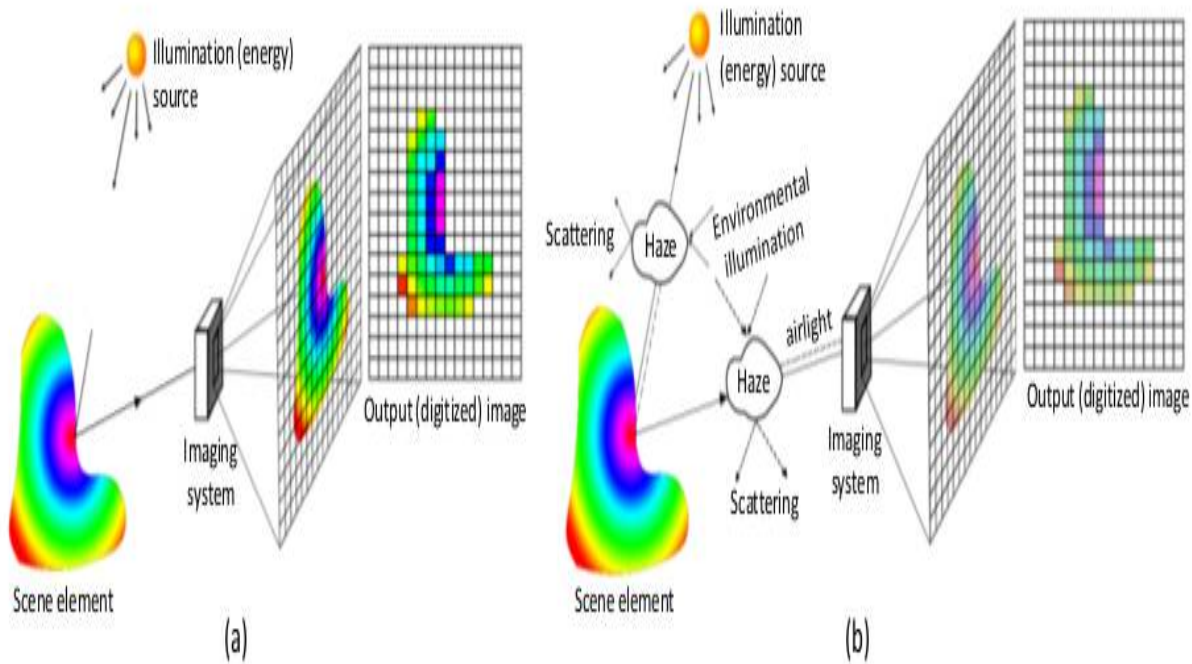


Fig.1.2 The process of imaging during sunny and hazy weather.

II. RELATED WORK

Concentration of the haze is different from place to place and it is hard to detect in a hazy image, image dehazing is thus a challenging task. Early researchers use the traditional techniques of image processing to remove the haze from a single image (for instance, histogram-based dehazing methods. However, the dehazing effect is limited, because a single hazy image can hardly provide much information. In polarization-based methods are used for dehazing with multiple images which are taken with different degrees of polarization. Haze removal approaches with multiple images of the same scene under different weather conditions are done. Dehazing is also conducted based on the given depth information.

Recently, significant progress has been made in singleimage dehazing and visibility restoration based on the physical model. Under the assumption that the local contrast of the haze-free image is much higher than that in the hazy image, a novel haze removal method by maximizing the local contrast of the image based on Markov Random Field (MRF) was developed and this approach is able to achieve impressive results, it tends toproduce over-saturated images. Haze from colour images can be removed based on Independent Component Analysis (ICA), but the approach is time-consuming and cannot be used for grayscale image dehazing.

VISIBILITY RESTORATION		
	FEATURES	DISADVANTAGE
Visibility Restoration Algorithm Using Laplacian-method	a visibility restoration approach using Laplacian-method to remove fog thickness estimation and color cast problems. So, a better image with clear visibility and colorful image can be generated.	This restoration approach usually cannot sufficiently restore images due to reduced evaluation of fog depth and the perseverance of colour cast problems.
Visibility restoration Based On Dark Channel Prior	This method dehazes foggy image after applying dark channel prior	Fails to dehaze heavy haze particles
Visibility restoration by Enhancement And Noise Reduction Of Very Low Light Level Images	The procedure is developed mainly for enhancing images acquired under extremely low light situation where the features of images are nearly unseen.	If intensity is not amplified then contrast gets dull.
Visibility restoration by Using Iterative Bilateral Filter	A simple but efficient iterative method for recovering fog free scene contrast and increasing scene visibility from an isolated foggy image	Fails to dehaze heavy haze particles
Visibility restoration in real scenes by edge collapse based dehazing algorithm	Dynamically repair transmission map there by achieve satisfactory Visibility restoration.	

FIG 1.2. COMPARISON OF DIFFERENT VISIBILITY RESTORATION METHODS

III. VISIBILITY RESTORATION TECHNIQUES

Visibility restoration refers to different methods that aim to reduce or remove the degradation that have occurred while the digital image was being obtained. For removing haze, fog, mist from the image various technique are used.

A) VISIBILITY RESTORATION BY LAPLACIAN METHOD

Images captured during fog conditions often feature corrupted visibility and undesirable colour cast property. In this method [1], visibility restoration approaches usually cannot sufficiently restore images due to reduced evaluation of fog depth and the perseverance of colour cast problems. The author presented a visibility restoration approach using laplacian. In case of local regions which do not cover the sky, it is very often that some pixels (called dark pixels) have very low intensity in at least one colour (rgb) channel. In the haze image, the intensity of these dark pixels in that channel is mainly contributed by the air light. Therefore, these dark pixels can directly provide accurate estimation of the hazes transmission. By combining a haze imaging model and a soft matting interpolation method, a high quality haze-free image can be recovered and produce a good depth map (up to a scale). Method to remove fog thickness estimation and colour cast problems in [1]. So, a better image with clear visibility and colourful image can be generated. It is a novel Laplacian-based visibility restoration approach for restoration of degraded images captured during inclement weather conditions, such as fog and sandstorms. This method is based on the Laplacian distribution model and features a combination of the proposed HTE module along with the proposed IVR module to adequately remove haze formation and recover vivid scene colour in an image. Laplacian-based gamma correction is used during the HTE module to refine an insufficient transmission map and thus achieve effective estimation of haze thickness, after which the refined transmission map is used to restore the visibility of a degraded image via the proposed IVR module.

B) VISIBILITY RESTORATION BASED ON DARK CHANNEL PRIOR

The dark channel prior [2] is based on the statistics of out-door haze-free images. In most of the non-sky patches, at least one colour channel (RGB) has very low intensity at some pixels (called dark pixels). These dark pixels provide the estimation of haze transmission. This approach is physically valid and work well in dense haze. When the scene objects are similar to the air light then it is invalid. The dark channel prior is based on the statistics of haze-free outdoor images.

C) VISIBILITY RESTORATION BY ENHANCEMENT AND NOISE REDUCTION OF VERY LOW LIGHT LEVEL IMAGES

A general method for image contrast improvement and noise reduction. This procedure [3] is developed mainly for enhancing images acquired under extremely low light situation where the features of images are nearly unseen. After using better and effective image defog algorithm to the inverted input image, the contrast get improved and the dark surface become bright when the intensity can be amplified. By applying an improved and effective image dehaze algorithm to the inverted input image, the intensity can be amplified so that the dark areas become bright and the contrast get enhanced. Then, the joint- bilateral filter with the original green component as the edge image is introduced to suppress the noise.

D) VISIBILITY RESTORATION BY ITERATIVE BILATERAL FILTER

A simple but efficient iterative method for recovering fog free scene contrast and increasing scene visibility from an isolated foggy image. The key benefit of this algorithm [4] compared with others is its speed and effectiveness for both gray level and colour images. By using the dark channel prior with the haze imaging model direct estimation of the coarse transmission map is possible. Then an iterative refinement module based on bilateral filter is applied to refine the transmission map. The main advantage of this algorithm [4] compared with others is its speed and efficiency for both colour and gray level images.

E) VISIBILITY RESTORATION BY EDGE COLLAPSE BASED AND DEHAZING ALGORITHM

Edge collapse based dehazing algorithm [5] dynamically repair transmission map by attenuating edge information and thereby achieve satisfactory visibility restoration. It is a novel dehazing algorithm for restoring hazy images captured under a wide range of weather conditions. This algorithm includes three operations: haze density estimation, edge collapse assumption, and image visibility recovery. First haze density is estimated by using the dark channel prior with respect to Koschmieders model [7]. Transmission map is refined by a guided filter [8]. It utilizes the variation of edge collapse to dynamically repair the transmission map whose haze thickness is underestimated and restores the degraded image as a haze-free image by adopting the repaired transmission map. Colour attenuation prior [6] can also be used with this edge collapse based dehazing algorithm [5].

IV. CONCLUSION

Visibility restoration algorithms is very useful for many computer vision applications. It is found that most of the existing researchers have neglected many issues; i.e. technique accurate for different kind of circumstances. Poor visibility caused by atmospheric phenomena in turn causes failure in computer vision applications, such as outdoor object recognition systems, obstacle detection systems, video surveillance systems, and intelligent transportation systems. In order to solve this problem, visibility restoration techniques have been developed and plays a key role in many computer vision applications that operate in various weather conditions.

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