Satellite and Natural Image Enhancement using DCP based multi level DWT-SVD with haze removal

D.Pavan kumar[1], Dr.P.Poorna Priya[2]

#1Student,Dept of Electronics and Communication Engineering(ECE), Specialization: Systems & Signal Processing(SSP), Dadi Institute of Engineering and Technology

NH-16,Anakapalle,Visakhapatnam-531002

#2Associate professor, ,Dept of Electronics and Communication Engineering(ECE), Specialization: Systems & Signal Processing(SSP), Dadi Institute of Engineering and Technology NH-16,Anakapalle,Visakhapatnam-531002

Abstract

Generally remote sensing images are in hazy conditions such as fog, snow, thin cloud, dust etc., which results in contrast degradations in image. This work is based on the Dark Channel prior (DCP) to eliminate the haze effect on remote sensing images. In this model both natural images and remote sensing images DE hazingis possible. In the enhancement of satellite image properties several steps are involved, the first step is to identify whether the image is natural image or remote sensing image and restore it for the purpose of removing haze. By using airlight values further the iteration takes place with the help of DCP to remove dust and then the haze is eliminated by applying Iterative dehazing method for remote sensing image (IDERS) model. The output image obtained after Low light image enhancement (LIME) process is free from haze, brightness is enhanced.

Keywords:*IDERS, LIME, DCP, ESTIMATEAIRLIGHT, GAUSSIAN*

1. INTRODUCTION

During the bad weather conditions, such as haze and fog, the quality of images degrades badly due to the influence of particles in the atmosphere. Suspended particles will scatter light results in attenuation of reflected light from the scene and the scatter atmospheric light will also mix with the light received by the camera and change the image contrast and color. It shows a comparison [1] between haze-free image and a hazy image. The scattered light due to the haze greatly reduce the image contrast and the image color appears dull. The Dark Channel prior (DCP) method used for the elimination of haze effect on remote sensing images. Recorded color images taken in bad environments exhibit problems such as low visibility, reduced contrast and generally bad" quality" [2]. For this reason, many methods known as DE hazing methods have been designed to improve the perceived image quality in order to be used later in Computer Vision applications, which require images of high quality. Unlike computational photography, image usability and fidelity may be promoted over preference in computer vision. Amongst these two aspects [3], we consider particularly the fidelity.

2. LITERATURE SURVEY

Consider the low light or hazy input image. Here only satellite image is considered as this method is applicable to only satellite image not for natural images. These images are consisting of noise, so for noise removal operations different types of filters are used such as median filter, wiener filter and mean filters are used.

Median filter:Median filtering is a nonlinear technique used to remove noises from pictures. ... Pixel, over the whole image. The median is determined by first arranging all the pixel values from the window into numerical manner, and afterward middle value is replaced in place of pixel being considered.

Mean filter: Average (or mean) filtering is a strategy of 'smoothing' images by decreasing the amount of intensity variation between neighbouring pixels. The average filter works by travelling through the image pixel by pixel, average value is compared with eachand every pixel value. Then based on these comparisons pixel values are replaced with their average value.

Wiener filter:The Wiener filtering is optimal in terms of the mean square error. In other words, it minimizes the overall mean square error in the process of inverse filtering and noise smoothing. The Wiener filtering is a linear estimation of the original image. The approach is based on a stochastic framework.

$$G(u,v) = \frac{H*(u,v)}{|H(u,v)|^2\, P_s(u,v) + P_u(u,v)} \quad (1)$$

After the first step, we will get two types of images those are equalized image and high contrast image. Then for both images discrete wavelet transformation is applied. Here wavelet refers to group of pixels and transformation refers to changing pixel properties. DWT uses the low pass filter and high pass filters, these are applied on rows and columns of an image to generate the four sub bands HH, HL, LH and estimates the singular value matrix of the low-low sub bandimage. All-important pixel properties are preserved in only low pass bands and not in high pass bands. So, LL and LH bands are considered for calculation of air light intensities and their parameters μ, ∑ and v these are referred to as atmospheric properties. Even though LL is affected more with light or haze HH, LH, HL with respect to LL.

For this purpose Bicubic interpolation will be introduced. Here no of pixels will introduce in a cube manner. Then resultant image obtained after Bicubic interpolation process is a difference image. Bicubic interpolation operation is performed between filtered image and LL image and results the difference image. Now HH, LH and HL are modified according to difference image by image addition properties, results the new estimated HH, LH and HL. In earlier steps we calculated the atmospheric coefficients from LH band and from light intensity and temp coefficient zeta are calculated by applying the radiance properties on it.Then image haze will changed in LL band. IDWT (Inverse discrete wavelet transformation) operation performed on new HL, LH, HH and LL bands to recover the new DE hazed image. The output of IDWT process gives Brightness and Resolution enhanced image due to the application of DWT technique in the earlier stage of this enhancement process.This technique is compared with conventional image equalization techniques such as standard general histogram equalization and local histogram equalization and global histogram equalization. As well as state-of-the-art techniques such as brightness preserving dynamic histogram equalization and singular value equalization.

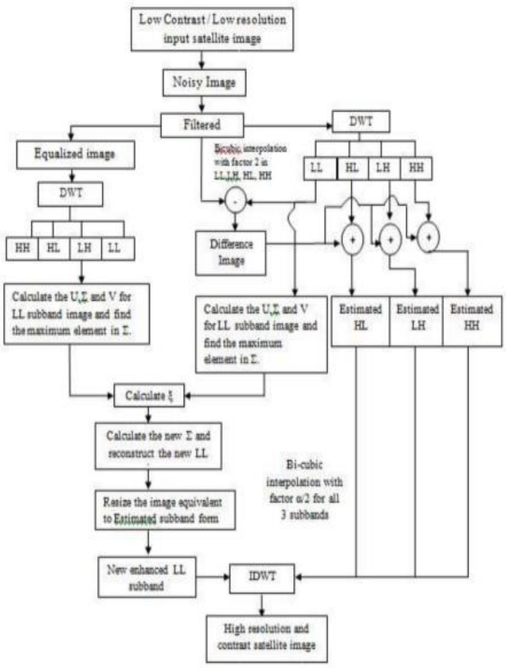

Fig 1: DE hazing using DWT

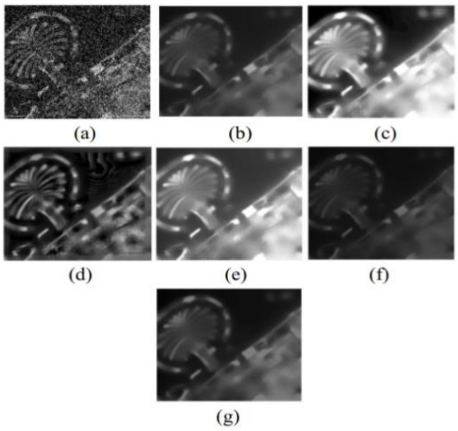

Fig.2: (a) Noisy image (Random Noise) (b) Filtered image as input image (Non local mean filter)(c) GHE image (d) LHE image (e) SVE image (f) DWT image (g) DWT method image.

The existing method drawbacks are as follows:

1. Less Dehazing capability.
2. Low PSNR and SSIM.
3. Applicable to only satellite images.
4. Pixel values are corrupted.
5. No image enhancement operations.

3. PROPOSEDMETHOD:

The existing model unable to remove the haze from the natural images and it is having lowest accuracy as noise increases. To overcome this problems new methodology is proposed as shown in Fig.3

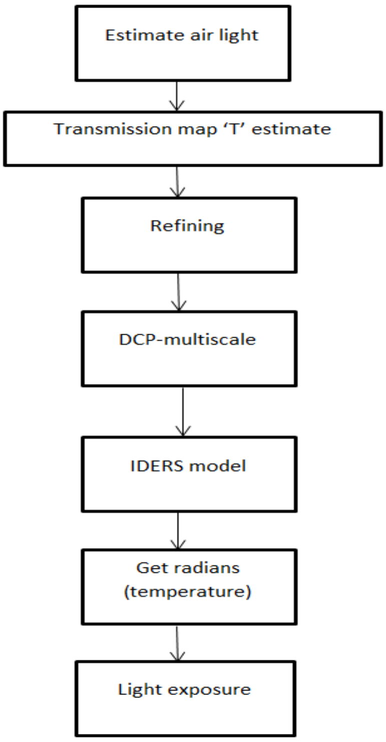

Fig 3. DE hazing using IDERS

3.1ESTIMATE AIR LIGHT:

The brightest pixels in the hazy image are considered to be the most haze-opaque, if and only if, the weather is overcast and the sunlight denoted by S is ignored and only the atmospheric light A∞ is considered.

The main block involved in the enhancement of satellite image properties by using DCP for remote sensing image process is estimate air light. This block mainly focuses on the estimation of air light values for generation of transmission matrix. In the first step color image is converted into 3-indexes such as red,green and blue.Then extract the low intensity pixels,for satellite images cluster count will be more and vice versa for normal images. Then the clusters must be rearranged for the new transmission map estimation.Depending upon the air light values these clusters will be divided into three groups or color channels (RG, GB, and RB). Then air light values will be generated based on updating of old air light values as show in fig 4.

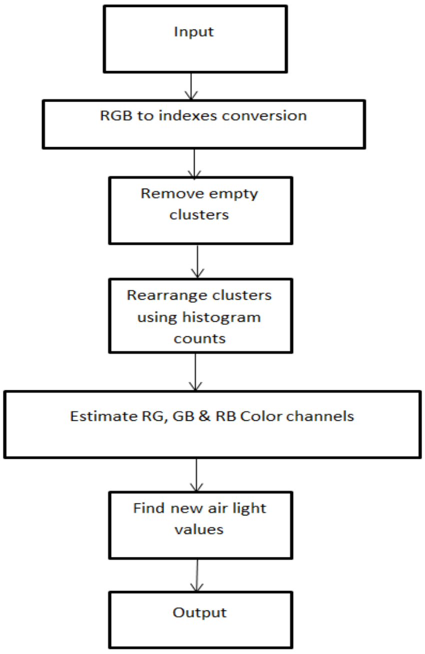

Fig 4. Process of estimate airlight

3.2TRANSMISSION MAP ESTIMATION:

Estimation of atmospheric light takes place, then transmission is estimated as follows:

$$t(x) = 1 - \omega \min_{y \in \Omega(x)} \left(\min_{c} \left(\frac{I^c(y)}{A^c_\infty} \right) \right) \quad (2)$$

ω is the amount of haze kept in image to avoid unnatural scenes (ω = 0.95).

In order to refine the transmission map, soft matting Laplacian is applied to smooth artifacts along edges. However, it increases dramatically the computational time.

3.3DCP MULTISCALE:

It depends on the presumption that, for a given pixel in a shading picture of a characteristic scene, one channel (red, green or blue) is typically dark, aside from the sky. The air light will in general light up these dark pixels, and accordingly it is assessed from the darkest pixels in the scene. This perception is motivated from [6], and it is called as dark channel prior. For a hazy picture J(x), the dark channel J dark(x) is given by

$$J^{dark}(x) = \min_{c \in \{r,g,b\}} \left(\min_{y \in \Omega(x)} (J^c(y)) \right) \quad (3)$$

Jc is a shading channel of J and Ω(x) is a local patch focused at x. In [7], dark channels are processed utilizing a patch size 15×15. Not many insights are given to characterize the patch size: the probability that patch contains dark pixel is increased with respect to bigger size bigger size. In this manner, dark channel could be precisely evaluated. In any case, with an enormous patch, the supposition that the transmission is steady in a patch turns out to be less proper and the hollow artifacts near depth edges become increased. Most DCP-based DE hazing strategies figure the dark channel by essentially utilizing a local patch with a fixed size to fundamentally diminish the computation time. A portion of the DCP based lining up strategies think about a patch with an alternate size from 15×15, which was fundamentally utilized. The patch size can be progressively adjusted dependent on the picture content. Some of them utilized a patch size of 11×11 to decrease time consuming work [8]. In genuine over-satiation impacts happen in the recovered scene radiance when a little patch size is utilized in the first cloudy picture including limited light. This prompts a disappointment in the recognizable proof of the environmental light source. Bigger size can resolve this issue, yet it prompts to halo effects and black artifacts, particularly along edges. In this manner, two patch sizes of 3×3 and 45×45, which are tentatively recognized, have been utilized in a procedure of DCP.

Incorrect estimation of the transmission map may prompt a few mutilations, for example, square antiquities. The patch-based dark channel figuring prompts a foggy transmission map. This is fundamentally because of the presumption that t is a consistent incentive in a local patch. This isn't in every case genuine, particularly when the patch contains a sharp edge. This off-base supposition prompts clear edge artifacts. So as to get a refined map, numerous strategies have been utilized.

Smoothing of the map takes place with the help of Gaussian filter in several DE hazing techniques. Some others have utilized rather than the bilateral filter, which is fundamentally the same as Gaussian convolution, however pixels are dealt with dependent on close by area and comparative qualities.Gaussian filter is a smoothing channel with edge-protecting.Similar to bilateral filter Guided filter performs edge_safeguarding. Yet it has a superior activity close to edges. Since the use of the soft matting, which has been utilized in the first DCP strategy, was incredibly moderate, the creators of this technique supplanted it by the guided filter to accelerate the transmission refinement map. Consequently, the soft matting has never been utilized later in some other DE hazing technique. Contrariwise, the guided filter has been utilized later in different strategies.

The fundamental contrast point between these refinement calculations, that not at all like the Gaussian and the Bilateral filters, the soft matting, the Cross-two-sided filter and the Guided filter consider the gray image and not just the color hazy image of the transmission map. This assists with evacuating the wrong surfaces dependent on the real colors and to hold a comparative sharpness to the first color hazy picture.

These improving calculations have been applied legitimately on the transmission map. Notwithstanding, different calculations apply a pre-preparing upgrading calculation to the foggy picture so as to forestall the transmission map from obscure and incorrect surfaces.

3.4. IDERS MODEL:

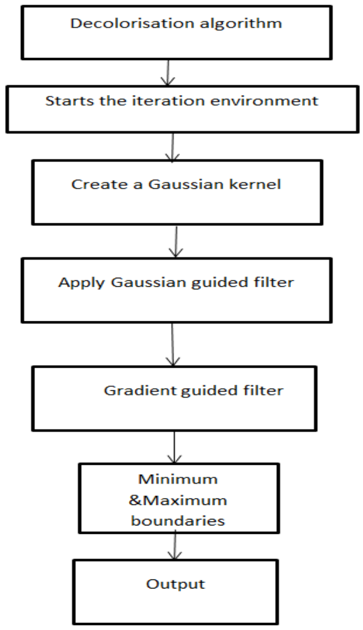

Fig 5.process of dehazing model

In IDERS decolorization operation will be performed to remove the white levels (or) else here basic color conversion will be performed. For this purpose three methods can be suitable such as GCS, SPD decolorization, RGB to gray conversion. Among these three methods GCS decolorization performs effectively. Here global and local contrast using IM (image adjust methodologies). Global contrast will modify top level, local is for pixel level based on three new contrast levels, new color composites operations will be performed with respect to both x and y direction in the matrix.Repeat the matrix for minimum gradient conditions by using absolute concept. Find out the correlation, average correlation between all the rows, all the columns will be calculated. Find out the maximum correlation value with respect to maximum value modify the input image using image linearity properties as shown in fig 5.

3.5GET RADAINS:

Light temperature is increased or decreased when compared with original image will be identified in this step for further enhancement operations.

3.6LIME: By applying the light exposure or lime concept light levels will be automatically adjusted. Within the image only the mid value is considered then it is adjusted to middle value only parts of image only modified.

4. SIMULATION RESULTS:

The simulations are performed on both satellite image and natural image datasets and implemented on mat lab software to get the following results.

(a)Input image (b)DCP process ouput

(c)DE hazed image

Fig 6. Natural image (Forest)

(a)Input image (b)DCP process ouput

(c) DE hazed output

Fig 7.Satellite image (City Buildings)

(a) Input image (b) DCP process output

(C)DE hazed output

Fig 8. Satellite image (water surface)

Table 1: Summary of comparison

Parameters	Existing method(DWT-PCA)	Proposed method(DCP)
PSNR	11.45	35.89
SSIM	0.67	0.82
MSE	34.46	11.36
ACCURACY	42.67%	84.67%

5. CONCLUSION:

The satellite image DE hazing is the essential operation to be performed for effectively identifying the resources. For this purpose DCP & IDERS method is showing better accuracy and enhancing capabilities compared to the previous DWT method. It can be extended to implement the identifying the type of resources from the satellite images.

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Author's Profile

D.Pavan kumar,

Dept of Electronics and Communication Engineering(ECE), Specialization: Systems & Signal Processing(SSP), Dadi Institute of Engineering and Technology

NH-16,Anakapalle,Visakhapatnam-531002

Dr.P.Poorna Priya

Working as Associate professor, ,Dept of Electronics and Communication Engineering(ECE), Specialization: Systems & Signal Processing(SSP), Dadi Institute of Engineering and Technology NH-16,Anakapalle,Visakhapatnam-531002