

# Nonlinearity of transform tone distortion white balancing Contrast enhancement using generalized equalization

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## Abstract

Generalized equalization model is proposed for image and video enhancement. Based on our analysis on the relationships between image histogram and contrast enhancement/white balancing, is established by integrating contrast enhancement and white balancing into a unified framework of convex programming of image histogram. The image enhancement tasks can be accomplished by the proposed model using different configurations of parameters. With two defining properties of histogram transform, namely contrast gain and nonlinearity, the model parameters for different enhancement applications can be optimized. And then deriving an optimal image enhancement algorithm that theoretically achieves the best joint contrast enhancement and white balancing result with trading-off between contrast enhancement and tonal distortion.

**Keywords:** Contrast enhancement, generalized equalization, nonlinearity of transform, tone distortion, white balancing.

## Introduction

Image enhancement is conversion of the original imagery to a better understandable level in spectral quality for feature extraction or image interpretation. It is useful to examine the image Histograms before performing any image enhancement. The x-axis of the histogram is the range of the available digital numbers, i.e. 0 to 255. The y-axis is the number of pixels in the image having a given digital number. Examples of enhancement functions include

- Contrast stretching to increase the tonal distinction between various features in a scene.
- Filtering is commonly used to restore imagery by avoiding noises to enhance the imagery for better interpretation and to extract features such as edges and lineaments [1].

The most common types of filters: mean, median, low-, high pass, edge detection

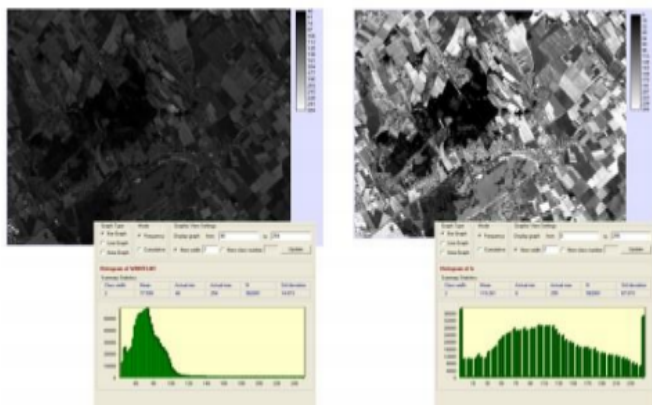


Figure.1 SPOT band before and after contrast stretching with histogram.

Generally, tone mapping algorithms can be classified into two categories by their functionalities during the imaging process.

**White Balancing:** Color balance is the global adjustment of the intensities of the colors. Color balance changes the overall mixture of colors in an image and is used for color correction; generalized versions of color balance are used to get colors other than neutrals to also appear correct or pleasing. Several aspects of the acquisition and display process make such color correction essential – including the fact that the acquisition sensors do not match the sensors in the human eye, that the properties of the display medium must be accounted for, and that the ambient viewing conditions of the acquisition differ from the display viewing conditions [2].

**Contrast enhancement:** Normally color images are stored in RGB color space. At the first glance it seems simple to apply histogram equalization to a color image: just does it on

each channel. However, applying histogram equalization separately on each channel of a RGB will probably destroy the balance of different color components and result in poor image quality [3].

**PRIOR ART:**

In this section, we briefly describe some enhancement methods. Graham D. Finlayson proposed color by correlation: a simple, unifying framework for color constancy related work, where image of a three-dimensional scene depends on a number of factors. First, it depends on the physical properties of the imaged objects that are on their reflectance properties. But, it also depends on the shape and orientation of these objects and on the position, intensity, and color of the light sources. Finally, it depends on the spectral sampling properties of the imaging device. Color constancy is the tendency to perceive surface color consistently, despite variations in ambient illumination. Central to solving the color constancy problem is recovering an estimate of the scene illumination and it is that problem which is the focus of this paper. Specifically, we consider how, given an image of a scene taken under an unknown illuminant, we can recover an estimate of that light. Ji-heehan proposed novel 3-d color histogram equalization method with uniform 1-d gray scale histogram method, in which majority

of color histogram equalization methods do not yield uniform histogram in gray scale. After converting a color histogram equalized image into gray scale, the contrast of the converted image is worse than that of a 1-D gray scale histogram equalized image. We propose a novel 3-D color histogram equalization method that produces uniform distribution in gray scale histogram by defining a new cumulative probability density function in 3-D color space. Test results with natural and synthetic images are presented to compare and analyze various color histogram equalization algorithms based upon 3-D color histograms. In gamut mapping, the gamut of colors in a test image is remapped to the visible gamut under a standard illuminant, and that mapping constrains the illuminant. In normalization approaches, the range of reflectances is normalized in each color channel, and the adjustment required for normalization yields an estimate of the illuminant. The Bayesian algorithm is shown also to perform significantly better than the grey world algorithms, even when the grey world algorithms are enhanced by inclusion of an illumination [5].

## Related Work

### Image enhancement:

Image enhancement transforms images to provide better representation of the subtle

details. It is an indispensable tool for researchers in a wide variety of fields including (but not limited to) medical imaging, art studies, forensics and atmospheric sciences. It is application specific: an image enhancement technique suitable for one problem might be inadequate for another. For example, forensic images/videos employ techniques that resolve the problem of low resolution and motion blur while medical imaging benefits more from increased contrast and sharpness. To cater for such an ever increasing demand of digital imaging, commercial software's were released for users who want to edit and visually enhance the images. The purpose of this research is to evaluate if image enhancement techniques improve the visualization of these images and to study the effect of such an approach. Additionally, this work aims at contributing towards shortening the training period of the novice researchers in the lab [4].

## Implementation

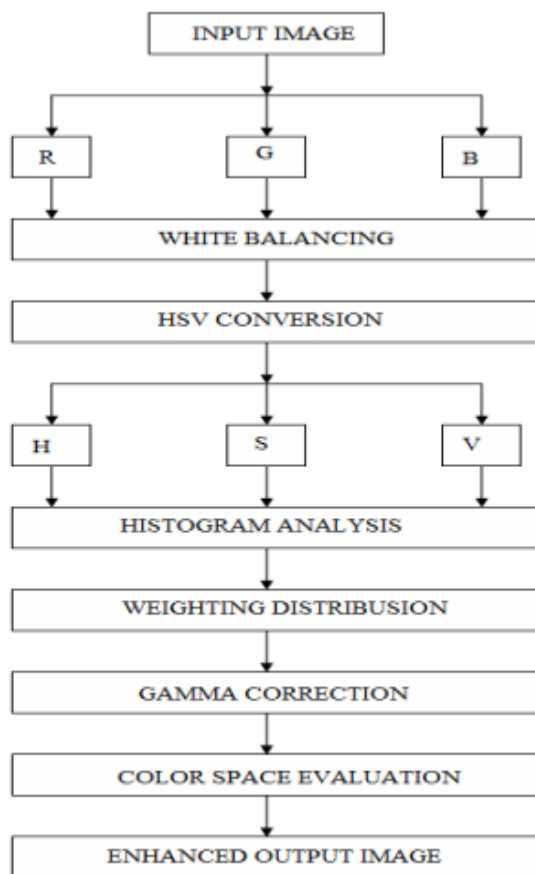
To overcome the disadvantages in existing enhancement techniques, here we are dealing with generalized equalization model. Generalized equalization technique: Generalized equalization model for image and video enhancement, establishes a relationships between image histogram and contrast enhancement/ white balancing, and integrating

contrast enhancement and white balancing into a unified framework of convex programming of image histogram. System model: This method unifies spatial filtering based enhancement methods, including bi-lateral filter, non-local means filter, steering regression and so on, which has potential applications in image enhancement. However, the computational complexity of filtering based method is much higher than traditional histogram based method in most situations. In many cases, such as real-time video surveillance, the histogram based methods are still being widely used [8].

Figure.2 Block diagram of proposed model.

**Whitening balance:** Color balance is the global adjustment of the intensities of the colors. Color balance changes the overall mixture of colors in an image and is used for color correction; generalized versions of color balance are used to get colors other than neutrals to also appear correct or pleasing

**Histogram Analysis On Gamma Correction:** Histogram-based algorithm has been widely used in contrast enhancement Gamma refers to the brightness of a monitor or computer display. By applying gamma correction, the brightness and contrast of the display are enhanced, making the images appear brighter and more natural looking.



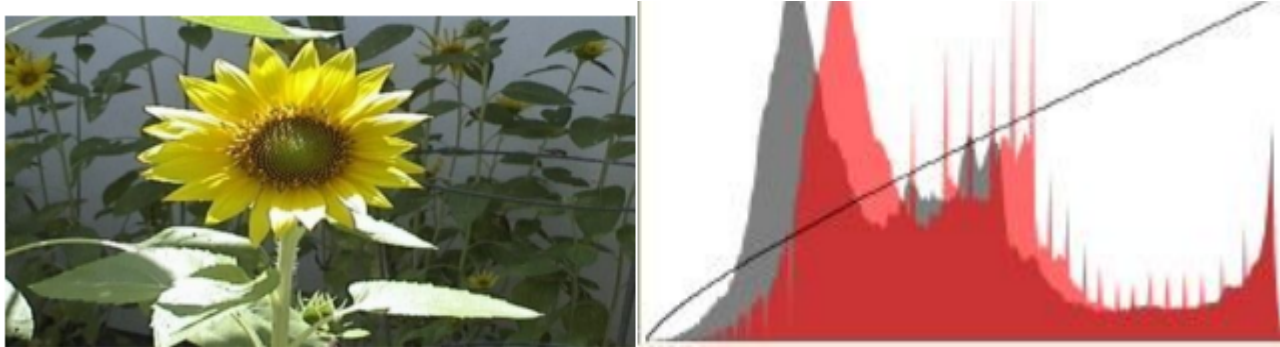


Figure.3 Image and its histogram value.

Histogram equalization is a method in image processing of contrast adjustment using the image histogram. This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values [9].

**Contrast Enhancement:** Contrast enhancement is a common operation in image processing. It's a useful method for processing scientific images such as X-Ray images or satellite images. And it is also useful to improve detail in photographs that are over or under-exposed. The goal of this assignment is to develop a contrast enhancement application that uses GPU acceleration. On this page, the basic ideas and principles of contrast enhancement using histogram modification are

given. We start with the simple case, contrast enhancement for grayscale images. Then, we try to apply the similar method to color images.

**Weighting Distribution:** The Gaussian blur is a type of image-blurring filters that uses a Gaussian function (which also expresses the normal distribution in statistics) for calculating the transformation to apply to each pixel in the image.

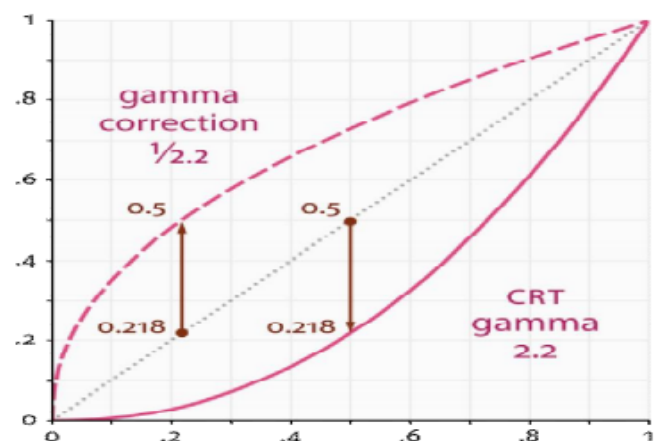


Figure.4 Graphical representations of gamma correction and CRT gamma correction.

Gamma encoding of images is required to compensate for properties of human vision, hence to maximize the use of the bits or

bandwidth relative to how humans perceive light and color. Human vision, under common illumination conditions, follows an approximate gamma or power function, with greater sensitivity to relative differences between darker tones than between lighter ones [7].

### Experimental Work

The generalized equalization model provides a joint strategy for image enhancement. If we relax to a small positive number, we can combine white balancing and enhancement into an integrated algorithm. we compare the proposed method with some existing white balancing algorithms, where we can see that the proposed method not only corrects the tone bias in original images but also enhances the contrast.

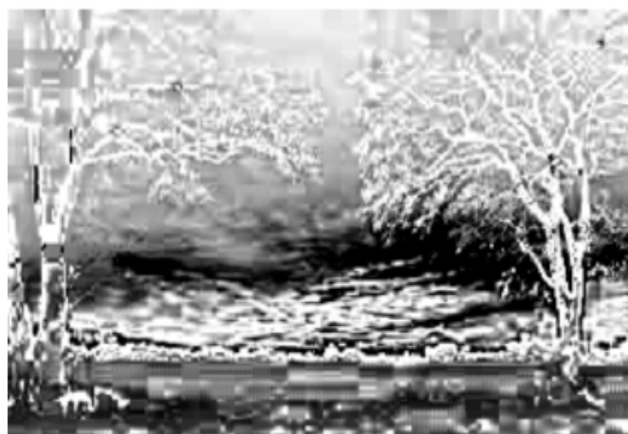


Figure.5 Defining the Intensity of image.

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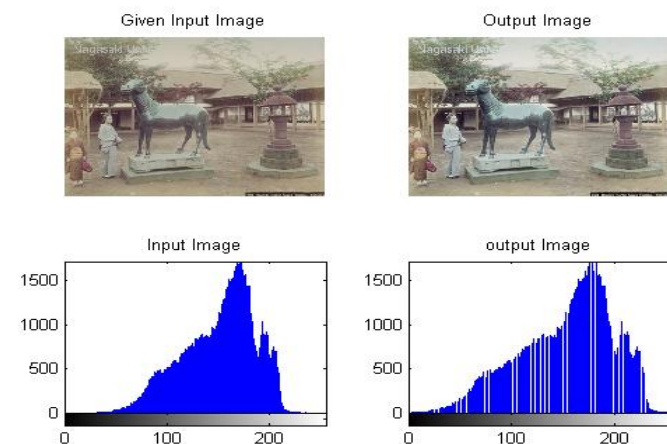


Fig 6: Output Screen 1.

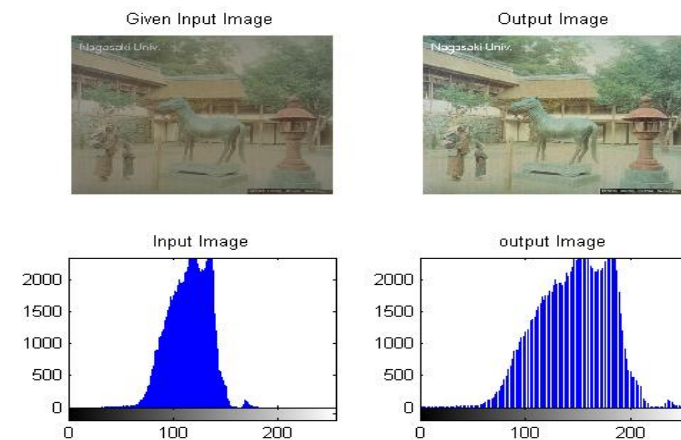


Fig 7: Output Screen 2.

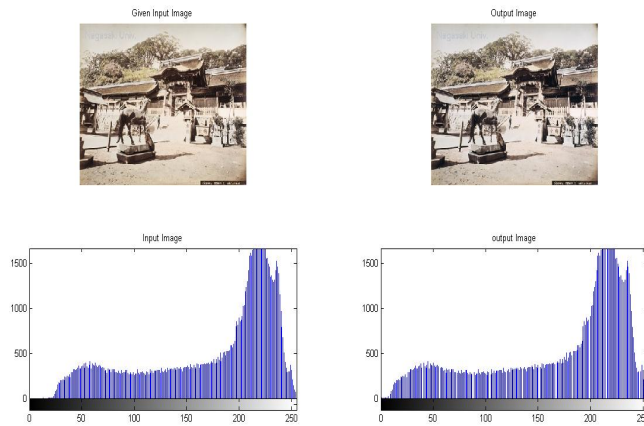


Fig 8: Output Screen 3.

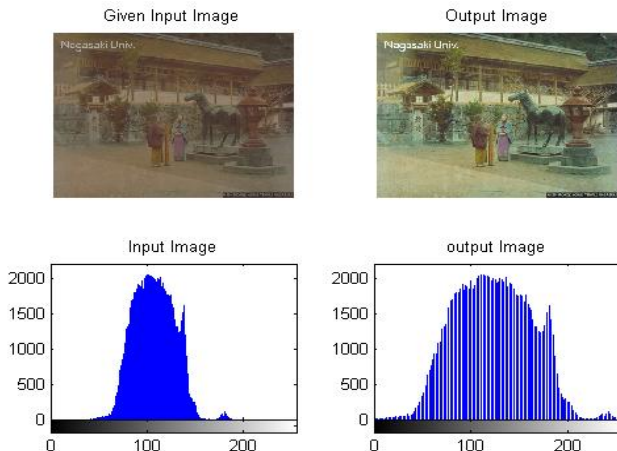


Fig 9: Output Screen 4.

## Conclusion

I have analyzed the relationships between image histogram and contrast/tone and established generalized equalization model for global image tone mapping. Extensive experimental results suggest that the proposed method has good performances in many typical applications including image contrast enhancement, tone correction, whitebalancing and post-processing of de-hazed images. In future work, I have to

expand the values of dark pixels in an image while compressing the higher values and compress the dynamic range of images with large variations in pixel values by using Bi-log transformation algorithm.

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