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Image Enhancement using Generalized Unsharp Masking Algorithm

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ABSTRACT: Enhancement of contrast and sharpness of an image is required in many applications. Unsharp masking is a classical tool for sharpness enhancement. We propose a generalized unsharp masking algorithm using the exploratory data model as a unified framework. The proposed algorithm is designed to address three issues: 1) simultaneously enhancing contrast and sharpness by means of individual treatment of the model component and the residual, 2) reducing the halo effect by means of an edge-preserving filter, and 3) solving the out-of-range problem. Experimental results, which are comparable to recently published results, show that the proposed algorithm is able to significantly improve the contrast and sharpness of an image. In the proposed algorithm,the user can adjust the two parameters controlling the contrast and sharpness to produce the desired results. This makes the proposed algorithm practically useful.

KEYWORDS: Exploratory data model, image enhancement, halo effect, unsharp masking.

I. INTRODUCTION

Enhancing the sharpness and contrast of images has many practical applications. There has been continuous research into the development of new algorithms. These related works include unsharp masking and its variants, histogram equalization. In this paper we analyse the image as low frequency and high frequency components. Firstly, we divide the image into two components and individual treatments will be applied separately and sufficiently based on user perception and finally add those two components in a (does not produce any halo effect, ringing phenomenon and noise etc.,)manner. The main content in this paper is to vary the contrast levels and amount of sharpness by using some parameters thus itself the name indicates generalized unsharp masking algorithm.

II. LITEARTURE SURVEY

The classical unsharp masking algorithm can be described by the equation $V = y + \gamma(x - y)$ where x is the input image, y is the result of a linear low-pass filter, and the gain γ $(\gamma > 0)$ is a real scaling factor. The signal $d = x - y$ is usually amplified $(\gamma > 1)$ to increase the sharpness. However, the signal d contains 1) details of the image, 2) noise, and 3) over-shoots and under-shoots in areas of sharp edges due to the smoothing of edges. While the enhancement of noise is clearly undesirable, the enhancement of the under-shoot and over-shoot creates the visually unpleasant halo effect. Ideally, the algorithm should only enhance the image details. This requires that the filter is not sensitive to noise and does not smooth sharp edges. The cubic filter and the edge-preserving filters have been used to replace the linear low-pass filter. The former is less sensitive to noise and the latter does not smooth sharp edges. Adaptive gain control has also been studied. Contrast is a basic perceptual attribute of an image. It is difficult to see the details in a low contrast image. Adaptive histogram equalization is frequently for contrast enhancement. The retinex algorithm, first proposed by Land, has been recently studied by many researchers for manipulating contrast, sharpness, and dynamic range of digital images. The retinex algorithm is based upon the imaging model in which the observed image is formed by the product of scene reflectance and illuminance. The task is to estimate the reflectance from the observation. Many algorithms use the assumption that the illuminance is spatially smooth. The illuminance is estimated by using a low-pass filter or multi resolution or formulating the estimating problem as a constrained optimization problem. To reduce the halo effect, weighted least-squares filter is used. An important issue associated with the unsharp

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masking algorithm is that the result is usually out of the range of the image. A careful rescaling process is usually needed for each image. A histogram-based rescaling process and a number of internal scaling processes are used in the retinex algorithm also presented in this algorithm.

III.IMAGE MODEL AND GENERALIZED UNSHARP MASKING

A well known idea in exploratory data analysis is to decompose a signal into two parts. One part fits a particular model, while the other part is the residual. In Tukey's own words the data model is: "*Data=fit* PLUS residuals". From this point of view, the output of the filtering process, denoted $y = f(x)$, can be regarded as the part of the image that fits the model. Thus, we can represent an image using the generalized operations as $x = y \oplus d$ where d is called the detail signal (the residual). The detail signal is defined as $d = x \ominus y$ where $\ominus$ is the generalized subtraction operation. Although this model is simple, it provides us with a unified framework to study unsharp masking algorithms. A general form of the unsharp masking algorithm can be written as $v = h(y) \oplus g(d)$, here v is output of the algorithm and both $h(y)$ and $g(d)$ could be linear or nonlinear functions. This model explicitly states that the part of the image being sharpened is the model residual. This will force the algorithm developer to carefully select an appropriate model and avoid models such as linear filters. In addition, this model permits the incorporation of contrast enhancement by means of a suitable processing function $h(y)$ such as adaptive histogram equalization. As such, the generalized algorithm can enhance the overall contrast and sharpness of the image.

IV.PROPOSED ALGORITHM

The proposed algorithm, shown in Fig. 4.1 is based upon the previous image model and generalizes the classical unsharp masking algorithm.

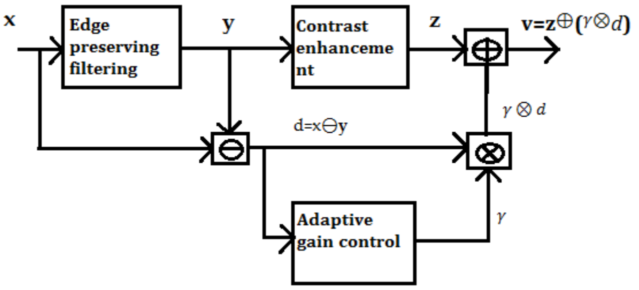

Figure 4.1 Block diagram of the proposed generalized unsharp masking algorithm.

We address the issue of the halo effect by using an edge-preserving filter-the IMF to generate the signal . The choice of the IMF is due to its relative simplicity and well studied properties such as the root signals. We address the issue of contrast enhancement and sharpening by using two different processes. The image y is processed by adaptive histogram equalization and the output is called h(y). The detail image is processed by $g(d) = \gamma(d) \otimes d$ where $\gamma(d)$ is the adaptive gain and is a function of the amplitude of the detail signal. The final output of the algorithm is then given by $v = h(y) \oplus [\gamma(d) \otimes d]$.

V. RESULTS

The results shown below describes the original image applied to the proposed algorithm with contrast factor 0.001 and 0.002(variable parameter) with two examples(hill and rock).Here contrast adjustment factor is one of the parameter and the sharpness adjustment parameter is indirectly depends on the contrast adjustment factor.

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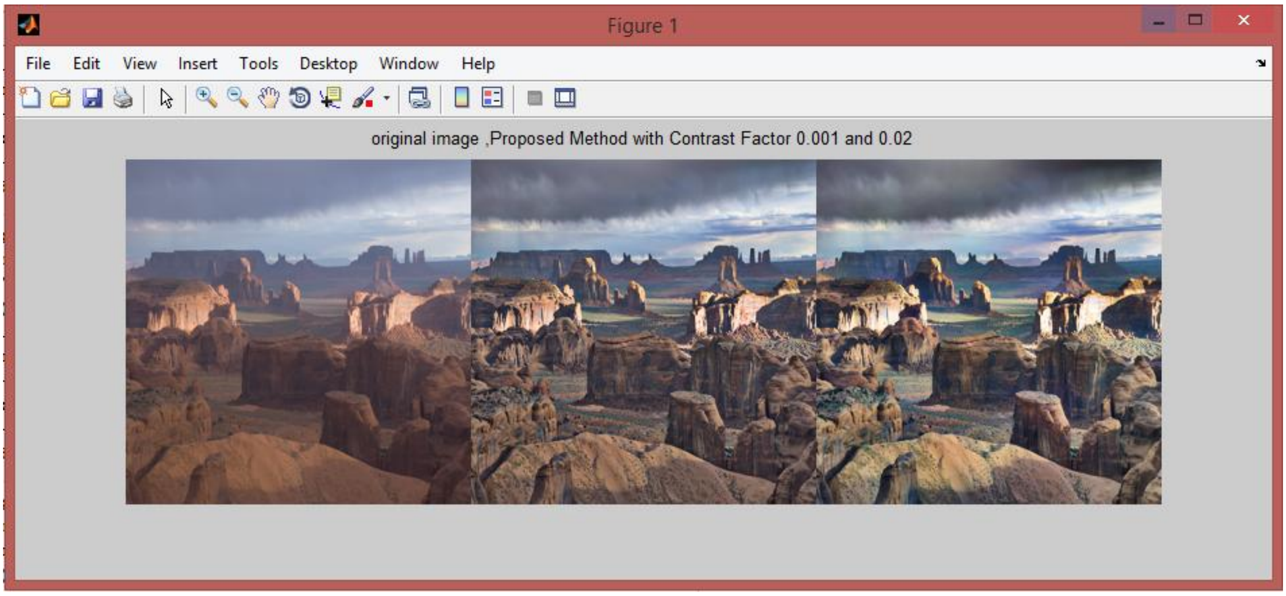
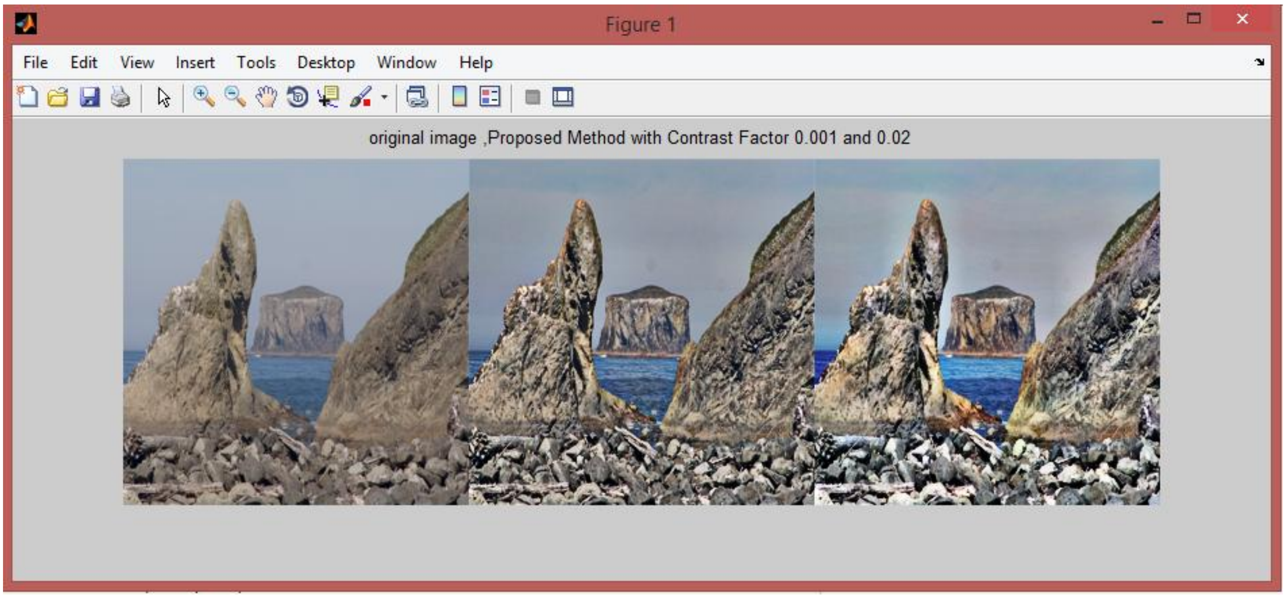


From the two examples the images are enhanced and will be re-enhanced based on some designed parameters. Here we noticed that the images are free from halo effect(white line along its sharp edges) and noise.



VI.CONCLUSION

In this paper, we use an exploratory data model as a unified framework for developing generalized unsharp masking algorithms. Using this framework, we propose a new algorithm to address three issues associated with classical unsharp masking algorithms: 1) simultaneously enhancing contrast and sharpness by means of individual treatment of the model component and the residual, 2) reducing the halo-effect by means of an edge-preserving filter, and 3) eliminating the rescaling process. Experimental results show that the proposed algorithm is able to significantly improve the contrast and sharpness of an image. In the proposed algorithm, the user can adjust the two parameters controlling the contrast and sharpness to produce the desired results. This makes the proposed algorithm practically useful.

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BIOGRAPHY

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