SURVEY ARTICLE

# A Literature Survey of Image Enhancement of Human Biology

**Elisee Aniwanou KPONOU[1], Wang Zhengning[2]**
[1] Electronic Engineering & uestc, China
[2] Electronic Engineering & uestc, China

[1] *kannel10@yahoo.fr,* [2] *zhengning.wang@uestc.edu.cn*

*Abstract— Image makes human biology interesting. Improving the contrast of biology images is an essential issue since most of these images suffer from low contrast phenomenon, fog, darker and faint characteristic. This work reiterates that adjusting the contrast of images before beginning its analysis process is highly desired. A comparison between several famous enhancement techniques was conducted likewise to choose the best, simplest and easy to implement method among the different popular methods. Therefore, experiments were performed to prove that adjusting the contrast or dehazing before analyzing images would lead to better results. This work will help biologist to get answers to meaningful biological questions.*

*Key Terms: - biology image; enhancement; contrast; noise; dehazing*

## I. INTRODUCTION

Biology is a field where images are ought to be understood and analyzed. As image analysis, biological images analysis involves the conversion of features and objects in image data into quantitative information about these measured features and attributes. Images in biology are often complex, noisy, foggy and consequently require roughly several image processing steps for the extraction of meaningful and quantitative information. We usually need to first process the image to correct for such defects and also to enhance the contrast to accentuate features of interest in some area in the image for subsequent analysis.

To correct artifacts and enhance contrast on the images, we apply various computational techniques to extract features and patterns from the images, such as contrast adjustment, removing noise, histogram equalization or dehazing using DCP...

The rest of this paper is organized as follow, section I introduces the works, section II highlights contrast adjustments. Section III introduces image de-noising. Image dehazing using DCP is developed in section IV. Section V and VI show some experiment results and summarize the unlimited applications of image enhancement in biology field and other field.

## II. CONTRAST ADJUSTMENTS

Biology images are often darker color, lower contrast and faint characteristic. Analysis biology image is not sometimes an easy task. The images that biologist often encounter, have a low dynamic range and most of its features are difficult to see. In this section we will try to focus our self on different intensity transformations that will improve the appearance of the images. Our goal is to solely enhance the contrast of an input image so that the visibility is improved and can enable reliable interpretation. Far to be an aesthetic role, improving the

appearance of an image can help to improve the performance of image analysis. The matlab command usually used to perform contrast adjustment is imadjust. Imadjust is only supported for 2-D grayscale images.

When the contrast is in an image is very low, then we increase the contrast in order to see more some details which are hidden. But sometimes we also reduce the contrast to view some particular features. As an example cameraman coat in the experiment below is too dark to reveal any information. Hence we reduce the contrast to be able to identify and distinguish the coat feature such as button.

Indeed during contrast adjustment, the intensity value of each pixel in the raw image (original image) is transformed using a transfer function to form a contrast-adjusted image.



Figure (1): Shows Cameraman at higher and lower resolution

## III. IMAGE DENOISING

As we introduced above, biology images suffer from many faint characteristics, such as noise, therefore denoising before analysis is necessary. Noise removal is the process of removing noise from an image. The aim of image denoising is to smooth out noise in an image without losing significant features such as edges and textures. Many techniques have been developed to achieve this task. Many further uses of these images require that the noise will be removed for some practical purposes such as image analysis.

The matlab commands used to remove noise are numerous. Wiener2 function, imfilter, fspecial are widely used to remove noise. Adaptive filter is also used and often outperforms linear filtering. The adaptive filter is more selective than a comparable linear filter, preserving edges and other high-frequency parts of an image. Wiener2 performs well when the noise is constant-power ("white") additive noise, such as Gaussian noise.

While reducing noise there is always a tradeoff between the original image and the denoising image. Indeed some detail may be sacrificed while getting smooth images.

## IV. IMAGE DEHAZING

As David Lindsay said 'It makes all the difference whether one sees darkness through the light or brightness trough the shadows '. In this section, we will talk about hazy image. Images taken under bad weather suffer from poor contrast. Indeed, under bad weather conditions, the light reaching a camera is severely scattered by the atmosphere. Therefore, the image obtained is highly degraded due to additive light. The equation widely used to describe the formation of image taken in that bad weather condition is [5]

$$I(x) = J(x)t(x) + A(1 - t(x)) \quad (1)$$

Where I is the observed intensity, J is the scene radiance; A is the global atmospheric light. And t is the transmission (the portion of light which doesn't scattered and reaches the camera).

Under fog weather conditions, the contrast and color characters of the images are drastically degraded. Clear day images have more contrast than hazy images. Hence, a haze removal algorithm should enhance the scene contrast. Enhancement of hazy image is a challenge due to the complexity in recovering luminance and chrominance while maintaining the color fidelity. During enhancement of hazy images, it should be kept in mind that over enhancement leads to saturation of pixel value. Thus, enhancement should be bounded by some constraints to avoid saturation of image and preserve appropriate color fidelity. Our goal is to solely remove the haze of an input image so that the visibility is improved and can enable reliable interpretation The dehazing method used is this paper is the DCP (Dark Channel Prior) proposed by Kaiming He et al [5].

For an arbitrary image J the DCP is given by

$$J^{dark}(x) \min_{c \in (r,g,b)} (\min_{y \in \Omega(x)} J^c(x)) \quad (2)$$

The transmission map t is given by

$$\tilde{t}(x) = 1 - \min_{y \in \Omega(x)} (\min_c \frac{I^c(y)}{A^c}) \quad (3)$$

We can clearly in section V we can see that the output image (the dehazed image) look much brighter than the hazy image.

## V. EXPERIMENTAL RESULTS

Some traditional enhancement methods are used to show how well the reconstructed image will look like. These extensive experiments have been conducted on several test images. To see the distribution of the intensity, a histogram was created by calling the matlab function imhist. For instance, for pout image, the intensity range of the original image is narrow. It does not cover the potential range of [0 255]. To solve this problem, histeq function is used to spread the intensity values over the full range of the image. This process is called histogram equalization.



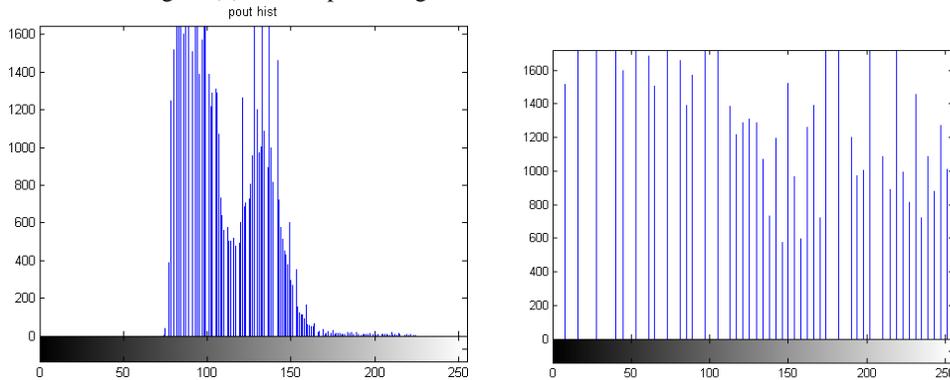Figure (2): Shows pout image before and after contrast enhancement



Figure (3): Shows histogram of pout image before and after contrast enhancement

**Note:** The image after enhancement is shaper than the original which enables us to see more details.
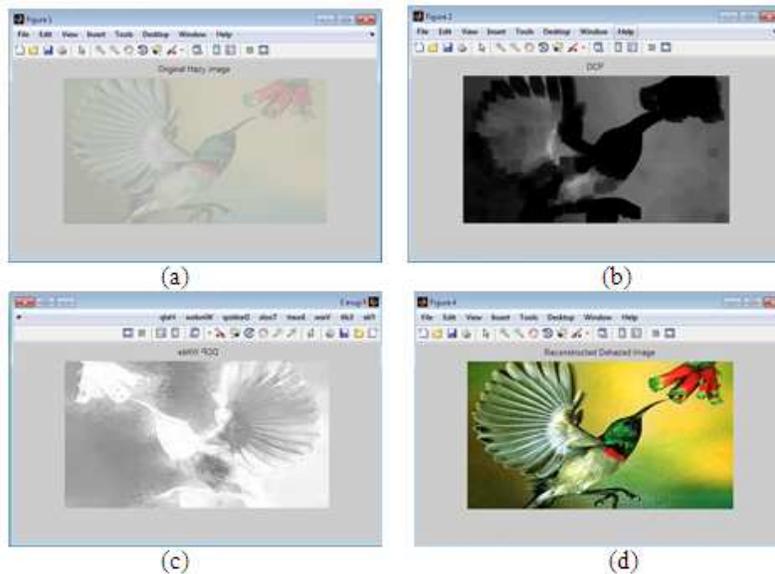


**Figure (4):** (a) is the original hazy image (b) is the DCP (c) is the white DCP (d) reconstructed image

We realized that all methods lead to good results. But running, g = imadjust (f, [low_in high_in], [low_out high_out], gamma) and the DCP algorithm are still a little bit difficult for a beginner. Gamma is in the [0 1]. If gamma is greater than 1, the mapping is weighted toward lower (darker) output values. When gamma is less than 1, then mapping is weighted toward higher (brighter) output values. When gamma is omitted from the function argument, gamma defaults to 1 (linear mapping) [4]. Any way when the image is noisy, medfilt2 is used to remove the noise. Compare to imadjust which require an extra parameter gamma, medfilt2 is simple and easy to implement. eg g = medfilt2(f) [2], where f is the input image. Histogram equalization is also wildly used technique for improving the appearance of an image. The goal of histogram equalization is to obtain a uniform histogram. This technique can be used on a whole image or just on a part of an image. This technique is also easy to implement. The novel DCP prior method is powerful when the in the input image is hazy. The figure (b) and (c) help the users to know which part should be enhanced or not. The transmission t is very important when we are dealing with the DCP method. It is used to estimate the haze thickness. The transmission t is the relative portion of light that manage to survive the entire path between the observer and the target object point in the scene.
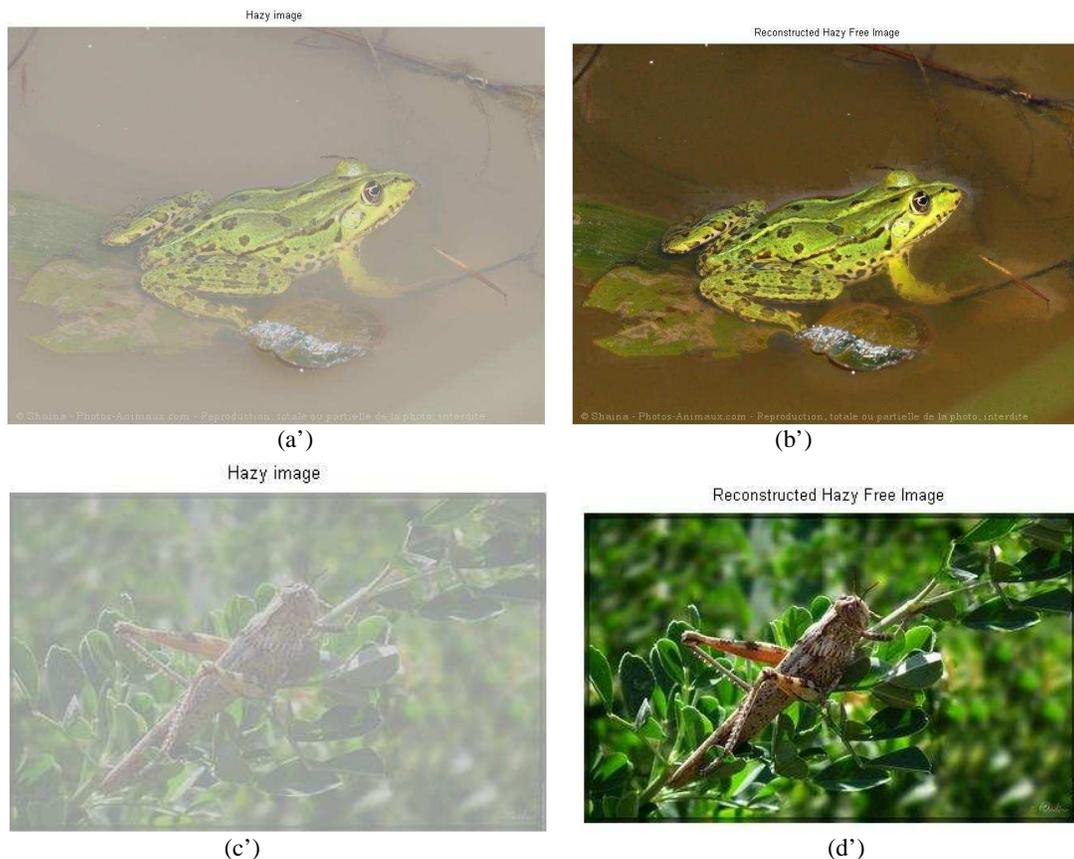


Figure (5) : (a') is hazy image  (b') is the Reconstructed hazy free image (c') is the hazy image (d') is the Reconstructed hazy free image

## VI. APPLICATIONS

Images play an increasingly important role in many fields of science and its countless applications. Biology is without doubt one of the best examples of fields that have come to depend heavily upon images for progress.

The advantages of computer processing over traditional visual methods of analysis are various:

(1) Human vision, while highly sensitive, can be easily biased by pre-conceived notions of objects and concepts. By using matlab, image analysis provides therefore an unbiased approach to extracting or emphasizing reliable information from image data and testing hypotheses.

(2) Once an image-analysis routine is devised, it can be applied to a large number of images, facilitating the collection of large amounts of data for statistical analysis.

The publication of this document satisfies that need for computerized image processing and analysis. It will cope with the rising rate at which some images are required to be obtained, or reach a higher level of sensitivity, accuracy, and objectivity than can be attained by biologist.

## VII. CONCLUSION

Image enhancement is a part of image processing which result is more suitable for a particular application. (Sharpening or deblurring an out of focus image, highlighting edges, improving image contrast, Dehazing or brightening an image, removing noise). This paper highlights several enhancement methods which are wildly used in image processing field. It enables people who are not from image processing field (non-professionals laypeople) to get start with image enhancement and be totally independent instead of waiting professional users. But we should note that while reducing noise there is always a tradeoff between the original image and the reconstructed image. By applying the Dark Channel Prior the reconstructed are sometimes bluish or look unnatural. The traditional DCP method fails to recover the scene radiance of the distance object. Our future works which will depend on the existing DCP and will solve all the problems encounter by the traditional DCP.

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