Full Reference-Image Quality Assessment with Global and Local Parameters Perception using SC-QI and SC-DM

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Abstract--- On measure quality of an image diverse scientific strategies need aid suggested. By utilizing these systems image quality assessment appraisal could be carried out effectively Furthermore we camwood get the flawless features which need aid matched of the human visual system (HVS) for the visual quality perception. A number existing IQA methods, calculation is was troublesome should describe those visual quality perception recognition to local image characteristics Furthermore distinctive distortions will happen. In this paper, we recommend An technique to purpose the problem, i.e. Structural contrast-quality index (SC-QI), by recognizing the structural quality index (SCI), we are likewise presenting some other parameters which will reflect the HVS for contrast sensitivity and chrominance component variation.. The mofified SC-QI will be known as structural contrast distortion metric (SC-DM), in this we might get those alluring scientific values and valid distance metric ability and quasi-convexity. Something like that this technobabble may be adequately utilized for separation metric issues.

Keywords: Image quality assessment, Human visual system, Image features, SC-DM, SC-QI

1. INTRODUCTION

The quality of any image is lost due to the occurrence of noise and these noises occurred during the storing and transmit of information or during sharing time of information between the devices. A wide range of applications depends on this transmitted digital information. Hence quality measuring is needed for assessing and control the quality of those images. Image quality assessment refers to a model which predicts the quality of distorted images. Image quality assessment methods are categorized as: subjective assessment by humans where the evaluation of quality by humans is obtained by mean opinion score (MOS) method and other is an objective assessment by algorithms which automatically predict the quality of the distorted images as would be perceived by an average human.

Image quality measurement is very important for various image processing applications such as recognition, retrieval, classification, compression, restoration and similar fields. The images may contain different types of distortions like blur, noise, contrast change etc. So it is essential to rate the image quality appropriately. Traditionally subjective rating methods are used to evaluate the quality of the image, in which humans rated the image quality based on time requirements. This is a costly process and it

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needs experts for evaluating image quality. Nowadays many image quality assessment algorithms are available for finding the quality of images. These are mainly based on the properties of human visual system.

A. IMAGE QUALITY: THE GRAND PICTURE

The first domain of interest is the field of experimental physics and instrumentation which abundantly uses signal processing tools as developed in Fourier analysis: spectral density function, point spread function, signal-noise ratio, etc. It nourishes abundantly the specific literature dealing with optimizing the sensor and the optical system, where, for instance, people is interested in compromising between f-number and exposure time, or ISO sensitivity and f-number. It purveys the most used tools for comparing camera performances in specialized journals for photographers or scientists or for choosing an adequate sensor for a given application. It relies on objective and deterministic physical measurements obtained from experimental benches, with normalized targets and controlled physical parameters. It does not pay attention to the image, nor to the observer. Its results are expected to be valid for any image and deterministically established.

The second domain has been developed mostly for broadcasting (either with still images or with videos) when the community is looking for the best visual quality under practical constraints on bandpass, computation power and storage facilities. It may also take into account viewing conditions and economical balance. These methods pay a great attention to the human visual system and consider the image as a whole. They often balance various types of drawbacks to evaluate a global judgment. Based on shared catalogs of image impairments, they propose heuristic formulas (often inspired from biological or psychophisical experiences) which adequately combine pooled local and specific measures. They generally take their value in a statistical sense, when many different experiments are done with various

and significant samples of images, and sufficient observer cliques.

The third family of approach is based on Information Theory. Within this framework, it is possible to provide a global modeling of the acquisition process, by considering the scene to be observed as an emitter, the digital photo as the received message and the camera, with its specific set-ups, as a channel possibly impaired with transmission impairments (noise, diffraction, focusing errors, integration on the sensor, etc.). Although rather difficult to instantiate, this approach is prone of fruitful results as shown in the recent literature. It provides bounds on the performances we may expect from a system and allows for a global optimization of the parameters. However it is not yet accepted by the community for well justified reasons.

B. CONTRIBUTION WORKS

(a) Initial contribution step is performing in-depth analysis on the existing FR-IQA methods in order to understand the HVS base parameters and its approach towards to get the quality assessment statistics in a well defined manner. A research on conventional methods gives indications that the introduction of the adaptive technologies to improve the system performance. The introduction of the adaptive global and local features to achieve the overall quality assessment in context to various distortion types along with the consideration of the image texture properties.

(b) The structure of the image object plays avital role in assessing the quality of the digital image in perceptional way using the human visual system as the basic parameter. A new FR-IQA method, which is abbreviated as Structural Contrast-Quality Index (SC-QI) is proposed in this work which acts based on the adaptive structural contrast index(SCI) and it is introduced as the additional boost to the already existing FR-IQA method for getting quality of image statistics for different image distortion types and to the various image textural characteristics. The SCI framework is further added with Structural Contrast-Quality Index (SC-QI) in order to perceive the image

properties by human eyes in proper way. The ability of the SC-QI is quite useful in getting the global and local feature qualities Structural Contrast-Quality Index (SC-QI). The proposed methodology outperforms the all exiting methodologies to achieve the better performance with much lower computational complexity.

(c) The most important contribution of the proposed methodology is to introduce a SC-QI modified state model which is also called as Structural Contrast-Distortion Metric (SC-DM) Structural Contrast-Distortion Metric (SC-DM). With valid distance measurements as statistics SC-DM came out as user friendly framework for the perception and the mathematical properties reveals that the proposed SC-DM has good impact in getting the best results compare to the other framework properties. The optimization problems are occurs frequently in assessing the image quality and the proposed SC-DM makes uses of an objective fuction for solving the optimization issues.

2. IMAGE QUALITY DEFINITION

Historically, image quality is described in terms of the visibility of the distortions in an image, such as colour shifts, blurriness, Gaussian noise and blockiness. The most common way of modeling an image quality metric is therefore by quantification of the visibility of these distortions. For example, Just Noticeable Difference (JND) model by Sarnoff [2] predicts subjective rating of an image by examining the visibility of distortions. In [3], Janssen has proposed a new philosophy for image quality. He regards image as carriers of visual information instead of two-dimensional signals, regards visual-cognitive processing as information processing rather than signal processing and regards image quality as image adequacy in the visual interaction process instead of visibility of distortions. Though this concept is interesting and seemapplicable, most of the works are still reported based on the former concept, due to its simplicity and good performance.

3. IMAGE QUALITY ASSESMENT

Image quality is a characteristic of an image that measures the perceived image degradation imaging systems may introduce some amounts of distortion or artifacts in the signal, so the quality assessment is an important problem. Basically image quality is measured in two ways subjective and objective method. In Subjective image quality assessment the evaluation of quality by humans is obtained by mean opinion score (MOS) method where in objective evaluation of quality is done by algorithms. It concerned with how image is perceived by a viewer and gives his or her opinion on a particular image and judge quality of the multimedia content. The human eyes extract structural information from the viewing field, so the human visual system is highly adapted for this purpose. Therefore, the measurement of structural distortion should be a good approximation of perceived image distortion .So the accurate and more efficient IQA measures will certainly enhance their applicability in real-world applications.

Basically image quality is measured in two ways subjective and objective method. In Subjective image quality assessment the evaluation of quality by humans is obtained by mean opinion score (MOS) method where in objective evaluation of quality is done by algorithms. The diagram for the IQA is shown in fig.1.It concerned with how image is perceived by a viewer and gives his or her opinion on a particular image and judge quality of the multimedia content. The human eyes extract structural information from the viewing field, so the human visual system is highly adapted for this purpose. Therefore, the measurement of structural distortion should be a good approximation of perceived image distortion .So the accurate and more efficient IQA measures will certainly enhance their applicability in real-world applications.

4. IMAGE QUALITY ASSESSMENT TECHNIQUES

There are two techniques of Image Quality Assessment:

1. Subjective Quality Assessment

We can say that human itself recognize the quality of image very well. In this type of method humans are involved and they have to recognize the quality of image. The scores evaluated by multiple subjects are averaged for each test image to obtain mean opinion score and difference mean opinion score. For this technique the answer is different for individual observer. Also the expenses are more as well it is not applicable to real time processing.

2. Objective Quality Assessment

The goal of objective IQA is to design mathematical models that are able to predict the quality of an image accurately and automatically. An ideal objective IQA method should be able to mimic the quality predictions of an average human observer. This is quantitative approach which is used to estimate the number which shows the quality of image. The objective image quality is classified into following three types as full-reference, no- reference and reduced-reference. The following types are depending on the use of the reference image.

A. No-Reference Model

Evaluation of noise content or distortions present in an image is same as assessing the quality of an image. Measurement of such quality index is challenging in the absence of reference image. In this type of model we don't have any priori knowledge. This type of model is also called as 'Blind Model'. The main advantage of this type of model is we can use this type model in any application because they don't require any reference information. These models are easy for calculation and gives approximate estimation.

B. Full-Reference Model

In this type of algorithm we known the perfect version of image or video and we have to calculate the distortions present. The perfect version we can get by high quality acquisition device before the errors will take place like transmission error and compression artifacts.

C. Reduced-Reference Model

In this partial information about the 'perfect version' is available and we can compare this version with 'distorted version'. This information is used to decide the quality of distorted image by the RR QA algorithms.

5. PROPOSED METHODOLOGY

A. Human Visual System based Quality Observation

The digital image quality perception by the human visual system (HVS) and its observations is carried out at different strategic levels for both the image texture properties as well as the image distortion types in a well defined manner. The image distortion types and its relationship with the human visual system is defined as following

These two kinds of distortions differently affect the perceived visual quality of HVS. For AGN distortions, HVS tends to mostly perceive such distortions (or quality degradations) in homogeneous image regions (e.g., green box) while hardly perceiving them in complex texture regions (e.g., yellow box). [5] proposed a principle in which the division is the urgent stage in iris acknowledgment. We have utilized the worldwide limit an incentive for division. In the above calculation we have not considered the eyelid and eyelashes relics, which corrupt the execution of iris acknowledgment framework. The framework gives sufficient execution likewise the outcomes are attractive. Assist advancement of this technique is under way and the outcomes will be accounted for sooner rather than later. Based on the reasonable peculiarity of the iris

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designs we can anticipate that iris acknowledgment framework will turn into the main innovation in personality verification.In this paper, iris acknowledgment calculation is depicted. As innovation advances and data and scholarly properties are needed by numerous unapproved work force. Therefore numerous associations have being scanning routes for more secure confirmation strategies for the client get to. The framework steps are catching iris designs; deciding the area of iris limits; changing over the iris limit to the binarized picture; The framework has been actualized and tried utilizing dataset of number of tests of iris information with various complexity quality.

B. Analysis on Contrast/Structure Features

We analyze the characteristics of visual features for contrast/structure information within FR-IQA methods with respect to the two different kinds of distortions (i.e., AGN and GB) in three image regions of different characteristics (homogeneous, edge and complex texture characteristics). To do so, we use the four popular visual features which have widely been used in the existing FR-IQA methods

In this qualitative analysis, we also use SCI to see its effectiveness of adaptive characterization power for visual quality perception with respect to different

image texture types for the two kinds of distortion types. It is known that most FR-IQA methods have estimated distortions using a difference (or relative difference) of feature/ signal values obtained from an original image and its distorted image. Likewise, in the paper, we compare the difference of feature values between the original image X and its distorted images Y1 and Y2 to see the estimated distortions by the features for the perceived visual qualities. We apply a simple difference operation to see local distortions estimated by feature values.

C. Proposed Structural Contrast-Quality Index:

Fig. 1 shows a block diagram ofLocal SC-QI computation between a reference local image signal x $\in$ X within a whole original image X and its local distorted image signal y $\in$ Y within a whole distorted image Y. A local SC-QI value is calculated for each 4 × 4 image block between x and y. First, the pixel intensity values for signals x and y are normalized to be in the range of [0,1]. And, if x and y are color image signals in RGB color spaces, they are converted into the LMN color space to de-correlate luminance (L) and chrominance (M, N).

$$\begin{bmatrix} L \\ M \\ N \end{bmatrix} = \begin{bmatrix} 0.06 & 0.63 & 0.27 \\ 0.30 & 0.04 & -0.35 \\ 0.34 & -0.60 & 0.17 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (1)$$
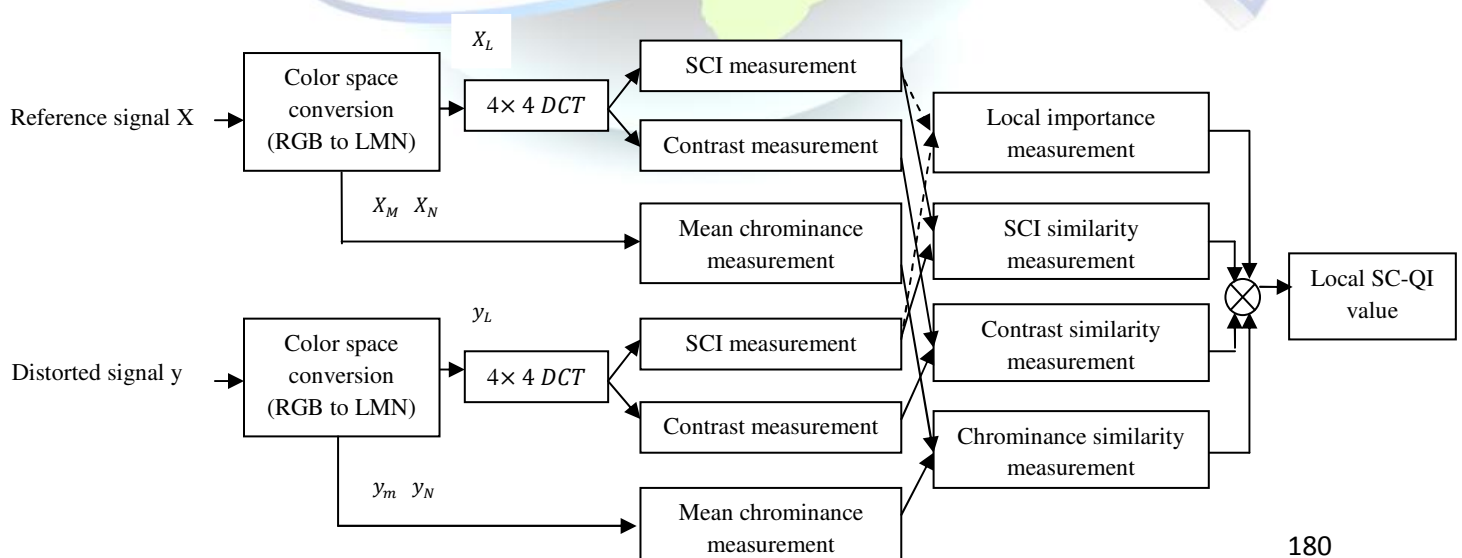
Fig.1: A block diagram of local SC-QI computation between a local image signal x and its local distorted image signal y.

A local SC-QI value between x and y is calculated by the multiplication of six similarity measures s_k, k = 1,. . ., 6 as

$$f(x,y) = \prod_{k=1}^{6} S_k \quad (2)$$

Where all the similarity measures have the same form as

$$S_k(\phi_{x(k)}\ \phi_{y(k)} \mid \theta_k, V_k\ ) = \left(\frac{2\ \phi_{x(k)}\ \phi_{y(k)} \mid \theta_k}{\phi_{x(k)}^2 + \phi_{x(k)}^2 + \theta_k}\right)^{v_k} \quad (3)$$

The contrast energy values $\phi_{x(2)}$, $\phi_{x(3)}$ and $\phi_{x(4)}$ for S_2, S_3 and S_4 in (3), respectively, are calculated as

$$\phi_{x(k)} = \sum_{(u,v)\in R_k} P(u,v) \quad (4)$$

The global perceptual visual quality value is

$$F(X,Y) = E\ [f] = \frac{1}{W} \sum_{j=1}^{J} W\left(x^{(j)}, y^{(j)}\right) f\left(x^{(j)}, y^{(j)}\right) \quad (5)$$

D. Proposed Structural Contrast Distortion Metric With Normalized Distance Metrics

Our SC-QI is extended to SC-DM using a normalized root mean squared error (NRMSE) such that SC-DM obtains a desirable mathematical property of valid distance metricability with quasi convexity in a feature space. The NRMSE is expressed as

$$d(x,y \mid \theta) = \frac{\|x - y\|_2}{\sqrt{\|x\|_2^2 + \|y\|_2^2 + \theta}} \quad (6)$$

NRMSE for a distortion measure

$$d(\phi_x, \phi_y \mid \theta) := NRMSE(\phi_x, \phi_y \mid \theta) = \frac{|\phi_x - \phi_y|}{\sqrt{\phi_x^2 + \phi_y^2 + \theta}} \quad (7)$$

The sum of squared six distortion measures

$$f(x,y) = \|d\|_2^2 \quad (8)$$

The NRMSE offers two advantages to SC-DM as follows:

(i) The NRMSE in (7) reflects the Weber's law in HVS, indicating that the sensitivity of HVS to signal differences depends on the current stimulus; NRMSE is capable of yielding much higher correlations with perceived visual distortions than the L2-norm.

(ii) The NRMSE based local SC-DM in (8) is a valid difference metric. Furthermore, it is quasi-convex and differentiable, which can widen the applicability of SC-DM in image quality optimization problems. More detailed proofs and mathematical validations of SC-DM as a valid distance metric with differentiable quasi-convex function are given in Appendix.
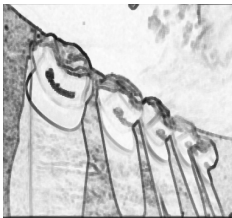
6. RESULTS

A. FOR MANUAL DISTORTION :

enter 1 for manual distortion

enter 2 for standard distorioton

enter your choice 1

PLEASE ENTER THE CHOICE

ENTER 1 FOR GAUSSIAN NOISE

ENTER 2 FOR COMPRESSION

ENTER 3 FOR GAUSSIAN BLUR

ENTER UR CHOICE 3

Answer :

SCQI = 0.9998

SCDM = 2.4133

psn = 33.6386

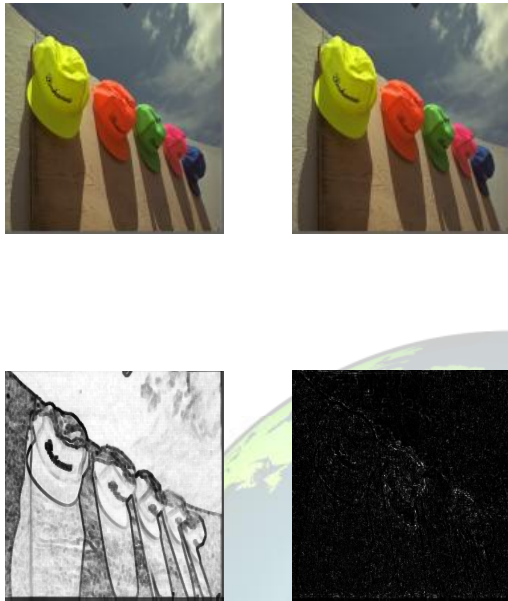ssimval = 0.9764

gs = 0.9985

mssim = 0.9874

Fig. 2: (a) Original Image (b) Noisy Image (c) Image used to calculate SC-QI   (d) Image used to calculate SC-DM

B. FOR STANDARD DISTORTION :

enter 1 for manual distortion

enter 2 for standard distorioton

enter your choice 2

enter 1 for white noise distortion

enter 2 for gaussian blur distorioton

enter 3 for compression distortion

enter your choice 3

Answer :

SCQI = 0.9999

SCDM = 0.8303

psn = 36.3832

ssimval = 0.9809

gs = 0.9980

mssim = 0.9882

qty = 400.6666

Fig. 3: (a) Original Image (b) Noisy Image (c) Image used to calculate SC-QI   (d) Image used to calculate SC-DM

7. CONCLUSION

Image quality assessment is one of the challenging field of digital image processing system. Image quality assessment has been of major importance for several domains of the industry of image as for instance restoration or communication and coding. New application fields are opening today with the increase of embedded power in the camera and the emergence of computational photography: automatic tuning, image selection, image fusion, image data-base building, etc. In this paper, we firstly reveal that HVS has different strategies in measuring perceived visual quality depending on different image texture characteristics and distortion types. Based on this, we propose a novel FR-IQA index, called SC-QI, which incorporates a very effective feature, i.e., SCI, to adaptively characterize local visual quality perception with respect to different image texture characteristics with structural-distortion types. We also further extend SC-QI to SC-DM based on a normalized distance metric such that SC-DM obtains desirable mathematical properties of valid distance metricability and quasi-convexity. To verify the performance of the proposed SC-QI and SC-DM, qualitative and quantitive experiments were extensively performed on large IQA datasets. The experimental results show that SC-QI and SC-DM can very elaborately predict global and local visual quality scores, thus yielding better prediction performance with fast computation compared to the state-of-the-art FR-IQA methods.

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