SUPRESSING ARTEFACT FROM COLOR AND CONTRAST MODIFICATION

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Abstract— This work is concerned with the modification of the gray level or color distribution of digital images. A common draw-back of classical methods is that it allows large number of artifacts or the attenuation of details and textures. In this work, we propose a generic filtering method enabling, given the original image and the radio metrically corrected one, to suppress artifacts while preserving details. The approach relies on the key observation that artifacts correspond to spatial irregularity of the so called transportation map, defined as the difference between the original and the corrected image. Then Transportation map which is the difference between original image and transformed image is calculated, then a generic filtering method also called TMR filter which draws on the nonlocal Yaroslavsky filter is used to regularize the transportation map so that artifacts are suppressed.

Keywords— Color and Contrast Modifications, Histogram Equalization, Adaptive Histogram Equalization, TMR Filter, Color Transfer

I. INTRODUCTION

Contrast enhancement increases the total contrast of an image by making light colors lighter and dark colors darker at the same time. It does this by setting all color components below a specified lower bound to zero, and all color components above a specified upper bound to the maximum intensity (that is, 255). Color components between the upper and lower bounds are set to a linear ramp of values between 0 and 255. Because the upper bound must be greater than the lower bound, the lower bound must be between 0 and 254, and the upper bound must be between 1 and 255. Some users describe the enhanced image that if a curtain of fog has been removed from the image.

There are several reasons for an image/video to have poor contrast:

- The poor quality of the used imaging device
- lack of expertise of the operator, and The adverse external conditions at the time of acquisition.

Image enhancement processed consist of a collection of techniques that seek to improve the visual appearance of an image or to convert the image to a form better suited for analysis by a human or machine. Enhancement of an image can be implemented by using different operations of brightness increment, sharpening, blurring or noise removal. Unfortunately, there is no general theory for determining what ‘good’ image enhancement, when it comes to human perception. If it looks good, it is good! While categorizing Image Enhancement operations can be divided in two categories. As shown in Fig. 1.1, image enhancement can be implemented by Noise removal or Contrast Enhancement. Noise Removal is an operation to remove unwanted details from an image. This detail gets attached to an image while capturing or acquisition process. Noise may be due to environment particles, capturing device inability, lack of experience of machine/ computer operator. Applying contrast changes to digital images is one of the most essential tools for image enhancement. Such changes may be obtained by applying a prescribed function to the gray values of images, as in contrast stretching or Gamma correction, or by prescribing the histogram of the resulting image, as in histogram equalization or specification from an example image [1]. Such operations are characterized by the way they affect the histogram of an image and may be seen as Modifications of their gray-level distribution. These techniques extend to color images by considering a luminance channel, as in Gamma correction, or by working on each color channel separately. The prescription of the 3-D color distribution is more satisfying because it avoids the creation of false colors, but is also more involved.

Applications of contrast or color changes are of course extremely numerous. With the popularization of digital photography, these techniques have become immensely popular through the use of various “curves” in image editing software. Early uses of contrast equalization are the enhancement of medical images [2] and the normalization of texture for analysis purposes. In a related direction, the construction of *midway* histograms [3], [4] is useful for the comparison of two images of the same scene. More recently, extensive campaigns of old movies digitization have claimed for the development of contrast modification techniques to correct flicker [5], [6]. Similar techniques are commonly used in the postproduction industry [7], [8]. Another field of increasing industrial interest in which contrast changes play a central role is the one of imaging in bad climatic conditions, see, e.g., [9]. Color modification or transfer is also useful for a wide range of applications, such as aquatic robot inspection, space image colorization, and enhancement of painting images.

The drawback of color and contrast modification techniques and compression techniques is to create visual artifacts such as noise enhancement, detail loss, texture washing, color proportion inconsistencies and compression artifacts. Several methods have been proposed in last few years to remove artifacts from color and contrast modification .The simplest one is proposed in [10] in the context of local histogram modifications and amounts to limit the modification depending on gradient values. While improving the results in some cases, this approach let most artifacts untouched. In [11], it is proposed to correct color transfer artifacts by using variation regularization after the transfer. Still in a variation framework, the authors of [12] propose a unified formulation containing both color transfer and regularity constraints in a single energy minimization. For the problem of color proportion, a possible approach is to transfer color after having identified some homogeneous regions, as proposed in [13] and [14]. A related class of works takes interest in the avoidance of compression artifacts, usually using the properties of the compression scheme [15].

II. LITERATURE REVIEW

Still in a variation framework, the authors of [17] propose a unified formulation containing both color transfer and regularity constraints in a single energy minimization. For the problem of color proportion, a possible approach is to transfer color after having identified some Color alteration is an active research area in the communities of image processing and computer graphics. There searches much related with this work in the area of color alteration include color transfer, color correction, colorization of gray scale and reverse processing. Applications of this work range from post processing on images to improve their appearance to more dramatic alterations, such as converting a daylight image into a night scene.

First, they convert pixel values in RGB color space to Rudermanetal's perception-based color space l α β in1998. Then, they calculate the mean and standard deviations along each of the three axes, and then scale and shift each pixel in the input image. Last, they transform pixel values to return to RGB space. While this method has produced some very believable results. Their approach is qualitatively and quantitatively superior to the conventional color correction. Another color correction method has been developed by Schechner and Karpel for underwater imaging and great improvement of scene contrast and color correction are obtained in 2004.Jiaetal propose a color correction approach based on a Bayesian framework tore cover a high quality image by exploiting the tradeoff between exposure etime and motion blur in 2004.

Colorization is a term that is now used generically to describe any technique for adding color to monochrome still sand footage. Welshetal introduce a general technique for colorizing grey scale images by transferring color between a source, color image and a destination, grey scale image in 2002. Their method transfers then tire color mood of the source to the target image by matching luminance and texture information between the images and allows user interaction. Levin presents a simple colorization method that requires neither precise image segmentation, nor accurate region tracking in 2004. This method is based on a simple premise: neighboring pixel sin space time that have similar intensities should have similar colors. In 2011 Julien Rabin, Julie Delon, and Yann Gousseau removes artifact from color and contrast modification in digital image by using TMR filter.

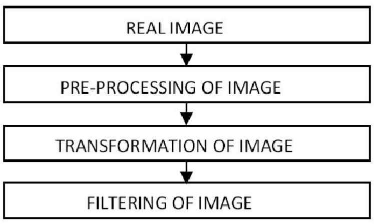
There are different approaches have been proposed to suppress artifacts due to contrast or color modification. The simplest one is proposed in [15] in the context of local histogram modifications and amounts to limit the modification depending on gradient values. While improving the results in some cases, this approach let most artifacts untouched. In [16], it is proposed to correct color transfer artifacts by using a variational regularization after the transfer homogeneous regions, as proposed in [18] and [19]. A related class of works takes interest in the avoidance of compression artifacts, usually using the properties of the compression scheme, see, e.g., [20]. Histogram Modification Framework [24] present a general framework based on histogram equalization for image contrast enhancement which is posed as an optimization problem that minimizes a cost function. Histogram equalization is an effective technique for contrast enhancement. The output of conventional histogram equalization (HE) is always excessive contrast enhancement. Noise robustness, white-black stretching and mean-brightness preservation may easily be incorporated into the optimization. The contrast of the image or video can be improved without introducing visual artifacts that decrease the visual quality of an image and cause it to have an unnatural look.

III. PROBLEM STATEMENT & MOTIVATION

A common drawback of most method in modification of the contrast or color content in images is visual artifacts. When increasing the contrast, parasite structures that were barely visible become prominent. Most noticeable is the enhancement of noise and compression scheme patterns, such as “block effect” due to the JPEG standard. In the other direction, contrast reduction or color transfer may yield detail loss and texture washing. A last artifact is particularly noticeable in the case of color transfer and appears when the proportions of colors are very different between images.

IV. DESIGN METHODOLOGY

The input image is preprocessed that is color image is separated into three planes and size will be changed to 256x256 image. Adaptive histogram equalization method is used to change contrast of an input image. Adaptive Histogram Equalization method is an extension to traditional Histogram Equalization technique. It enhances the contrast of images by transforming the values in the intensity image. The main steps of the methodology for removal of artifacts are shown in Fig I and include the following: read the input image, preprocessing of image, transformation of image, filtering of image by different methods, comparing performance measures for all filter outputs.



V. HISTOGRAM EQUALIZATION

Contrast enhancement techniques in the second subgroup modify the image through some pixel mapping such that the histogram of the processed image is more spread than that of the original image. Techniques in this subgroup either enhance the contrast globally or locally. If a single mapping derived from the image is used then it is a global method; if the neighborhood of each pixel is used to obtain a local mapping function then it is a local method. Using a single global mapping cannot (specifically) enhance the local contrast [25], [24]. One of the most popular global contrast enhancement techniques is histogram equalization (HE).

The histogram in the context of image processing is the operation by which the occurrence of each intensity value in the image is shown. Normally, the histogram is a graph showing the number of pixels in an image at each different intensity value found in that image. For an 8- bit grayscale image there are 256 different possible intensities, and so the histogram will graphically display 256 numbers showing the distribution of pixels amongst those grayscale values [26]. Histogram equalization is the technique by which the dynamic range of the histogram of an image is increased. HE assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities. It imp roves contrast and the goal of HE is to obtain a uniform histogram. This technique can be used on a whole image or just on a part of an image. 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 without affecting the global contrast

VI. ADAPTIVE HISTOGRAM EQULIZATION [AHE]

Adaptive histogram equalization [AHE] is a computer image processing technique used to improve contrast of the images. Adaptive histogram equalization [AHE] is a brilliant contrast enhancement for both natural images and medical images and other initially non visual images. It differs from ordinary histogram equalization [HE] in the respect that the adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute lightness value of the image. In image fusion process, fusion process may degrade the sharpness of the fused image so to overcome this problem of poor brightness adaptive histogram equalization will be used to enhance the results further. We can say that adaptive histogram equalization will come in action to preserve the brightness of the fused image. The main point of AHE is that in which at smaller scales contrast of an image is enhanced, while at larger scales contrast of an image is reduced or decreased. The advantage of adaptive histogram equalization [AHE] is that it is automatic, reducible, and locally adaptive and usually produces superior images.

VII. TMR FILTER

The block diagram for TMR Filter is shown in Fig VI. The transportation map M (u) which is the difference between transformed image and original image is applied to TMR Filter. In this, weighted factor is computed, Regularization term is evaluated, finally stopping criterion is found out regularization process convergence. Then enhanced image will be obtained by combining the regularized image with original image(u).

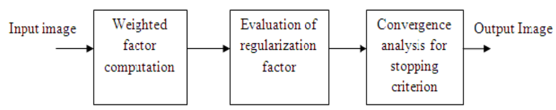


Figure 3: Block diagram of TMR Filter

All the artifacts mentioned above are removed by regularizing the *transportation map*, which is defined as the image of the differences between the original image and the one after contrast or color modification. All these artifacts may be interpreted as spatial irregularities of this transportation map. In order to regularize this map without introducing blur in the final image, inspiration is taken from nonlocal methods that have been proposed for image de-noising and more precisely from the Yaroslavsky filter.

The transportation map is filtered by averaging pixel values using weights that are computed on the original image, therefore adapting to the geometry of this initial image. It will be shown that artifacts are progressively suppressed by iterating this filtering stage.

We calculate the transportation map which gives the difference between original image and transformed one. Yu is the operator, a weighted average with weights depending on the similarity of pixels in the original image u. We calculate the weights for each and every pixel leaving the first pixel; we start from second pixel .we take 8 neighbor hoods of each pixel. Where ||.|| stands for the Euclidean distance in Rn, where, N(x) = x + N(0) ⊂ Ω with N(0) a spatial neighborhood of 0, where σ is a tuning parameter C(x) of the method and is the normalization constant.

We will add all the weights which are calculated for each and every pixel. Observe that if we apply to the image u , we obtain the Yaroslavsky filter. If the weights also decrease as a function of the distance to x, Yu, becomes similar to the cross bilateral filter introduced in [19] for flash photographic enhancement. The regularization of the image T(u), referred to as transportation map regularization (TMR), is then defined as TMR u(T(u)) : = u + Yu M(u). Now, observe that this formulation can be divided in two terms as of image TMR u(T(u)) = Yu(T(u)) + u - Yu(u)

First, the image T(u) is filtered by a nonlocal operator Yu, following the regularity of the image . This operation attenuates noise, compression, and color proportion artifacts but also the details of the image T(u). The second operation performed by the TMR filter consists in adding the quantity details =: u – Yu(u).

VIII. TRANSPORTATION MAP REGULARIZATION

Recall that $T(u)$ is the image after color or contrast modification. In what follows, we write $\mathcal{M}(u) := T(u) \_ u$ for the transportation map of image u. We propose to regularize it thanks to the operator Y_u, a weighted average with weights depending on the similarity of pixels in the original image u. The effect of this operator on an image $v:\Omega \mapsto \mathbb{R}_n$ with $n \geq 1$ is defined as

$$\mathbf{Y}_u(v) : x \in \Omega \mapsto \frac{1}{C(x)} \int_{y \in \mathcal{N}(x)} v(y) \cdot w_u(x \;\; y) dy$$

With weight

$$w\left(x,y\right) = - \frac{\| u(x) \;\; u(y) \|^2}{\sigma^2}$$

The regularization of image t(u) is defined as Transportation map. $\mathrm{TMR}_u(T(u)) := u + \mathrm{Y}_u \mathcal{M}(u)$. Now, observe that this formulation can be divided in two terms as

$$\mathrm{TMR}_u\,(T(u)) = \underbrace{\mathbf{Y}_u\,(T(u))} + \underbrace{u - \mathbf{Y}_u(u)}_{\text{Image detail}}.$$

First, the image $T(u)$ is filtered by a nonlocal operator Y_u, following the regularity of the image u. This operation attenuates noise, compression, and color proportion artifacts but also the details of the image $T(u)$. The second operation performed by the TMR filter consists in adding the quantity u, which can be considered as details of the original image (e.g., texture and fine structures).

IX. RESULT

The images after applying TMR filter on transformed Original image are shown in Fig-h, and Fig-I. The Fig-h has less artifacts and much similar to original image as the mean square error for transformed image-I after applying TMR filter is less. The images after applying various filters on transformed image-I are shown in Fig IV. The Fig IVI(f) has less artifacts and much similar to original image as the mean square error for transformed image-I after applying TMR filter is less.

CONCLUSION

In this paper, we apply a generic filtering procedure in order to remove the different kinds of artifacts created by radiometric or color modifications. The ability of the proposed TMR filter to deal with these artifacts while restoring the fine details of images. First, we have to notice that the computation time of the TMR operator is similar to those of the Bilateral filter or nonlocal means. Second, the whole concept be strengthened by the automatic estimation of the parameter σ.

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