# Contrast and Luminance Enhancement using Discrete Shearlet Transform and Discrete Cosine Transform

**Miss. Priyanka V. Pawade[1] Dr. M. A. Gaikwad[2] Prof. A. W. Hignikar[3]**
[1]M.Tech. Student [2]Principal [3]Assistant Professor
[3]Department of Electronics & Tele-Communication Engineering
[1,2,3]B.D.C.O.E. Sewagram

*Abstract*— Image enhancement is a process of improving the perception or interpretability of the information in image. The main objective of image enhancement is to improve some characteristics of an image to make it visually better for human viewer. These are the various types of image enhancement techniques like contrast enhancement etc. Contrast enhancement technique includes the methods like Histogram Equalization (HE), Brightness preserving Bi-Histogram Equalization(BBHE), Dualistic sub-image Histogram Equalization (DSIHE), Minimum mean Brightness Bi-Historgram Equalization (MMBEBHE). Contrast enhancement improves the perceptibility of an image by changing the pixel intensity of input image. This paper presents review of different image contrast enhancement techniques.

***Key words:*** Image Enhancement, discrete shearlet transform, discrete cosine transform, filter

## I. INTRODUCTION

Image enhancement is basically the process of improving the interpretability or perception of information in images for human viewers and providing better input for other automated image processing techniques. The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer. During this process, one or more attributes of the image are modified.

The choice of attributes and the way they are modified are specific to a given task. Moreover, observer-specific factors, such as human visual system and the observer's experience may introduce a great deal of subjectivity into the choice of image enhancement methods. There exist many techniques that can enhance a digital image without spoiling it. The enhancement methods can broadly be divided in to the following two categories:

1) Spatial Domain Methods
2) Frequency Domain Methods

In spatial domain method directly deals with the image pixels. The pixel values are manipulated to achieve desired enhancement. In frequency domain methods, the image is transferred in to frequency domain by computing its transform first. All the enhancement operations are performed on the transformed image and then the inverse transform is performed to get the resultant image. These enhancement operations are performed in order to modify the image brightness, contrast or the distribution of the grey levels. As a consequence the pixel value (intensities) of the output image gets modified according to the transformation function applied on the input values.

Image enhancement is applied in every field where images are ought to be understood and analyzed like medical image analysis, analysis of images from satellites etc. The enhancement does not increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily.

Different researches worked on image contrast enhancement by varying only one parameter either hue(H) or intensity(V) We proposed a new image contrast enhancement technique were the hue(H) intensity(V) will be considered as parameters for image contrast enhancement to obtained higher level of contrast enhancement.

## II. RELATED WORK

Deepak Ghimire et. al proposed at nonlinear transfer function-based local approach for color image enhancement**.** The image enhancement is applied only on the V (luminance value) component of the HSV color image and H and S component are kept unchanged to prevent the degradation of color balance between HSV components. The V channel is enhanced in two steps.

First the V component image is divided into smaller overlapping blocks and for each pixel inside the block the luminance enhancement is carried out using nonlinear transfer function.

In the second step, each pixel is further enhanced for the adjustment of the image contrast depending upon the centre pixel value and its neighbourhood pixel values. Finally, original H and S component and enhanced V component image are converted back to RGB image.[1]

Khalid Hussain et al. proposed dark image enhancement by locally transformed histogram. The process of enhancing images may produce different types of noises such as unnatural effects, over-enhancement, artifacts, etc. These drawbacks are more prominent in the dark images. To overcome the above drawbacks, they propose a method for dark image enhancement. In this paper, the image is enhanced by applying local transformation technique on input image histogram. They smoothen the input image histogram to find out the location of peaks and valleys from the histogram. Then a transformation method is applied on each segment of image histogram. Finally, histogram specification is applied on the input image using this transformed histogram. This method improves the quality of the image with minimal unexpected artifacts. The process of enhancing image produces different types of noises such as unnatural effects, over enhancement artifacts etc. These drawback are more prominent in the dark image.[2]

S.Premkumar,et. al proposed an efficient approach for colour image enhancement using discrete shearlet transform. They proposed a novel method for image contrast enhancement based on Discrete Shearlet Transform (DST) for colour images. In order to obtain high contrast enhancement image, the RGB image is first converted into HSV (Hue, Saturation and Value) color space. The converted hue color channel is only taken into the account for DST decomposition. After that higher sub bands of hue component are eradicated and lower sub bands are only considered for reconstruction. Finally, high contrast image is obtained by using reconstructed Hue for HSV color space and then it is converted to RGB color space.[3]

## III. COMPARISION OF RELATED WORK

| Paper | Parameter | Algorithm | Transform |
|---|---|---|---|
| [1] | V parameter | —— | Discrete cosine transform |
| [2] | V parameter | Gaussian smoothing filter | —— |
| [3] | H parameter | —— | Discrete shearlet transform |

Most of the researches proposed methodology for image enhancement. Some of the researchers concentrated only on V (luminance value) component of the HSV color image and H and S component are kept unchanged to prevent the degradation of color balance between HSV components. For dark image enhancement some reaserces proposed local transformation techniques on input image histogram and for color images, they usesed Discrete Shearlet Transform (DST) in order to obtain high contrast enhancement image. We combine the two approaches for color image enhancement in terms of contrast enhancement and luminance enhancement.

## IV. PROPOSED WORK

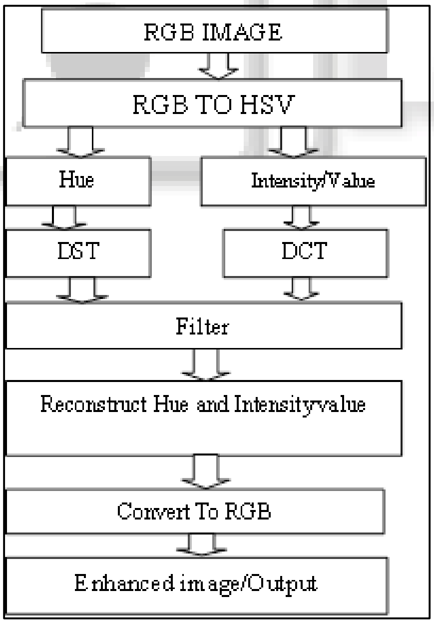



Fig. 1:

Image enhancement is a key processing on an image for wide range of applications. Contrast enhancement improves the perceptibility of an image by changing the pixels intensity of the input image. In this project, a novel method for image contrast and luminance enhancement is proposed based on Discrete Shearlet Transform(DST) and Discrete Cosine Transform(DCT) for color images. In order to obtain high contrast enhancement, the RGB image is first converted into HSV(Hue, Saturation and Value) color space. The converted hue color channel and V *(*luminance value*)* component of the HSV color image is only taken into the account for DST and DCT decomposition. After decomposition we use filter to smooth the histogram. Finally we get enhanced image by reconstructing RGB values from HSV color space.

## V. DISCRETE SHEARLET TRANSFORM

Shearlet is multiscale directional representation of an image is called Discrete Shearlet Transform. Shearlets were introduced with the expressed intent to provide a highly efficient representation of images with edges. In fact, the elements of the shearlet representation form a collection of well-localized waveforms, ranging at various locations, scales and orientations, and with highly anisotropic shapes. The applications of Discrete Shearlet Transform can be summarized as denoising of natural image corrupted with white Gaussian noise, detection of cracks in textured image, denoising of videos.

The mathematical properties of Shearlet are as follows.

1) Shearlet are well localized. In fact they are compactly supported in frequency domain and have fast decay in frequency domain.
2) Shearlet satisfy parabolic scaling.
3) Shearlet exhibit highly directional sensitivity
4) Shearlet are spatially localized.
5) Shearlet are optimally sparse.

The special properties of the shearlet approach have been successfully exploited in several imaging application. For example, the combination of multi-scale and directional decomposition using shearing transformations is used to design powerful algorithms for image denoising in the directional selectivity of the shearlet representation is exploited to derive very competitive algorithms for edge detection and analysis in the sparsity of the shearlet representation is used to derive a very effective algorithm for the regularized inversion of the Radon transform. many applications from areas such as medical diagnosis, video surveillance and seismic imaging require to process 3D data sets, and sparse 3D representations are very useful for the design of improved algorithms for data analysis and processing.

An $N*N$ Image consist of a finite sequence of values$\{x[n1;n2]\{x[n1,n2]\}\begin{matrix} N-1, N-1 \\ n1, n2 = 0 \end{matrix}\}$

where $N \in$N. Identifying the domain with the finite group $Z^2_N$, the inner product of images $x; y$ : $Z^2_N \rightarrow C$ is defined as

$(x,y) = \sum_{V=0}^{N-1} x(u,v)\overline{y\ (u,v)}$

Thus the discrete analog of $L^2(R^2)$ is $l^2\ Z^2_N$. Given an image $f \in l^2(Z^2_N)$, let $\hat{f}[k_1,k_2]$ denote its 2D Discrete Fourier Transform(DFT)

$\hat{f}[k_1,k_2]=\frac{1}{N}\sum_{n1,n2=0}^{N-1} f[n_1,n_2]e^{-2\pi i(\frac{n1}{N}k_1+\frac{n1}{N}k_2)}$

The brackets in the equation denote array of indices, and parentheses denote function evaluation. Then the interpretation of the number $\hat{f}[k_1,k_2]$ as samples $\hat{f}[k_1,k_2] = \hat{f}(k_1,k_2)$ is given by the following equation form the trigonometric polynomial.

$$\hat{f}[\varepsilon_1,\varepsilon_2]=\sum_{n1,n2=0}^{N-1} f[n_1,n_2]e^{-2\pi i(\frac{n1}{N}\varepsilon_1+\frac{n1}{N}\varepsilon_2)}$$

First to compute

$$\hat{f}(\varepsilon_1,\varepsilon_2)\overline{V}(2^{-2j}\varepsilon_1,2^{-2j}\varepsilon_2)$$

In the discrete domain at the resolution level j, the Laplacian pyramid algorithm is implemented in the time domain. This will accomplish the multi scale partition by decomposing $f_a^{j-1}[n_1,n_2]$, $0 \le n_1,n_2 < N_{j-1}$, into a low pass filtered image $f_a^{j}[n_1,n_2]$ , a quarter of the size of $f_d^{j-1}[n_1,n_2]$ and a high pass filtered image $f_d^{j-1}[n_1,n_2]$. Observe that the matrix $f_d^{j-1}[n_1,n_2]$ has size $N_j*N_j$ where $N_j = 2^{-2j}N$ and $f_a^0[n_1,n_2]=f[n_1,n_2]$ has size $N*N$ .

In this paper H(hue) parameter is applied for the Discrete Shearlet Transform. Original RGB Image is having a size of 1024*1024 pixel. And then resize the image 256*256 pixel. After that RGB image is converted to HSV image. Then only H(Hue) component is applied to Discrete Shearlet Transform. After that to get 48 images.

## VI. Discrete Cosine Transform

The Discrete Cosine Transform expresses a finite sequence of data points in terms of a sum of cosine function oscillating at different frequencies. DCT are important to numerous application in science and engineering from lossy compression of audio and image to spectral method for numerical solution of partial differential equation. The Discrete Cosine Transform used to decompose the spatial frequency of image in terms of various cosine. These are widely used in Image compression. Used of DCT to calculate the frequency complexity of image. Discrete cosine transform is a real transform that transform a sequence of real data points into its real spectrum therefore avoids the problem of redundancy. These are the application of Discrete Cosine Transform. The need for image compression is reduced pixels size or reduced size of image. The basic objective of image compression is to find an image representation in which pixels are less correlated. The two fundamental principles used in image compression are redundancy and irrelevancy. Redundancy removes redundancy from the signal source and irrelevancy omits pixel values which are not noticeable by human eye.

The mathematical representation of Discrete Cosine Transform is given below.

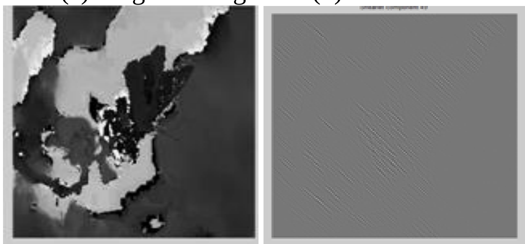
$$C_{(k*n)} = \begin{cases} \frac{1}{\sqrt{N}} & \text{if } k=0, \quad 0<=n<=N-1 \\ \frac{\sqrt{2}}{N}\cos\left[\frac{\pi(2n+1)k}{2N}\right] & 1<=k<=N-1; \end{cases}$$

In this paper original RGB imge is having size of (1024*1024) pixels. and then resize the image (256*256) pixels. Then the RGB image is converted to HSV. Then V component is applied to the DCT (Discrete Cosine Transform).

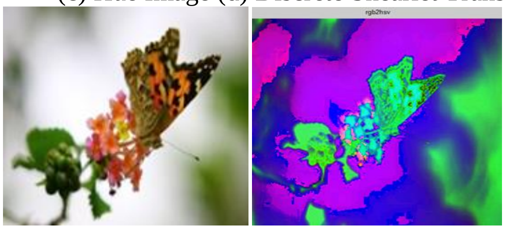
## VII. Experimental Result

The performance of the proposed contrast image enhancement approach is evaluated by using transform. The image is RGB color space. To implement proposed system the RGB image is converted to HSV color space. Then H(Hue) component is applied to Discrete Shearlet Transform and V(Value/Intensity) is applied to Discrete Cosine Transform.

(a) Original Image (b) RGB TO HSV



(c) Hue Image (d) Discrete Shearlet Transform



(a) Original Image (b) RGB TO HSV


(c) V Component (d) Discrete Cosine Transform

Fig. 2:

## VIII. Conclusion

In this work we have implemented Discrete Shearlet Transform on H (Hue) parameter and Discrete Cosine Transform on V(Value/Intensity) parameter on the input of HSV image. Resultated images are used to modified contrast of the images.

## Reference

[1] Deepak Ghimire and Joonwhoan Lee Nonlinear transfer function-based local approach for color image enhancement IEEE Transaction on consumer electronics,vol 57,No 2 May 2011.

[2] Khalid Hussain, Shanto Rahman, S. M. Khaled, M. Abdullah-Al-Wadudy and Mohammad Shoyaib Dark image enhancement by

locally transformed Histogram ISSN:-978-1-4799-6399-7/14/$31.00 c 2014 IEEE.

[3] S.Premkumar,K.A.Parthasarathi:“AnEfficientApproach forColour An Efficient Approach for Color Image Enhancement Using Discrete Shearlet Transform International Conference on current Trends in Engineering And Technology, ICCTET’14.

[4] Soo-Chang Pei, Fellow, IEEE, Yi-Chong Zeng, and Ching-Hua Chang Virtual Restoration of Ancient Chinese Paintings Using Color Contrast Enhancement and Lacuna Texture Synthesis IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 13, NO. 3, MARCH 2004.

[5] J.Alex Stark Adaptive Image Contrast Enhancement Using Generalizations of Histogram Equalization IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 9, NO. 5, MAY 2000.

[6] Y.Wang Q. Chen, and B. Zhang,”Image enhancement based on equal area dualistic sub-image histogram equalization method,” Consumer Electronics IEEE TRANSACTIONS on vol.45 no..1 pp 68-75,1999.

[7] C.M Tsai and Z.M. Yeh, “Contrast enhancement by automatic and parameter-free piecewise linear transformation for color images,” Consumer Electronics, IEEE Transaction on,vol.54 no. 2, pp.213-219,2008.

[8] J.C.Clement M Parbukunmar, and A. Basker, ”Color image enhancement in compressed DCT domaim” ICGST-GVIP Journal, vol. 10,no 1 pp 31-38.Feb 2010.

[9] George Zentai,(2011), Contrast Enhancement in Memmography Imaging Including K Edge Filtering.

[10] S.D Chen and A.R Ramli,”Minimum mean brightness error bi-histogram equalization in contrast enhancement”, Consumer Electronics, IEEE Transaction on, vol.49 no. 4, pp.1310-1319, 2003.

[11] R. C. Gonzalez and R. E. Woods,” Digital image processing,”20002.