A Contrast Enhancement Algorithm using Histogram Threshold and Dynamic Range Control

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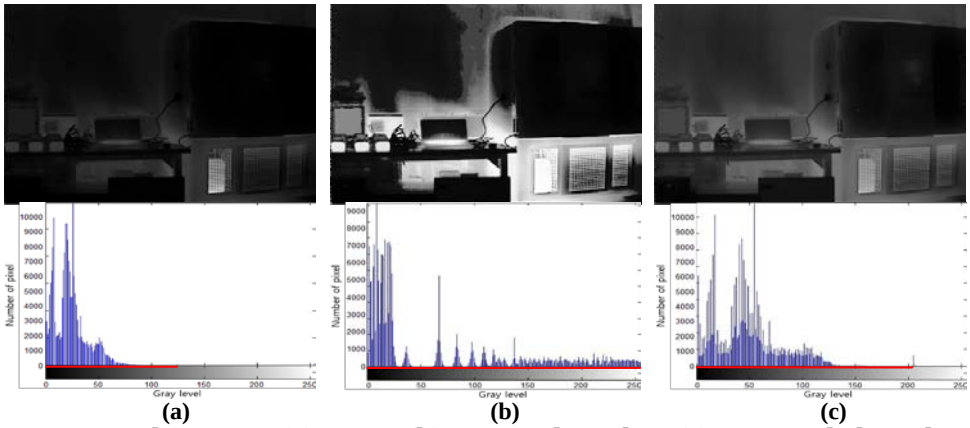
Contrast enhancement techniques are widely used for improving the visual quality of low light level contrast images. Many algorithms based on Histogram Equalization(HE) have been proposed for preventing the over-enhancement and the false-contouring. BBHE(Contrast Enhancement Using Brightness Preserving Bi-Histogram Equalization) divides the dynamic range of the image histogram into the sub-regions and then performs each HE[1]. DCHE(Histogram Equalization based on Differential Compression for Image Contrast Enhancement) compresses the frequency of the image histogram and then performs HE[2]. CLAHE(Contrast Limited Adaptive Histogram Equalization) divides the image and performs the HE to each of the sub-images and then uses the bilinear interpolation for recombination[3].

In this paper, a contrast enhancement algorithm is proposed by using the histogram threshold and the dynamic range control. The proposed algorithm automatically finds the optimized parameters for preventing the dominant of high frequency of the histogram. The optimized histogram threshold is determined by using the standard deviation of the brightness of the image. If the each bin of the frequency is higher than a threshold value, the frequency is replaced to the threshold and the scale factor is applied for the reasonable adjustment. Dynamic range control is realized by the optimized variation factor calculated by the average brightness of the image. Therefore, the entire dynamic range is always not used but the adjusted dynamic range is employed in accordance with situation. Infra-red images are used for the experiment. And its resulted images and AAMBE(Average Absolute Mean Brightness Error) are shown in Fig. 1 and Table 1, respectively.



(a) (b) (c)

Fig. 1. Result images: (a) Input, (b) BBHE algorithm, (c) Proposed algorithm

Algorithm	AAMBE
HE	102.29
BBHE	40.12
DCHE	41.55
CLAHE	25.80
Proposed	25.19

Table 1. AAMBE

Fig. 1 shows that the proposed algorithm results in more improved visual quality than BBHE algorithm, i.e., the proposed algorithm identifies the object and background clearly due to the histogram threshold. The proposed algorithm keeps the shape of the histogram of the original image and expands the dynamic range to fit the situation. That is, the resulted image shows smoothly varying and less excessive brightness. Table 1 shows that the proposed algorithm results in smaller AAMBE value than other contrast enhancement algorithms. Therefore, the proposed algorithm might provide the effective contrast enhancement and prevent the over-enhancement and the false-contouring.

References

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