REMOTELY SENSED IMAGE ENHANCEMENT BY USING FUZZY METHOD

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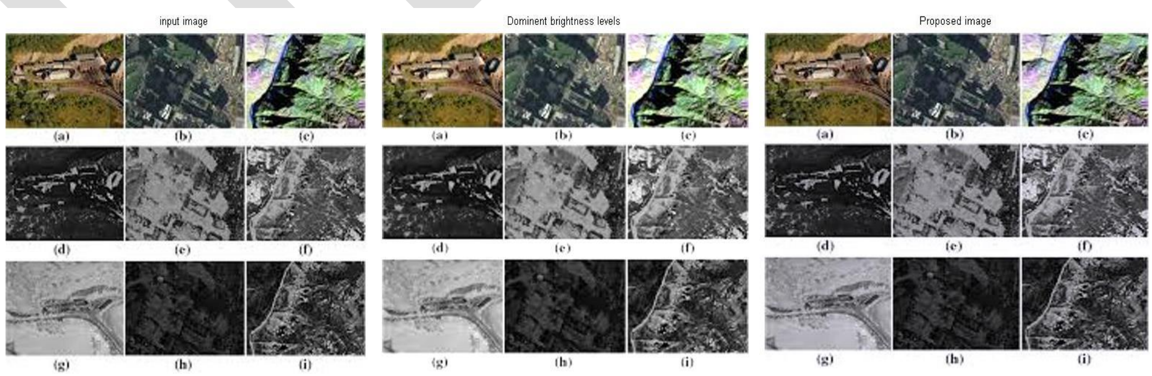
Abstract— Image Processing is a way in which any image can be changed into its digital version to conduct certain processes on it to get an enhanced image. Image enhancement plays main role in digital image processing applications. Enhancement means highlighting main details and improving features and quality of images and making images more visually appealing. In latest times abundant work is done to enhance the clarity for improving the exactitude of remote sensing images. This research work projected the DWT, DBLA as well as Fuzzy logic technique as the post processing utility to enhance the exactitude of image by decreasing the problematic of noise.

Keywords: DWT, SVD, DCT,Fuzzy technique, Dominant brightness level analysis.

1. INTRODUCTION

Remote sensing images have an essential function in several areas for example for instance metrology, agriculture geology etc[1]. Dominant brightness level analysis (DBLA)[1] indicates that it is an efficient method for the image enhancement. Contrast improvement images could have power distortion and eliminate image data in number of sections. To irresistible the glitches of images ,decompose the original image into numerous levels. The projected algorithm conduct discrete wavelet transform (DWT)[2] on the original images that decompose the original image into different sub-bands LL, HL, HH and HL[2]. From then decompose the LL sub-band into low, middle, and high intensity layers. Intensity transfer functions are adaptively estimated by applying the knee transfer function and the gamma adjustment function. The resultant improved image is obtained by applying the inverse DWT(IDWT).



Fig(a) Fig(b) Fig(c)

Fig 1.1(a) show input image Fig (b)show dominant brighness level output(c)show proposed technique outpot

2. DIFFERENT TECHNIQUES OF IMAGE ENHANCEMENT

2.1DWT The decomposition images into several regularity ranges lets the particular seclusion involving the regularity in to particular sub-bands. This method brings about isolating small variations in an image largely in low frequency sub-band images. The 2D wavelet decomposition with an image is conducted by using 1D DWT along the lines of image 1st, as well as, next, the email address are decomposed along the columns[3]. This particular Decomposition brings about several decomposed sub-band images referred to as low-low (LL), low-high (LH), high-low (HL), as well as high-high (HH)[5].

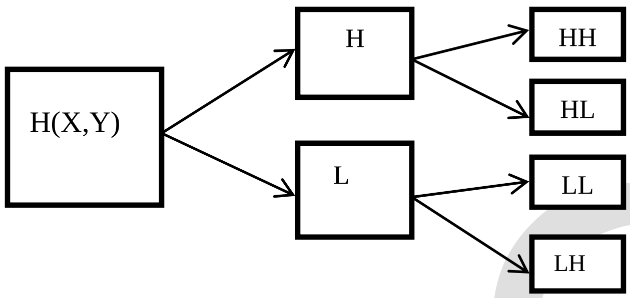


Fig 1.2 Block diagram of DWT

2.2 DCT

The DCT changes a transmission out of spatial domain into a frequency domain. DCT is definitely real-valued and supplies a more rewarding approximation of a transmission by using couple of coefficients[2]. This approach decreases how big is the traditional equations by discarding increased frequency DCT coefficients. Essential design data is within the reduced consistency DCT coefficients. Hence, distancing the high-frequency DCT coefficient and utilizing the lights advancement while in the low–consistency DCT coefficient, it can acquire and include the extra edge information out of satellite tv images

2.3 SVD

SVD is actually with different theorem through straight line algebra that states that a rectangular matrix Some sort of, a product regarding about three matrices that is (i) an orthogonal matrix UA, (ii) a diagonal matrix ΣA and (iii) the transpose of orthogonal matrix VA[2].Singular-value-based image equalization (SVD) process draws on equalizing the unique importance matrix acquired by means of unique importance decomposition (SVD). SVD of image, is often translated being a matrix. Basic advancement develops due to scaling with single ideals in the DCT coefficients

2.4 FUZZY BASED ENHANCEMENT

A new fuzzy logic and histogram based algorithm for enhancing low contrast color images has been proposed here. The method is computationally fast compared to conventional and other advanced enhancement techniques[2]. It is based on two important parameters M and K, where M is the average intensity value of the image, calculated from the histogram and K is the contrast intensification parameter. The given RGB image is converted into HSV color space to preserve the chromatic information contained in the original image[6]. To enhance the image, only the V component is stretched under the control of the parameters M and K. The proposed method has been compared with conventional contrast enhancement techniques as well as with advanced algorithms.

2.5ADAPTIVE HISTOGRAM EQUALIZATION

Adaptive histogram equalization [AHE] is an excellent contrast improvement method for both natural images and medical images[2]. It is dissimilar from standard HE in the respect that the adaptive process figures numerous histograms, each equivalent to a dissimilar part of the image[8]. AHE is the process by which at lower scales contrast is improved, though at larger scales contrast of a image is reduced. The benefit of AHE is that it is , reducible and frequently creates superior images.

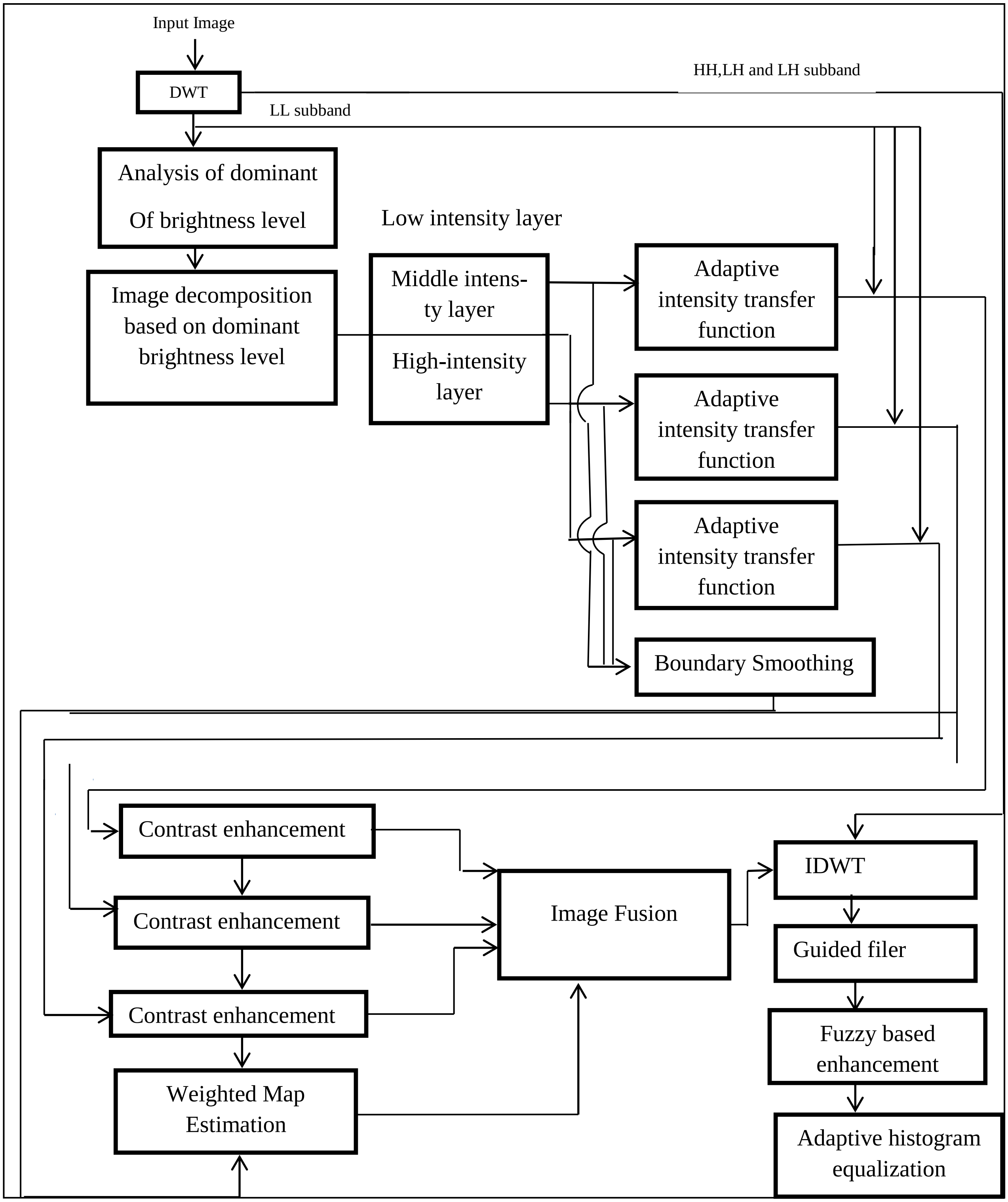
2.6 DOMINANT BRIGHTNESS LEVEL ANALYSIS

This algorithm computes brightness by using the Low–intensity factor in the wavelet domain and transfer intensity values[12]. First of all DWT is attained on the new images and formerly utilise the log-average luminance. The LL sub group split in to three different forms. Power transfer functions are adaptively predicted utilise the log transfer function and the gamma adapt function. Since at that point, the subsequent improved image is attained usage the inverse DWT[10]. The algorithm promotes the complete contrast and recognition facts better than present techniques

3. LITERATURE SURVEY

Jayaram et al.(2011)[1] has proposed a fuzzy inference system based contrast enhancement of gray level images .A new method of generating the fuzzy if-then rules actual to a specified image based on the local information wieldy to be used by a fuzzy inference system. Akho et al.(2012) [2] has recommended a novel fuzzy logic based algorithm for increasing low contrast color images. It is founded on two significant variables M and K, where M is the average depth value of the image which is determined from the histogram and K could be the contrast amplification parameter. The given RGB image is changed into HSV color room to preserve the chromatic data contained in the original image. To enhance the image, only the V element is stretched to manage of the variables M and K**4.**Zhang et al. (2012) [3] has described approximate histogram analysis technique based on gamma correction by a local pilot. First, image based on histogram portioned settlement means each partition local minima and gray-level calculations. Then, gamma correction resulted in median gray-level access. Analyze histograms, portioned by parameters are adjusted automatically. Experimental results demonstrate good contrast enhancement and preservation of image brightness can be obtained by the proposed method. Lee et al. (2013) [4] has presented an optimal contrast enhancement strategy for remote sensing images which is founded on dominant brightness level analysis and adaptive intensity transformation for remote sensing images. The assessed process perform discrete wavelet transform (DWT) on the input images and then divide the LL sub band in to low, heart, and high intensity levels utilising the log average luminance. The knee transfer function and the gamma adjustment function on the basis of the dominant brightness level of each layer are used to determine the adaptive intensity transfer functions. Srivastava et al. (2013) [5] has discussed histogram equalization has one of the best method to process the digital contrast enhancement but has not been suitable for every image. Sometimes it shows not good outcomes. To overcome this problem it provides a new method to improve the image result. Yu et al.(2014)[6] has offered that edge protection ratio (EPR) objective image quality evaluation (IQA) for a full reference metric. This is the notion that the human visual system for important messages are mainly of image structures, and can be extracted by these structures under edge detection. Deshmukh et al.(2015)[7] has presented novel fuzzy based contrast enhancement method. Contrast enhancement is important and stimulating region of image processing. The first image fuzzify, function and defuzzify image pixels back plane is proposed. Fuzzy set classic set in place more than improbability comes into an image is used. Arora et al.(2015)[8] has defined that a vastly overexposed color image is considered by high brightness, low chromaticity and loss of detail. Improves the contrast and lightness in a fuzzy based approach development is proposed. Brightness and color of a alike brightened white brightness relative to selecting fuzzy operators are accurate. Hue, saturation and intensity value (HSV) color model images to preserve hue. Jin et al.(2015)[9] has offered a new method for both noise suppression and edge protection. To detect the edge information the structure tensor is applied in wavelet domain. Both reduction and detection and quantified process are integrated as a matrix mask. Mamoria P et all.(2015)[10] has defined the methods of Digital Image processing to change input image into an superior image form.Many methods are presented to improve the images as per necessities.There is different present approaches of Contrast enhancement methods are being equated with the fuzzy based image enhancement method.

4.**PROPOSED METHODOLOGY**



5. RESULTS AND DISCUSSIONS

Towards appliance the planned algorithm, plan and implementation has been prepared in MATLAB applying image control toolbox.

This method provides superior effects than surviving procedures. As revealed in provided numbers, were comparing the outcomes of many images. Results shows assessed method results which are a lot better than existing methodologies. The outcomes shows the performance analysis between existing and in the projected methods.

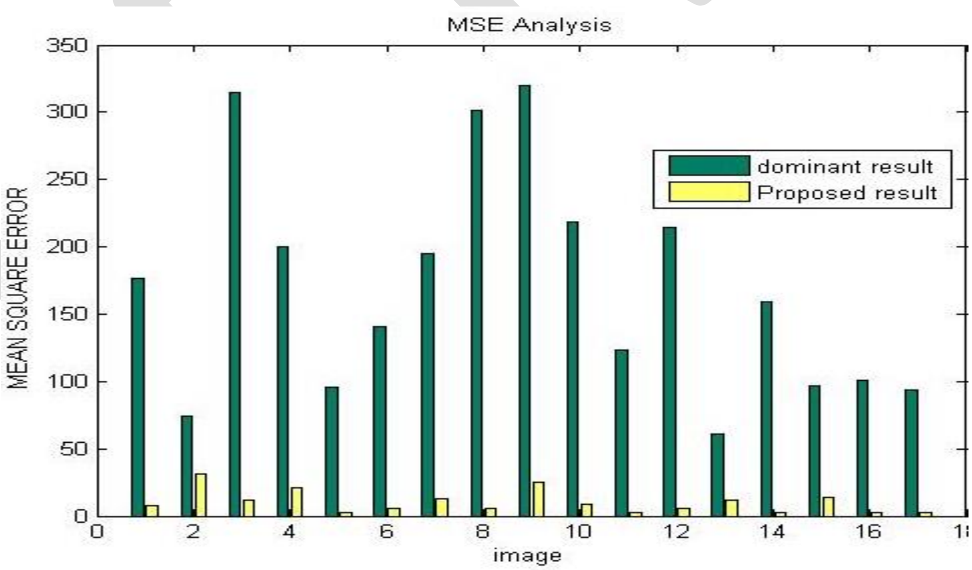
5.1Mean square error:MSE is the best common measure for performance measurement of the surviving technique and the the coded Images.

$$\mathrm{MSE} = \frac{1}{MN}\sum_{i}^{M} = 1\sum_{j}^{M} = 1(f(i,j) - f'(i,j))^2$$

Where *f* (*i*, *j*) signifies the original image and *f'* (*i*, *j*) signifies the distorted image and i and j are the pixel position of the M×N image. MSE is zero when: *x* (*i*, *j*) = *y* (*i*, *j*)

Table 1.1. Mean square error

Image	Dominant results	Proposed dominant results
Image 1	177	8
Image 2	74	31
Image 3	315	12
Image 4	200	21
Image 5	96	3
Image 6	141	6
Image 7	195	13
Image 8	301	6
Image 9	335	25
Image 10	218	9



Analysis of mean square error

5.2Peak signal to noise ratio evaluation: PSNR is the ratio between the maximum probable degree of signal and the power of corrupting noise that affect the quality of image. PSNR represent the peak error. To measure the PSNR first complete the MSE. PSNR is defined as:

PSNR is defined as:

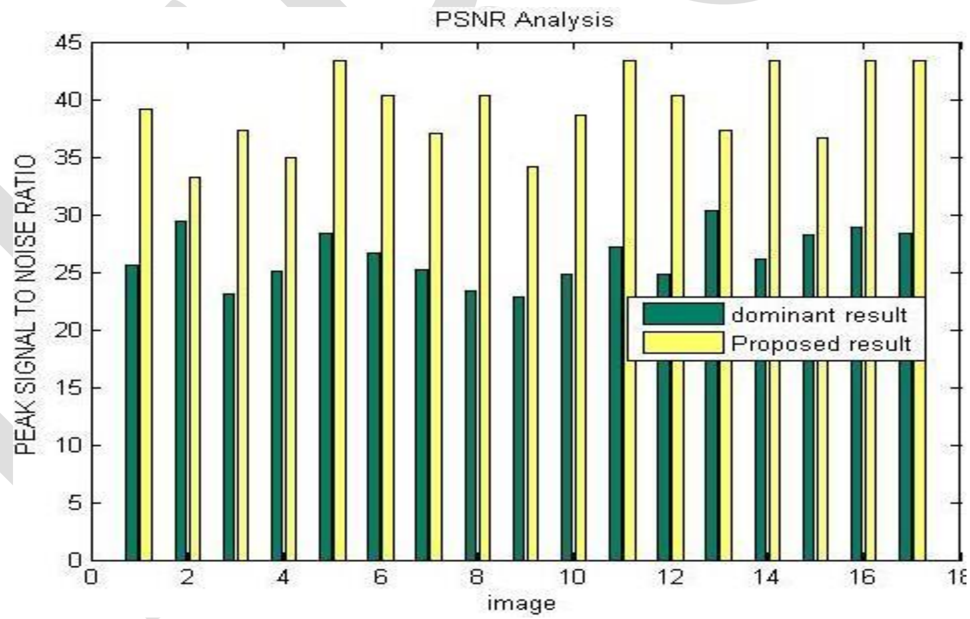
$$PSNR = 10.\log_{10} \frac{MAX_I^2}{MSE}$$

$$=20.\log_{10} \frac{MAX_I^2}{MSE}$$

$$=20\log_{10}(MAX_{10}) - 10.\log_{10}(MSE)$$

1.2 Peak Signal to Noise Ratio Evaluation

Image	Dominant results	Proposed dominant results
image 1	25.6511	39.0999
image 2	29.4385	33.212
image 3	23.1477	37.3390
image 4	25.1205	34.9086
image 5	28.3081	43.3596
image 6	26.6386	40.3493
image 7	25.2305	36.9914
image 8	23.3451	40.3493
image 9	22.8804	34.1514
image 10	24.7462	38.5884

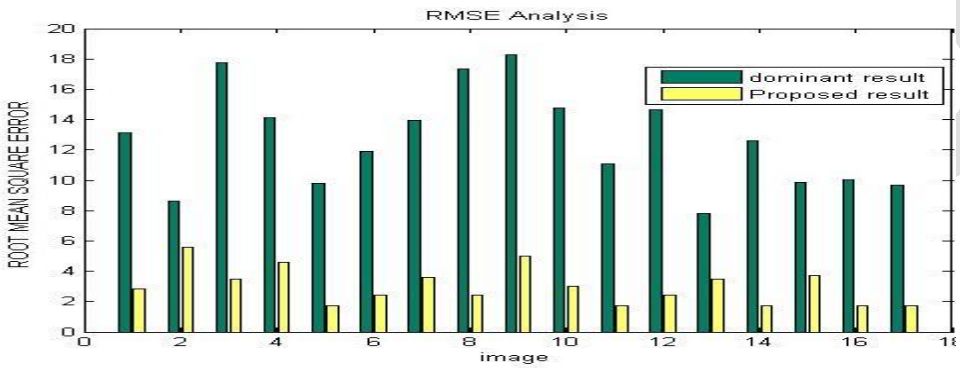


Analysis of Peak signal to noise ratio

5.3Root mean square error (RMSE): The RMSE is used to calculate the difference between the predicted values and values actually observed from the surroundings that is being demonstrated. RMSE need to be minimized.

Table 1.3Root Mean Square Error

Image	**Dominant results**	**Proposed dominant results**
image 1	13.1421	2.8284
image 2	8.6023	5.5678
image 3	17.7482	3.4641
image 4	14.1421	4.5826
image 5	9.7980	1.7321
image 6	11.8749	2.4495
image 7	13.9642	3.6056
image 8	17.3494	2.4495
image 9	18.3030	5



Analysis of Root Mean Square Error

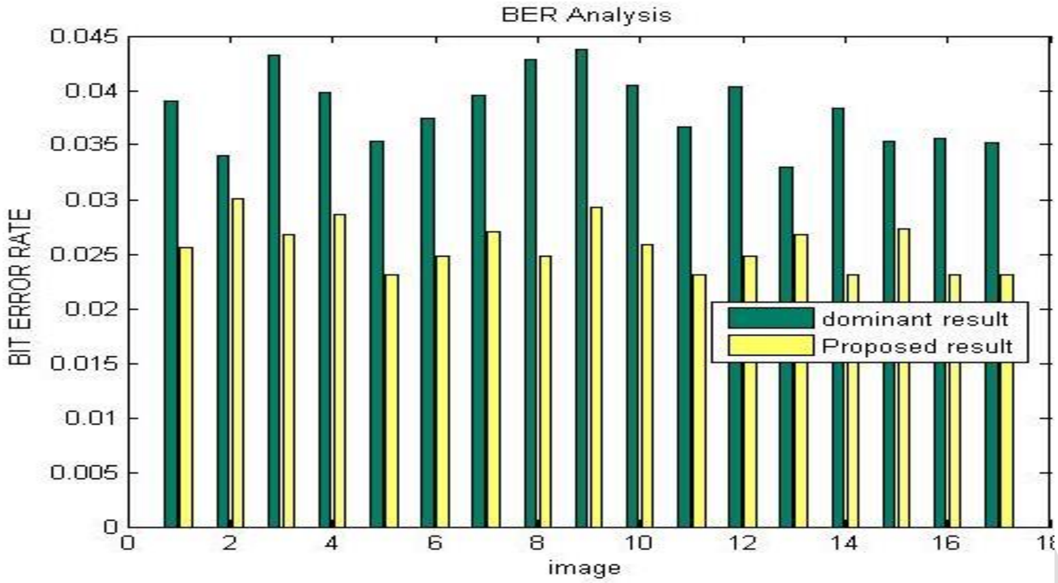
5.4 Bit error rate (BIR): Bit Error Ratio is simply the Bit Error Ratio among the input image and final image. It need to be minimized.

$$\text{BER} = \frac{1}{\text{MN}} \sum_{i=1}^{M} \sum_{j=1}^{N} [f(i,j) - f'(i,j)]$$

f(i,j)signifies the input image and $f'(i,j)$ signifies the slanted image and i and j are the pixel position of the M×N image.

Table 1.4 Bit Error Rate

Image	**Dominant results**	**Proposed dominant results**
image 1	0.0390	0.0256
image 2	0.0340	0.0301
image 3	0.0432	0.0268
image 4	0.0398	0.0286
image 5	0.0353	0.0231
image 6	0.0375	0.0248
image 7	0.0396	0.0270
image 8	0.0428	0.0248
image 9	0.0437	0.0293
image 10	0.0404	0.0259



Analysis of Bit Error Rate

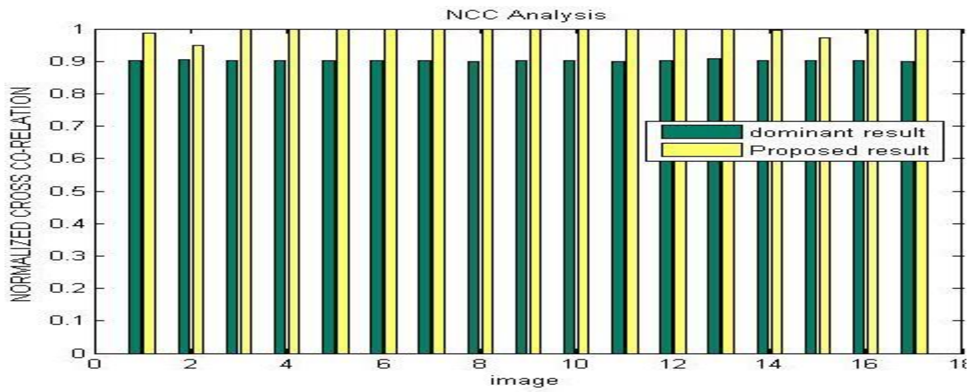
5.5 Normalized cross co-relation(NCC)

An Improved Dominant Brightness Level Analysis (DBLA) Approach for Image Contrast EnhancementNCC necessities to be close to 1, so planned algorithm show improved results than the existing methods as NCC is close to 1 in every instance .The main objective is to preserve NCC as much as possible to close to one.

$$NCC = \frac{\sum_i^m = 1 \sum_j^n = 1 (A_{ij} - B_{ij})}{\sum_i^m = 1 \sum_j^n = 1 (Aij^2)}$$

Table 1.5 Normalized cross co -relation

Image	**Dominant results**	**Proposed dominant results**
image 1	0.9007	0.9875
image 2	0.9057	0.9489
image 3	0.9010	0.9998
image 4	0.9014	0.9991
image 5	0.9007	0.9998
image 6	0.9014	0.9996
image 7	0.9034	0.9990
image 8	0.9005	0.9995
image 9	0.9012	0.9998
image 10	0.9009	0.9999



Analysis of Normalized cross co- relation

CONCLUSION

This paper represents enhancement approach based on dominant brightness level analysis Fuzzy logic for remote sensing images. The existing technique has been done work on the low-contrast images acquired by a satellite camera . As such no work has done for the images having the color artifacts.In this work proposed the DWT as well as adaptive histogram equalization as the post processing function and also uses the illuminate normalization to enhance the accuracy of image by reducing the problem of noise.The evaluation of technique is done on the basis of the parameters Mean square error, Peak signal to noise ratio, Root mean square value, Bit error rate, Normalize cross co-relation, Normalize absolute error has performed well as compared to existing technique.

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