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Smoothen Edge Preservation using Rapid Bilateral Filter Process

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ABSTRACT

Images predict the real scenario of the human life. The images that are captured can be insensitive to noise. These noises destruct the images and as a result the image has the poor quality, leads to unreliable predictions. Enhancing the contrast improves the brightness and contrast of the digital images. Edge filtering is the recent research work on the high quality images and video. Edge features are extracted and preserved. The edge preservation filters has been 5proposed for handling the noise of the contrast images. This filter reduces the multi-resolution processing. Handling the multi-resolution images is a significant research challenge for the users on the edge filtering contrast images. In this paper, Rapid Bilateral filtering process is proposed to filter the edges of the contrast images. This filter decomposes the image into several base layers. This filter process handles the high dynamic contrast images for smoothen the edge preservation. The result analysis shows that the filtering time has been reduced by 54% while comparing to the GUMA, HMRF, SWT and EHS methods.

Keywords: Bilateral Filter, Denoising, Edge Preservation, High Dynamic Contrast Image, Shift-Invariant Base Pass Domain Filter, Weighted standard distance.

Introduction

The new derivative filter [6] was proposed to find the edge which was restored in a gray scale image to discover a higher quality edge map image. Subjective and objective process was employed to improve the performance of the image denoising. This algorithm handles the corrupted image using the appropriate filtering techniques. The image map was done by derivative operators. The first order and second order derivatives are involved in edge filtering takes much time.

Weighted median guided filtering process [7] is used to remove rain noise in an image, This filer contains two filtering operations, weighted median and guided filter. The weighted median filter was used to remove the hard rainy drops in the image and guided filter to improve the image.

An effective method [8] was presented to enhance the contrast of the image using the histogram function. To avoid the loss of information in the processed image, a histogram function was used to improve and make the histogram curve smoother. The brightness of the image was done using the gamma correction on the histogram of the image. The log-exp transformation strategy was presented to increase the low intensity and decrease the high intensity of the image. A novel method [9] was presented for enhancing the image contrast which contributes a twofold scheme. The image is transformed from spatial to wavelet domain for achieving the multi-resolution image. The mean brightness of an image is preserved by using the gamma correction. Further, the values of the pixels are optimized using the Particle Swarm Optimization (PSO). The brightness function brings the maximize performance using PSO with time taken is high.

Histogram-Equalized Hypercube Adaptive Linear Regression (HE-HALR) scheme [14] performs the preprocessing step analyze the quality of the image by extracting the features. Further, in this model ROI localization identifies the contrast masking and luminance value of the images results as a feature vectors. A machine learning technique called hyper cubical neighborhood reduces the dimensions of images. Finally, Adaptive Learning Regression

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was used to assess the quality of images. The assessment time of the images can be further improved.

Contrast Enhancement using Rapid Bilateral Filter

The main objective of the proposed work is to improve the contrast using Rapid Bilateral Filter. This filter filters the edges and handles the high dynamic contrast multi-resolution images for smoothing the edge preservations with less time in filtering process. Initially, the input object is filtered for its sharp edge location. These sharp edges are features to have high accuracy performance. The process of edge filtering is shown in Figure 1.

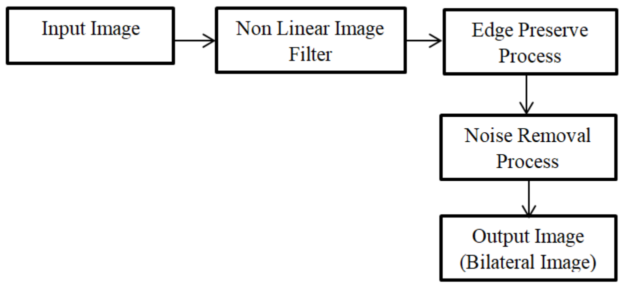

Figure 1 Rapid Bilateral Filter Process

The Rapid Bilateral Filtering process works on the image with multi-resolution pixels to enhance the contrast. Initially, non-linear image intensity values and weighted standard values of the nearby pixel are computed. The edge preservation on the high contrast images are observed using the weighted standard values.

Weighted standard computation depends on the Euclidean Distance of the pixels. The pixel point is extracted using the Rapid Bilateral Filtering Process. Further, this filter computes the weighted standard distance of the intensity values. The base and upcoming layer's intensity values are measured for observing the noise level on the image.

The Multi-Resolution high contrast image pixels are detected in the image to perform the edge filtering with sharp localization. The Rapid Bilateral Filter is used to filter the radiance of the multi-resolution high contrast image. The high contrast image pixel is calculated as

$$\text{Contrast Image} = \text{pixel}\ (I(x,y)) \qquad (1)$$

In the equation (1) 'I' represents the contrast image at the channel pixel intensity value. This value is based on pixel point 'x' and nearer pixel point 'y' along the latitude and longitude axis.

Let us assume the solution as $S_c[I(x,y)]=I(x-y)]$ to obtain the geometric distance between the pixel points 'x' and 'y' respectively. This implies the filtering of edges with total mass factor with the smoothing on the pixel intensities. The total mass factor implies the weighted standard measure with the rapid factor and it is based on the difference of pixel intensities as

$$Sc\ [I(x,y)=(I(x)-I(y))] \qquad (2)$$

The Rapid Bilateral filtering is computed as,

$$I_{\text{filtered}}\ (x,y) = \frac{1}{W_E}\sum_{x,y} I(x_i,y_i)S_r[I(x,y) - \{I(x) - \ I(y)\}]\ S_c[I(x,y) - \{I(x) - \ (I(y)\}](3)$$

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From equation (3), WE means the weighted standard measure based on the Euclidean distance with the pixel value (x,y). The Sr represents the range kernel of smoothing on the pixel intensity value. Sc denotes the spatial kernel coordinate smoothing for the edge preservation filter on the original highly contrast image 'I' with the pixel value 'x' and 'y'. The weighted standard distance WE can be calculated as,

$$(W_E) = e^{\left(-\frac{I\,(x^2-y^2)}{2\sigma^2}\right)} \qquad \text{----------} (4)$$

From the equation (4) the closeness between the edge pixels is identified using the Weighted Standard Measure WE. The spatial closeness of the high contrast image is filtered through these preserved edges. The Euclidean distance 'e' is measured by the pixel values 'x' and 'y' where σ denotes the average speed of edge filtering operation. Finally, the weighted standard distance of the intensity values is computed using the proposed Rapid Bilateral Filtering Process.
The Shift-Invariant Base Pass Domain Filter (SIDF) is used to identify the intensity values efficiently by using the nearby spatial location which removes the noise factor. The mathematical representation of SIDF is given below:

$$\mathrm{SIDF} = KP^{-1} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} I(x) S_r(\in) S_c(\in, x) d \in \qquad (5)$$

From the equation (5) SIDF recognizes the noise level on the base layer of a high contrast image which filter out the Key Points (KP) with geometric closeness between the pixel intensity 'x' and nearby pixel '€'

Input: High Contrast Images $\{I_n = I_1, I_2, .. I_a\}$, KP, a, n
Output: Smoothed edge preserved filtering
Step 1: For each I_n
Step 2: Compute pixel intensity using (1)
Step 3: Evaluate Weighted Standard Measure based on the Euclidean Distance using (4)
Step 4: Apply Rapid procedural scheme for extraction of Key Points 'KP' using (5)
Step 5: Perform noise removal on based layer edge filtering
Step 6: End For

Algorithm 1 Key Points Extraction using Rapid Bilateral Filter

The key points from the edges are extracted using the Rapid Bilateral Filtering by using the Algorithm 1. The Bilateral Filtering with weighted Distance is evaluated in the proposed work. Further, Sharp Localization Points are extracted with the helps of this filter. The normalization "KP" extracts the Key points that ensures the pixel intensity weights and smoothens the edges. Hence, the noise level is eliminated as a result of Rapid Bilateral Filter with the help of Self-Invariant Base-Pass Domain Filter procedure.

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Results and Discussions

The proposed work is compared with the existing methods namely Generalized Unsharp Masking Algorithm (GUMA) [10], Huber-Markov Random Field (HMRF) [11] model, Stationary Wavelet Transform (SWT) [12], Exact Histogram Specification (EHS) [4] technique and multi-level histogram shape segmentation method [13]. The performance is analysed based on the filtering time taken on the contrast image.

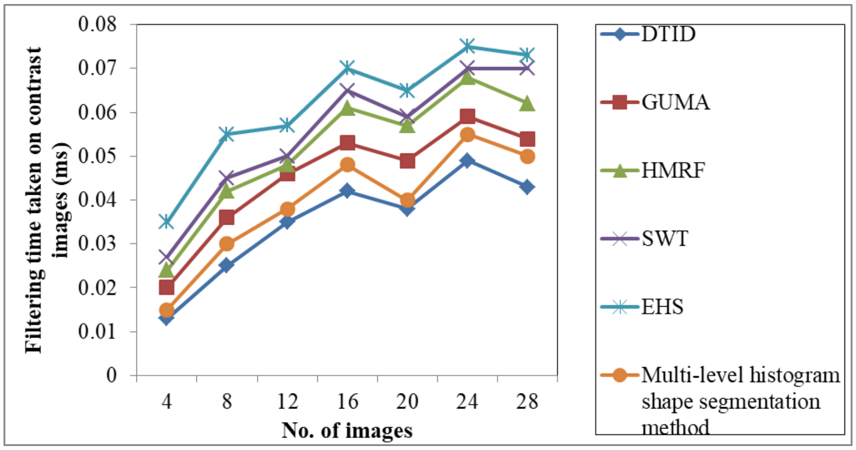

Figure 2 Measure of filtering time taken on contrast images

The analysis is made using different number of images using this filter and is compared with the existing method GUMA, HMRF, SWT, EHS and Multilevel Histogram Shape Segmentation methods for various implementation runs. In the Figure 2, upon applying the proposed work the time taken for the filtering the contrast image gets reduced when comparing the state-of-arts methods. The nonlinear image intensity values and weighted standard of the neighbour pixel are handled by Rapid Bilateral Filter. This value helps to maintain the value of the edges on the filtering process of the high contrast images. Henceforth, the sharp edge location for diverse scene characteristics is obtained with less time and also the filtering time gets reduced. The evaluation procedure helps to efficiently identify the closeness between the edge pixels. The filtering time taken on the contrast images are reduced by 24% of GUMA, 34% of HMRF, 38% of SWT, 45 % of EHS and 11% of Multi-level histogram shape segmentation method.

Conclusion

The Proposed work efficiently concentrates on filtering the edges of the contrast image. The edges are filtered with high accuracy results. These efficient results are achieved by applying the Rapid Bilateral Filtering computations for non-linear image. These computations increase the closeness between the edge pixels for filtering using the weighted standard distance. This process will be further extended to detect the images by the planar transformation as per the user satisfaction.

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