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REVIEW ARTICLE

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REVIEW ON CURRENT CONTRAST ENHANCEMENT TECHNIQUES FOR REMOTE SENSING IMAGES

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ABSTRACT

Input images that are captured by remote sensing devices are sometimes not really in good brightness and con-trast. Therefore, a process known as a digital image contrast enhancement is normally required to increase the quality of these low Contrast images. Histogram Equalization (HE) has been an essential addition to the Image Enhancement world and other Enhancement techniques like Classical Histogram Equalization(CHE),Adaptive Histogram Equalization (AHE), Bi-Histogram Equalization (BHE) and Recursive Mean Separate Histogram Equalization (RMSHE) methods enhance contrast of remote sensing images but brightness is not well preserved, which gives an unpleasant look to the final image obtained. hence improvement in these old techniques are done by various researchers in the world. This paper contain a survey of all the current techniques used to enhance contrast of remote sensing images with results, advantages and disadvantages of these techniques.

Index Terms—Contrast Enhancement, Remote Sensing, brightness.

I. INTRODUCTION

Image processing is the study of any algorithm that takes an image as input works on it and returns an image as output. It includes image displaying and printing, image editing, image enhancement, feature detection, image compression which has various applications in the fields of biology, astronomy, Medicine, Security, Satellite imagery, personal photos etc. Various techniques exist for processing an image namely noise removal, contrast adjustment, edge detection, region detection, image compression, digital painting etc. Narrowing down, Contrast enhancement is the technique that automatically enhances and brightens images that appear dark and hazy, and applies appropriate tone correction to deliver optimal quality and clarity. The contrast of an image was formally enhanced by 3 major techniques, linear stretch, and Gaussian stretch and histogram equalization. The stretch operation re distributes the values of an input image map over a wider or narrower range of values. In linear stretch the input values of the image are redistributed over the output values and then the values are linearly adjusted to obtain enhanced contrast. In similar ways, Gaussian stretch re distributes the input image values and the adjustment is made in a non linear fashion that is, the values are adjusted in minor values to gain more contrast. The histogram is the graphical representation of a frequency distribution of an image showing the class intervals horizontally and the frequencies vertically. Using this histogram graph the frequency values are modified so that the overall brightness and luminance of the image is improved. Concerning the satellite images, the images taken from the geostationary satellites are used. The geostationary satellites are those that are present above the equator and rotate along with the axis of the earth and with the same speed as the earth. The images from these satellites may be grey or colored, infra red or ultra violet images taken from a longer distance. Such images contain most of the information hidden due to the fuzzy and hazy nature of the image. To improve the image readability and image information collection ability the image must be enhanced in terms of various features of the image such as image brightness, image luminance, image contrast etc. Some of the disturbing features must reduced such as noise, blur etc.

This paper is organized as follows. Section II gives an review of different contrast enhancement techniques. Section III com-parison of above mentioned techniques. Conclusions are given in the final section.

II. REVIEW OF IMAGE CONTRAST ENHANCEMENT TECHNIQUES

In this section some selected contrast enhancement tech-niques are listed. Group of researchers namely Chi-Farn Chen, Hung-Yu Chang, Li-Yu Chang from Jhongli City, Taiwan, China introduced a fuzzy based approach to contrast en-hancement of the remote sensing images in The International Archives of the photogrammetric on Remote Sensing and Spatial Information Sciences, remote sensing image data to partition the image pixel values into dissimilar degrees of associates in order to refund the local brightness lost in the dark and bright areas. The algorithm includes three steps: primarily, the satellite image is distorted from gray-level space to membership space by Fuzzy c- Means clustering. Secondly, suitable stretch model of each cluster is constructed based on corresponding memberships. Third, the image is changed back to the gray-level space by merging stretched gray values of each cluster. Presented method provide better contrast image than the conventional enhancement methods in terms of visual looks and image details [1].

A robust inverse diffusion equation method which sharpens image details by a robust Laplacian after demonstrating the equivalence of the sharpening by the Laplacian to inverse heat equation processing. Image gradient magnitude is used to avoid the noise magnification. At the same time, the min-mod function is used to manage diffusion flux adaptively, which reduces effectively overshoots inherent in the Laplacian. The Experimental results demonstrate that this algorithm can enhance important details of image data effectively exclusive

Fig. 1: Result of proposed method in [1]. (Left) Original image. (right) Output image

of overshoots, giving the opportunity for a good interpretation and subsequent processing [2].

An efficient way for image contrast enhancement is offered with a mapping function which is a mixture of global and local transformation functions that improve both the brightness and fine details of the input image. The final mapping func-tion incorporates a local intensity-pair distribution generated expansion function from each image block to control the enhancement of image details that the global transformation function alone may fail to improve. The strength of this approach lie in the interpolation of more than two trans-formation functions: first global and second local functions because of this mixing of more than one function can produce natural looking images with more sharpness while preserving brightness closer to the input image [3].

Fig. 2: Result of proposed method in[3]. (Left) Original image. (right) Output image

Hasan Demirel and other two researchers proposed a new method for enhancement of satellite images contrast. Their method was based on Discrete Wavelet Transform (DWT) and singular-value decomposition. They first applied DWT to input image to divide it into four frequency sub-bands, then used singular value decomposition and then again applied inverse DWT to reconstruct the image. This technique showed enhanced results than conventional Brightness preserving Dy-namic Histogram Equalization (BPDHE) method and other methods [4].

A new technique has been introduced by G. Praveena and M. Venkatasrinu in September 2012 this method based on the Singular Value Decomposition (SVD) and Discrete Cosine Transform (DCT) that means SVD-DCT domain for enhancement of low-contrast satellite images. This method converts the image into the SVD-DCT domain after normal-izing the singular value matrix. Then the modified image is reconstructed by using inverse DCT with use of Adap-tive Histogram Equalization (AHE), results of this method clearly indicates increased efficiency and flexibility over the exiting methods such as Linear Contrast Stretching technique, GHE technique, DWT-SVD technique, DWT technique, De-correlation Stretching technique, Gamma Correction method based techniques[5].

A real time contrast enhancement technique for digital video applications set up by S. Srinivasan and N. Balram in Proc.of ASID06, 8-12 Oct, New Delhi. This method called ACE is stand on a modified histogram equalization course of action that adapts to the input video. ACE calculates the amount of enhancement needed depending on the shape of the histogram and decides whether to amplify dynamic range or to brighten up dark portion of the image. For images with normal brightness the dynamic range of the picture is increased. The implementation offers a high degree of flexibility that is needed for consumer electronics functions such as terms of a variety of degrees of enhancement and leaving out of letter box regions [6].

As traditional results of global histogram equalization (GHE) usually causes unnecessary contrast enhancement while local histogram equalization may cause block effect. To over-come these problems, a new method for image contrast en-hancement is developed. The freshness in the planned method is that the weighted average of the histogram equalized, gamma corrected and the original image are combined to obtain the enhanced processed image. Planed method achieve contrast enhancement with perseveration of brightness level. Proposed method has good performance on enhancing contrast and visibility for most of images [7].

Fig. 3: Result of proposed method in[7]. (Left) Original image. (right) Output image

As a result of previous contrast enhancement methods brightness is not well preserved which gives an unpleasant look to output image, considering solution on this problem Sayali Nimkar and other two introduced a novel technique Multi-Decomposition Histogram Equalization MDHE decom-pose the input images using a unique sense and then in-terpolated pars of images in correct order. Resultant image after applying MDHE gives the best results based on contrast enhancement and brightness preservation aspect compared to all other previous related techniques [8].

G.Veena, V.Uma and Ganapathy Reddy are proposed an algorithm in which it first performs the DWT to decompose the input image into a set of band-limited components, called HH, HL, LH, and LL sub bands. Since the LL sub band has the illumination information, the log-average luminance is calculated in the LL sub band for computing the dominant brightness level of the input image The LL sub band is divided into three low, middle, and high concentration layers according to the principal intensity level. The adaptive intensity transfer function is deliberated in three partitioned layers by the foremost intensity level, the knee transfer function, and the gamma alteration function. Subsequently, the adaptive transfer function is concerned for colour preserving high quality con-trast enhancement. The resultant enhanced image is obtained by the inverse DWT (IDWT) [9].

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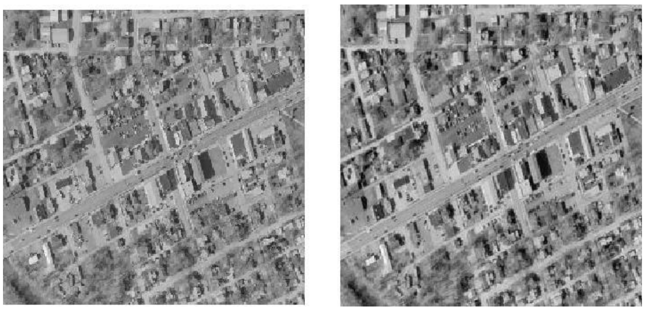

Fig. 4: Result of proposed method in[9]. (Left) Original image. (right) Output image

In many applications such as geosciences studies, geo-graphical information systems etc satellite images are used. Technique in [10] decomposes the input image into the four frequency sub- bands by using discrete wavelet transform (DWT) and estimates the singular value matrix(SVD) of the low sub band image and then it restructure the enhanced image by applying opposite DWT (IDWT) to obtain brightness enhanced image. This technique has been tested result shows PSNR and RMSE and visual results show the superiority of the proposed technique over traditional methods. Result shows PSNR improvement up to 7.19 dB as compared to standard bilinear interpolation, Shows accuracy of 70 percent for high resolution images and for low resolution images accuracy of about 95 percent [10].Present techniques fail to clear noise from satellite images to overcome these problem authors [11] introduced DWT with 3D and SVM method which has two significant parts first is the interior point method and second is boundary value selection. But till contrast of the converted image is worse in 1D and 2D to overcome this authors move on to 3D for good contrast enhanced result. Because of this improvement problem of noise removal, contrast and brightness is handled successfully.

Adin Ramirez Rivera, Byungyong Ryu, and Oksam Chae [12] proposed a content-aware algorithm that improves the dark images, sharpens edges, expose details in textured re-gions, and conserve the smoothness of flat regions. This algorithm generates an ad hoc transformation for every image, adjusting the mapping functions to each image characteristic to produce the maximum enhancement. They examined the contrast of the image in the boundary and surface regions, and cluster the information with common characteristics. These clusters model the relations within the image, by which the transformation functions were extracted. The outcomes were then adaptively united, by considering the human vision system characteristics, to boost the details in the image. This method improves the manifestation of human features, blue skies with or without shades without initiating object. Conversely, it is unable to reobtain the information from the shadowed or dark areas of images that had near-black intensities. Artur oza, David R. Bull, Paul R. Hill , Alin M .Achim [13] proposed a new method for contrast enhancement of images and image sequences of low-light or unevenly illuminated scenes based on statistical modeling of wavelet coefficients of the image .A non linear enhancement function has been designed based on the local dispersion of the wavelet coefficients modeled as a bivariate Cauchy distribution inside the same statistical framework, a synchronized noise reduction in the image is presented by means of a shrinkage func-tion, therefore preventing noise strengthening. The projected enhancement method has been publicized to execute very well within sufficiently lighted up and noisy imagery, better performing than the other ordinary methods, in provisions of contrast enhancement and noise go down in the output data. Eunsung Lee [14] proposed the method which uses dominant brightness level of Image for decomposing the Image in different three layers and then these layers are used for appraisal of adaptive intensity transfer function. This pre-dictable adaptive intensity transfer function is used for image contrast enhancement subsequently these layers are fused to get enhanced image. Deepak Kumar Pandey, Rajesh Nema [15] proposed a method to improve the quality of image using Kernel Padding and DWT with Image Fusion that enhances the contrast of Images that has varying intensity distribution particularly satellite images, maintain the brightness of images, sharpens the edges and abolish the blurriness of images. Fundamentally this is a pixel based edge guided image fusion technique. In this technique LL sub band of Image DWT is processed by contrast enhancement section where based on image brightness level image is decomposed in different layers and then every layers intensity is stressed or compressed by generating intensity transformation function. The partitioned intensity layers are also processed by canny edge detection method as all the satellite images includes the noise due to atmospheric turbulence and this is Gaussian by nature. The Canny edge detector is the best method for detecting edges of image in the existence of Gaussian noise. At last the contrast enhanced images are fused according to the weight map determined by edge map of image.

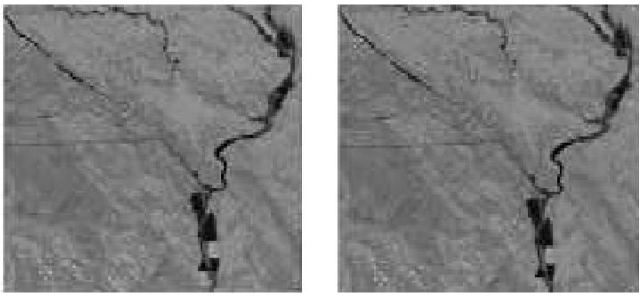

Fig. 5: Result of proposed method in[10]. (Left) Original image. (right) Output image

III. CONCLUSION

In digital image processing contrast image enhancement for remote sensing image data field a lot of work has been done to get better the quality of image such as histogram equalization, multi-histogram equalization and pixel depen-dent contrast preserving, Homomorphism filtering, Unsharp Masking etc. Here in this paper these selected techniques are presented. After comparing and analysing these techniques on the basis of results presented by various researchers it is clearly shown that accuracy of image processing algorithm is increased upto 95 percent for the low resolution images but for high resolution images accuracy is 70 percent, that means till some improvement is required for high resolution images.

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