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Fast Removal of Single Image using Pixel-based Median Channel Prior

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Abstract. This paper proposes a fast method to enhance the image, which is taken for the bad weather such as fog, haze. Using pixel-based median channel offog image, we can estimate atmospheric light. As a result, high-quality image can be recovered with lower computation complexity compared to patch-based dark channel prior.

Keywords: dark channel, fog removal, median dark channel

1 Introduction

Many applications in computer vision assume input images are clear. Unfortunately, it is not always true [1].

One of the several algorithms for single image is proposed by Kaiming[2]. It is Dark channel prior(DCP), which is assumed to have low intensity in one color channel. However, Kaiming's method needs post-processing because of the halo effect.

In this paper, we propose improved DCP using pixel-based median channel prior.

2 Fog Removal Algorithm

In computer vision, the fog optical model used to described the formation of a fog image is given as follows [1,2,4]

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

Where I(x) is the observed image, J(x) is the fog-free image, A denotes Air light, and t(x) is medium transmission.

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2.1 Proposed dehazing based on pixel-based median channel prior

Our proposed method takes advantage of the property that one of RGB channels is close to zero in the image without the sky. We call this as "pixel-based median channel prior".
The median channel J^{median} is inferred as :

$$J^{median}(x) = med_{C\in R,G,B} J^C(x) . \quad (5)$$

Where J^C is the each of the three channels for a pixel..

To extract the air light, we find the maximum value among R, G, and B for a pixel. Then each maximum values for a pixel are compared to decide the highest value.

$$Air\ light = \max\ [max_{c\in R,G,B} J^C(x)] \quad (6)$$

After estimating air light, we can derive the transmission map as :

$$t(x) = 1 - w * [med_{C\in R,G,B} \frac{I^C}{Air\ light^C}] \quad (7)$$

A constant parameter, w ($0<w\leq1$), is used for preserving the original color.w is fixed at 0.75 for all results in this paper.

With the transmission map, we can recover the fog image. Removal fog image J(x) is given by

$$J(x) = \frac{I - A}{t(x)} - A \quad (8)$$

In the next section, we discuss the comparison of DCP based patch and MCP based pixel.

3 Comparison Experiments

We compare of the two algorithms, which is the patch-based DCP and pixel-based MCP. In Table 1, our method performs about 20.87 seconds. We use the image in Visual Studio 2013 using the OpenCV. From these result it seems that pixel-based MCP is the outstanding patch-based DCP.

Table 1. Results showing the speed comparison of our method and Kaiming

Image size	Patch-based DCP	Pixel-based MCP
320*240	11.52s	0.62s
600*450	56.51s	32.93s
1280*720	214.91s	79.36s

Figure 1 shows original image, fog image and the removal fog images applied by MCP and DCP. DCP enhances the image but looks sharp and has halo effect. It needs post-processing to eliminate halo effect. Meanwhile, our method does not need post-processing. Our method has a high chroma, but is lower complexity than DCP.

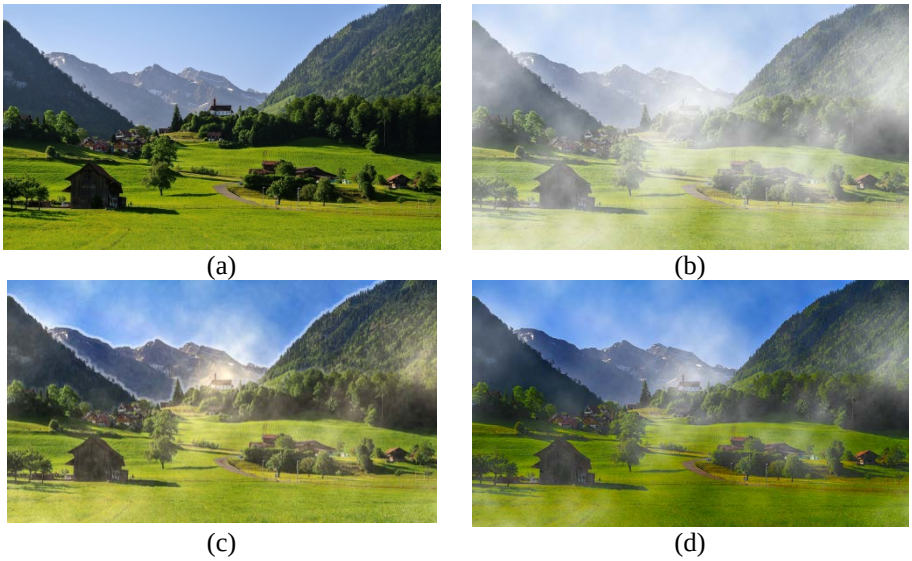

Fig. 1. (a) original image,(b) image with artificially appliedfog,(c) result of DCP using patch that is 11*11 size (d) result of our method.

5 Conclusion

In this paper, we propose the method using the pixel-based MCP. Before the design of our method, we simulate MCP using the Matting filter and the bilateral filter. Result of the experiment, our method has the outstanding performance and the low complexity.

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