Image Quality Determination System Using Directional Statistics

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***Abstract* - The Image Quality Determination System (IQDS) presents a computational model for quantifying the quality of color images consistent with subjective evaluations. The full-reference color metric, also known as, a directional statistics-based color similarity index, is designed to perform well over commonly encountered chromatic and achromatic distortions. In order to accurately predict the visual quality of color images, we make use of local color descriptors extracted from three perceptual color channels: hue, Chroma and lightness. Moreover, two weighting mechanisms are exploited to accurately combine locally measured comparison scores into a final score. The proposed Image Quality Determination System is a flawless application for users to add and find the quality of color images in very fast and easy way. Which is implemented as an application software.**

Keywords - Color image, perceptual image quality, hue, directional data, directional statistics, chromatic distortion.

I. INTRODUCTION

Throughout the last few decades, peoples have witnessed rapid growth of color image contents and imaging devices in various sectors of multimedia communication systems. With such transition, perceptual assessment of color image quality has become essential in the development and optimization of visual data processing algorithms. IQDS introduce a full-reference (FR) color image quality metric, called the Directional Statistics based Color Similarity Index (DSCSI), which can properly handle image data exhibiting both achromatic and chromatic distortions.

The Image Quality Determination System allows the user to add and find out the quality of desired images. User can register and login into the system and they can add two same or different images to find out the similarity in quality of that images rapidly. The full-reference (FR) color image quality matric, used in this system that is also called DSCSI, which can properly handle image data exhibiting both achromatic and chromatic distortions to get the desired result. Without this system's it is difficult to managing and finding the quality of color images. The use of Directional Statistics makes this system's output very accurate and clear. The main contributions of this article are as follows:

- We derive hue similarity measures for accurate quality prediction based on two complementary directional statistics: a circular mean and a circular variance. They are designed to quantify the perceived quality degradation caused by changes in large-scale image structures and changes in edge details of hue channels. The proposed hue measures and other similarity measures considered in DSCSI provide complementary information for quality perception and, together, improve the accuracy of the metric.

- We exploit two spatial weighting schemes in order to accurately combine the locally measured color similarity scores into a combined quality score: i) a weighting scheme that considers the significance of hue depending on its chromavalue;and ii) a weightingscheme basedon a Minkowski framework that distinguishes strong local deviations from weaker ones [8]. These weighting schemes effectivelyincrease the correlationbetween the proposed metric and the visual perception.

- Throughout a systematic validation, we show that the proposed metric correlates well with subjective ratings not only for images with chromatic distortions, but also for images with generic distortions.

This system can be used by any users for finding quality of two color images. The user can add two images and view the corresponding result of that images. For doing this the users must register first and then they can enter into the system.

II. METHODOLOGY

The following methodology is used in this project,

DSCSI: full-reference (FR) color image quality metric, called the Directional Statistics based Color Similarity Index (DSCSI), which can properly handle image data exhibiting both achromatic and chromatic distortions. FR metrics are intended for the evaluation of image data in off-line scenarios where both original and distorted images are available. For example, at the off-line prototyping or optimization stage of color image processing systems, FR quality metrics become useful since algorithm developers can have access to both original and distorted data.

III. SCOPE

Image processing being applied in many fields in today's world. The assessment of image quality plays a significant role in a wide range of image processing applications, e.g. compression, enhancement, and reproduction. In recent years, major efforts have been made to replace subjective judgements with computational metrics that closely agree with Human Visual System (HVS) characteristics [1][2]. Existing objective metrics can be classified into three groups depending on the accessibility of the original image to compare with: i) full-reference (FR) ii) reduced-reference (RR) and iii) no-reference (NR) [3]. In this project, the discussion is confined to FR metrics. One can easily find out the quality of two images very quickly by implementing this as an application.

IV. PROPOSED COLOR IMAGE QUALITY METRIC

The proposed metric provides an accurate prediction of perceived image quality by extracting local image descriptors from both chromatic and achromatic components of input color signals. In this project derives hue similarity measures for accurate quality prediction based on two complementary directional statistics: a circular mean and a circular variance. Throughout a systematic validation, this project shows that the proposed metric correlates well with subjective ratings not only for images with chromatic distortions, but also for images with generic distortions.The proposed full-reference color metric, is designed to consistently perform well over commonly encountered chromatic and achromatic distortions. This application provides an easy way to find out the quality of two same or different images. So, this will help the users to save their time. It sure that this system will produce the accurate result about the quality of two images.

In this section, we introduce a full-reference metric to quantify the perceived visual quality of color image data, called the Directional Statistics based Color Similarity Index (DSCSI). The proposed metric is general-purpose, in the sense that it consistently performs well over commonly encountered chromatic and achromatic distortions. The inputs to the metric are two RGB images with identical spatial resolution, X and Y, denoting the original and the distorted images, respectively. They are assumed to be consistent in bit depth and properly aligned. The output quality score, denoted as Q(X,Y), lies in the range of [0,1], where the best quality value 1 is achieved when both images are identical. The steps included in this are:

A.Color Space Conversion

To better approximate the color perception, original RGB images are transformed to a color space that is more compatible with human intuition. Among various perceptual color models, e.g. HVS and CIELAB, we make use of the S-CIELAB [3]. After RGB to S-CIELAB transformation, each pixel of X contains three color components: lightness L∗, red-green a∗, and blue-yellow b∗.

B. Derivation of Local Color Similarity Measures

The proposed metric models the perceived image quality as a combination of six similarity measures extracted from hue, chroma, and lightness channels [4]. The concept of applying Directional Statistics on hue data in order to formulate the color descriptors is initially introduced in [5]. Hue-based measures are primary indicators of visual artifacts when they are used to evaluate color constancy algorithms. On the other hand, chroma-based measures are important in the evaluation of gamut mapping algorithms. In the rest of this section, we develop similarity measures from ones based on directional hue component to ones based on linear color components, e.g. chroma and lightness.

- Hue-Based Similarity Measures: To compare hue channels of two images, denoted as X_H and Y_H, we derive two measures based on directional statistics: a circular mean and a circular variance. First, we compute the weighted circular mean θ_H and the weighted circular variance v_H for each pixel by taking a k×k local window.
- Chroma-Based Similarity Measures: To quantify the visual distortion in chroma components, we exploit two chroma descriptors: a weighted mean μ_C and a weighted standard deviation σ_C. The rationale behind the use of two chroma descriptors is similar to the argument of complementarity made for hue descriptors; that μ_C allows for the comparison of smoothed chroma images, while σ_C allows for the comparison of edge details (or contrast) in chroma images.

C. Integration for Combined Quality Metric

In order to derive a single aggregated score representing the overall perceived quality, we need to combine locally estimated similarities, h_l, h_c, c_l, c_c, l_c, and l_s from the previous stage. In this, we first perform a spatial pooling of each comparison map, followed by a component pooling of each channel score into a final value [6].

The calculation of scores for other measures, i.e. H_c, C_l, C_c, L_c, and L_s, can be done. From these values, we can find two scores representing the degree of similarity for chromatic and achromatic components, namely the chromatic similarity and achromatic similarity scores, as follows:

$S_C = H_l \cdot H_c \cdot C_l \cdot C_c$ (1)

$S_A = L_c \cdot L_s$(2)

In (2), individual measures are combined in a multiplicative manner as they are assumed to be relatively independent of each other. Finally, the overall DSCSI score can be obtained by combining two aforementioned scores as follows:

$Q(X,Y)=S_A \cdot (S_C)^{\lambda}$(3)

where the nonnegative parameter λ adjusts the significance of chromatic components in evaluation of overall quality. The λ is introduced since sensitivities of the HVS for variations in chromatic and achromatic components are not equal. λ = 0 completely ignores the contribution of chromatic components in image quality prediction; as we increase λ, the significance of chromatic components increases. In this paper, λ is fixed at 0.8 by default. This value is consistent with the visual mechanism that the HVS is generally more sensitive to achromatic information than to chromatic information [7].

V. CONCLUSION

IQDS introduce a full-reference color image quality metric, namely the DSCSI, capable of handling both chromatic and achromatic distortions originated from various imaging applications. The DSCSI extracts various kinds of local color descriptors from a perceptually uniform color space, which convey complementary information for quality perception and, together, improve the accuracy of the quality prediction model. These schemes are implemented as an application software which is called Image Quality Determination System (IQDS). The prediction accuracy of the proposed scheme can be further enhanced by incorporating a more advanced pooling mechanism that closely simulates HVS mechanism. This system can be further expanded by adding videos for finding its quality.

There are several issues which require further investigation to improve the effectiveness and applicability of the proposed metric. The prediction accuracy of the proposed scheme can be further enhanced by incorporating a more advanced pooling mechanism that closely simulates HVS mechanism, e.g. a color saliency model. As another direction of future research, the proposed general-purpose metric can be tailored to specific target applications, e.g. compression or preferred color reproduction systems, by adjusting free parameters based on domain-specific knowledge. Such application-specific metrics can be incorporated as objective functions for optimizing existing image processing solutions.

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