Optimization of Image Enhancement Algorithm in Foggy Area

Zhang Hong-wei\textsuperscript{1,2,a} and Zhang Jiu-gen\textsuperscript{1,2}

\textsuperscript{1}College of electrical engineering and control science, Nanjing University of Technology, Jiangsu Nanjing 211800, China
\textsuperscript{2}Institute of Intelligent Building, Nanjing University of Technology, Jiangsu Nanjing 211800, China
\textsuperscript{a}Corresponding Email:736159774@qq.com

Abstract. Nowadays, tourism scenic area gradually become people to relax, one of the best place to rest, the huangshan mountain, the Yellow River and other famous scenic spots, for example, however, at present, most of the scenic area in the design of the monitoring equipment does not consider the influence of the bad weather, so under the condition of rain day, under the influence of atmospheric scattering function monitoring equipment, unable to capture the image; At the same time, monitoring equipment working for a long time, more or less there will be a certain degree of degradation. Therefore, this article on the basis of defects based on the existing scenic spot to fog, mainly focus on a single scale fog image enhancement algorithm Retinex algorithm and multiscale Retinex algorithm concept, and gives the specific process of two kinds of algorithm of Matlab programming, through the analysis judgment, evaluation and prediction, and plenty of experimental data and theoretical support, through a large number of experiments, the results prove multiscale Retinex algorithm in image contrast to the scenic spots in the fog effect is best, in the process of use in the future to the scenic spot of fog, can get the desired effect.

1. Introduction

Nowadays, with the development of national economy and the improvement of people's living standard, the monitoring equipment of tourist scenic spots is getting more and more attention [1].

In the case of fog, haze, rain, snow and other severe weather conditions, the imaging effect of monitoring equipment is not significant due to the effect of atmospheric scattering effect [2]. Literature [3] proposed in many scenic areas, typical of Huang Shan scenic spot, the year of cloud mist, the weather is unpredictable, perhaps the first second cloud cover, but then the eyes of the sun; For example, in July and August, the Yangtze river basin is a rainy season, and most of the scenic spots are hazy with rain and fog.

However, the vast majority of the existing scenic spot monitoring equipment at the beginning of the design, did not consider the weather factors to the impact of its imaging, monitoring of the scenic spots workers cause serious interference. Therefore, according to the actual problem, realize the degradation of image processing, effectively improve the contrast, to improve the visual effect, to achieve real color of the scene, monitoring is of great significance to the security of the scenic spot. The experimental results show that the multi-scale Retinex algorithm is superior to the fog effect.
2. Image enhancement defog algorithm

2.1. Scale Retinex algorithm

The mathematical expressions of the single-scale Retinex algorithm are as follows:

\[ r(x,y) = \log S(x,y) - \log [F(x,y) * S(x,y)] \]  

In equation (1), \( r(x,y) \) is the brightness value of the coordinates at \( (x,y) \). (*) said convolution operation, \( F(x,y) \) surrounding the function, SSR method of convolution is forecast for light weight, it is used by a template center pixel with a weighted average of the other pixels in the template to replace the center pixel values, in order to eliminate the interference of light weight [4-5].

2.1.1. Simulation results of SSR at different scales. In figure 1, A-1 represents the original graph; The SSR simulation results of A-2 are presented; Simulation results of A-3; A-4 represents the simulation results.

![Simulation results of SSR at different scales](image)

Figure 1. Simulation of SSR at different scales

Can be seen from the results, for SSR, the choice of different constant gaussian scale, will have different image enhancement effect, when the image can complete dynamic range compression, but the overall color distortion is serious; When the color distortion of the image decreases, the local details are more abundant. When, the overall color fidelity of the image is good, but the dynamic range compression completion is poor. In the SSR processing results of different scales, there is obvious "halo".

2.1.2. Single scale Retinex algorithm summary. By using gaussian function to deal with the input image in detail, the single-scale Retinex algorithm achieves good enhancement effect.

However, the choice of gaussian scale directly decides the image enhancement effect is good or bad, the dynamic range of inverse gaussian scale in image compression, but is proportional to the image of color constancy, SSR method is difficult to in the scope of the image compression and image color constancy both at the same time obtain good effect. To solve this problem, we introduce a multi-scale Retinex algorithm [6-8].

2.2. Multiscale Retinex algorithm

MSR is a weighted average of the results of different scales of SSR. It can also ensure the overall contrast and local details of the images have a good effect. Its expression is as follows:
\[ R_{MS}(x,y) = \sum_{i=1}^{K} W_i \left[ \log S_i(x,y) - \log \left( F_i(x,y) \ast S_i(x,y) \right) \right] \] (2)

In equation (2), MSR is represented in the output of the ith color spectrum segment; The number of gaussian functions is denoted by K, and it also represents the scale of the surrounding function; The weight of each scale is represented by [9-10].

2.2.1. Simulation results of different scale MSR. In figure 2, A-1 represents the original figure, and A-2 represents the image after MSR simulation.

Figure 2. Simulation of different scale MSR

As can be seen from the processing results, MSR also has good local details as well as the overall contrast of the image, and there is no obvious "halo" generation [11-13].

3. Experimental results and conclusions

Whatever image processing method is adopted, the ultimate aim is to improve the quality of degraded images. Therefore, the evaluation of image quality is an indispensable link in the field of image processing, and also an important basis for evaluating the effectiveness of image processing methods.

This paper selects three basic parameters which are obvious in physical meaning and suitable for evaluation of image quality: brightness mean, variance and information moisture.
Figure 3. Image quality comparison of three basic parameters

In Figure 3, A-1 represents the original graph; A-2 represents the image after histogram equalization; The simulation results of the SSR are shown in A-3. The simulation results of SSR when A-4 is expressed; The simulation results of SSR when A-5 is expressed; A-6 represents the simulation result of MSR.

| Enhancement method | A-1 | SSR 25 | SSR 125 | SSR 250 | MSR |
|--------------------|-----|--------|---------|---------|-----|
| Mean brightness     | 188.5258 | 166.7752 | 170.6851 | 172.8772 | 139.4169 |
| Variance           | 3679.5  | 6888.6  | 6282.1  | 5982.5  | 10461 |
| Information quantity | 5.1930  | 5.6701  | 5.5961  | 5.5822  | 5.3574 |

It can be seen from Table 1 that the images with SSR method are adopted, and the selection of different Gaussian scales has different image enhancement effects. The scale of SSR can achieve dynamic range compression, but the overall color distortion is serious. The overall color sense consistency of the large scale SSR is good, but the dynamic range compression is poor, and in the processing results of the original Figure 1, there is obvious "halo" generation.

SSR MSR algorithm because it contains a number of different scale, the advantages of the processed image is so use it to the improvement of the overall image contrast and local details shows two aspects that can achieve good results at the same time, although not completely eliminate the "halo", but effectively suppresses the production of "halo", in order to gain the better image processing effect. Therefore, this paper has a certain reference value for the research on the optimization of image calculation in foggy scenic spot.

4. Conclusion
This paper first introduces the existing basic principle and method of image enhancement to the fog, and in view of the single dimension Retinex algorithm and multiscale Retinex algorithm from the theoretical basis to the specific implementation expounded in detail. The experimental results show that compared with single scale Retinex algorithm of SSR method, the algorithm of multiscale
Retinex method of MSR in overall image contrast and local details shows in two aspects, can obtain good effect. According to the experimental results can not completely eliminate the "halo", the next step is to explore the formation of effective inhibition of the "halo", thus obtained a more ideal method of image processing effect.

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