I J C T A, 9(26) 2016, pp. 225-232

Quality Metrics Digital Image Compression

R. Priyanga[1], M. Arivu Kannamma[2] and J.G.R. Sathiaseelan[3]

ABSTRACT:

The much larger luminance and dissimilarityindividuality of high dynamic range (HDR) images, well-known objective quality metrics, generally used for the measurement of low dynamic range (LDR) substance, cannot be straightfunctional to HDR images in order to forecast their perceptual faithfulness. To overcome this limitation, advanced fidelity metrics, such as the HDR-VDP, have been planned to correctly predict visually considerable differences. However, their composite calibration may create them hard to use in perform. A simpler advance consists in computing arithmetic or structural fidelity metrics, such as PSNR and SSIM, on perceptually prearranged luminance values but the performance of quality prediction in this crate has not been obviouslycalculated. In this paper, we aim at as long as a better understanding of the restrictions and the potentialities of this approach, by way of a subjective learn. We compare the performance of HDR-VDP to that of PSNR and SSIM computed on perceptually programmed luminance standards, when considering compressed HDR images. Our outcome show that these simpler metrics can be successfullyworking to assess image faithfulness for applications such as HDR image compression.

Keywords: High dynamic range image, image quality assessment, tone mapping operator, perceptual image processing, structural similarity, statistical naturalness.

1. INTRODUCTION

High dynamic range (HDR) substance has been latelyaheadimpetus thanks to its ability to replicate a much wider range of luminance and disparity than conventional low dynamic range (LDR) formats. This has aggravatedinvestigate towards story HDR dispensation algorithms, with acquisition/generation 1 and compression 2, 3 and, therefore, towards methods for assessing the value of the processed consequences. In standard, the most precisemethod to estimate image quality is to take out wideindividual test campaigns. However, this is frequentlyunreasonable, particularly when the number of parameters and tryingsituation is great. In adding, the possibilityof skewedtough in the case of HDR satisfied is additionalsummary by the limited dispersal and the high cost of HDR displays. This calls for the plan of automatic and precisepurpose quality metrics for HDR content.

Dynamic range (DR) of conservativeexhibitstrategy is on the regulate of 100 to 1 whereas that of real view is larger than 10,000 to 1. Digital still and video cameras have the facility to attain the DR larger than 100 to 1 to convincesatisfactoryeminence, with less noise intrusion and natural differencedemonstration. Moreover, to obtain a perceptually high-quality image, purchaser digital cameras need to capture real scene as human eyes do. To envision real sight more precisely, a method is wanted to successfully compress intensity dissimilarity of high dynamic range (HDR) image data. Tone mapping operators (TMOs) allow show devices to show HDR descriptions as low dynamic range (LDR) images. However, renewed LDR images using TMOs may lose aspectin sequence of HDR images, and have distortions and artifacts because TMOs condense intensity principles of HDR images to the incomplete range of 0–255.

[1] Research Scholar, Dept. of CS, Bishop Heber College, Tiruchirapalli, TN,India. *E-mail: Priyangamphil101193@gmail.com*

[2] Research Scholar, Dept. of CS, Bishop Heber College, Tiruchirapalli,TN, India. *E-mail: arivu.mak.@gmail.com*

[3] Head Dept. of CS, Bishop Heber College, Tiruchirapalli, TN, India. *E-mail:jgrsathiaseelan@gmail.com*

In the LDR case, admired metrics, such as the Structural Similarity Index (SSIM), are known to provide good predictions of image eminence and even the criticized Peak Signal-to-Noise Ratio (PSNR) producecompelling quality communication for a given content and codec type. 5 A key advantage of these metrics is that they can be easily computed through simple pixel operations on LDR descriptions. This is moderately due to the fact that LDR pixel values are gamma corrected in the sRGB color space, 6 which not only does recompense for the non-linear luminance response of inheritance CRT displays, but also accounts somehow for the lower distinction sensitivity of the human visual system (HVS) at dark luminance levels. In other vocabulary, the non-linearity of the sRGB color space provides a pixel encoding which is roughly linear with deference to discernment

2. RELATED WORKS

In Bo GU, Wujing LiMinyun Zhu, and Minghui Wang et al presents a novel filter is planned for edge-preserving disintegration of afigure. It is diverse from preceding filters in its nearby adaptive possessions. The filtered images contain local means ubiquitously and conserve local outstandinglimits. Comparisons are made among our filtered effect and the consequences of three other methods. [1] A completestudy is also complete on the performance of the filter. Multi scale disintegration with this filter is proposed for manipulating a high dynamic range image, which has three feature layers and one foundationcoating. The multi scale rotting with the filter addresses three assumptions:

1. the base layer conserve local means universally;
2. every scale's salient boundaries are moderatelygreat gradients in a local window; and
3. all of the nonzero disposein series belongs to the feature layer.

In HojatollahYeganeh and Zhou Wang et al presents Tone mapping operators (TMOs) that change high dynamic range (HDR) images to normal low dynamic range (LDR) images are exceedinglypleasing for the revelation of these descriptions on typical displays. Although many presented TMOs construct visually appealing images, it is until recently validated purpose measures that can assess their worth have been proposed. Without such purposeprocedures, the plan of conventional TMOs can only be based on sensitivethoughts, lacking clear goals for additionaldevelopment. In this paper, we [2] propose a considerablydissimilar tone mapping advance, where instead of openlyscheming a new computational structure for TMO, we search in the hole of images to find better quality descriptions in conditions of a newpurposecalculate that can charge the structural fidelity between two images of dissimilar dynamic ranges.

In Marcelo Bertalmý´o, Edoardo Provenzi et al presents Tone Mapping is the problem of compressing the range of a High-Dynamic Range image so that it can be displayed in a Low-Dynamic Range screen, without losing or introducing novel details: The final image should produce in the observer a sensation as close as possible to the perception produced by the real-world scene. We propose a tone mapping operator with two stages. [3] The first stage is a global method that implements visual adaptation, based on experiments on human perception, in particular we point out the importance of cone saturation. The second stage performs local contrast enhancement, based on a variational model inspired by color vision phenomenology. We evaluate this method with a metric validated by psychophysical experiments and, in terms of this metric, our method compares very well with the state of the art.

In Qi Shan, and Michael S. Brown et al presents a new tone mapping operator that performs local linear adjustments on small overlapping windows over the entire input image. [4] While each window applies a local linear adjustment that preserves the monotonicity of the radiance values, the problem is implicitly cast as one of global optimization that satisfies the local constraints defined on each of the overlapping windows.

Local constraints take the form of a guidance map that can be used to effectively suppress local high contrast while preserving details. Using this method, image structures can be preserved even in challenging high dynamic range (HDR) images that contain either abrupt radiance change, or relatively smooth but salient transitions. Another benefit of our formulation is that it can be used to synthesize HDR images from low dynamic range (LDR) images. Although our method is regarded as a local operator, it does not involve scale decomposition, layer separation, or image segmentation, and therefore, is resistant to the artifacts known with these procedures.

In Lu ZHANG(1-2), Patrick LE CALLET et al presents With medical imaging technologies growth, the question of their assessment on the impact and benefit on patient care is rising. Development and design of those medical imaging technologies should take into account the concept of image quality as it might impact the ability of practicing while they are using image information.[5] Towards that goal, one should consider several human factors involved in image analysis and interpretation, e.g. image perception issues, decision process, image analysis pipeline (detection, localization, characterization…). While many efforts have been dedicated to objectively assess the value of imaging system in terms of ideal decision process, new trends have recently emerged to deal with human observer performances. This task effort is huge considering the variability of imaging acquisition methods and the possible pathologies. This paper proposes a survey of some key issues and results associated to this effort.

3. IMAGE QUALITY ASSESSMENT WITH METRIC BASED

Contour let is employed to decompose image into different scales and direction sub bands, and then contrast sensitivity function (CSF) masking is applied to obtain same visual sensitivity information within an image. Thereafter, based on the properties of human vision systems (HVS), we define a rational sensitivity threshold, and, with this threshold, compute visual sensitivity coefficients in each sub band. Finally, evaluation measurement of distorted images is built by comparing the computed coefficients between original and distorted images. The step wise process is as shown in figure 1 and contour let decomposition is as shown in figure 2. It calculates the quality of images and to verify that it compares it with subjective score of same images from data base. Two correlation coefficients are used to measure the accuracy of quality of images

3.1 Image Quality Assessment Process

With a visual attention prediction method, the proposed method first detects interest regions of a reference image *x* and tone mapped image *y*. In quality measurement step, a weight map is used with saliency maps of *x* and *y* to obtain overall quality score, which is highly correlated with subjective evaluation of tone mapped images. A weight map is combined with two saliency maps of reference and tone mapped images to measure attention image region in both images, *x* and *y*.

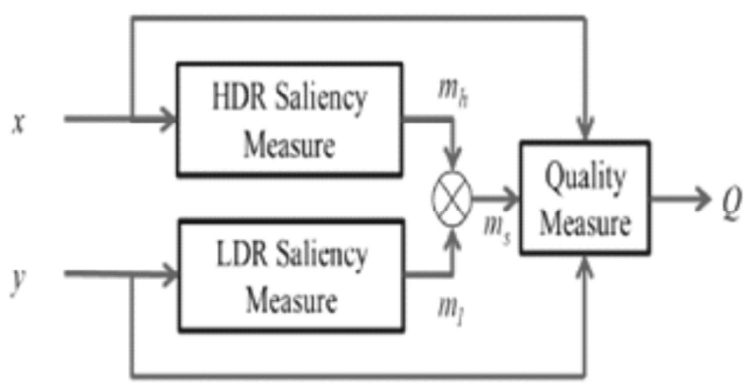

Figure 1: Quality Assessment

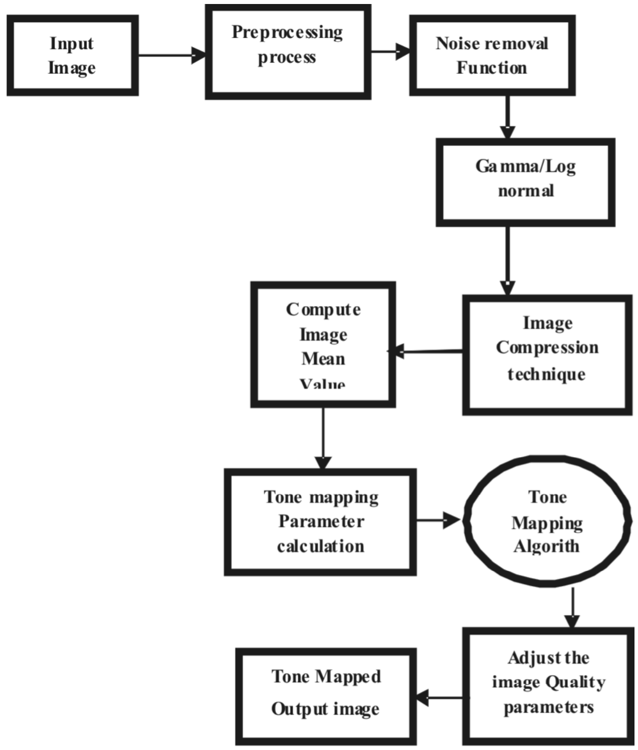

Figure 2: Block Diagram

4. ENHANCEMENT WORK

4.1 Tone Mapping Operators (TMOS)

Tone mapping operators (TMOs) fill in the gap between HDR imaging and visualizing HDR images on standard displays by compressing the dynamic range of HDR image. TMOs provide a useful surrogate for HDR display technology, which is currently still expensive. In addition compressing the dynamic range of an HDR image while preserving its structural detail and natural appearance is by itself an interesting and challenging problem for human and computer vision study. In recent years, many TMOs have been proposed. Most of them were demonstrated on specific examples without being thoroughly evaluated using well-designed and subject-validated image quality assessment (IQA) models.

A promising approach is to develop objective IQA models that can automatically evaluate the performance of TMOs. Traditional objective IQA metrics such as peak signal-to-noise ratio and the structural similarity index (SSIM) assume that the reference and compared images have the same dynamic range; thus they are not applicable in this scenario

4.2 Tone Mapped Image Quality Index (TMQI)

The Tone Mapped illustration Quality Index score ranges involving 0 to 1 where 0 means low and 1 means elevated. The Tone Mapped illustration Quality Index gain is anarrangement of both Structural Similarity index and Statistical Naturalness determine. The charge of computing structural similarity is secret into three comparisons *i.e.* luminance, contrast and structure. First, the luminance of each indication is compared. Second, the mean strength is removed from the signal. Third, the signal is normalized by its own normalvariation, so that the two signals being compared have unit typical deviation. Finally, the three mechanisms are combined to give in an overall similarity measure. The main thoughtfollowing tone mapping is to change the dynamic range *i.e.* from High Dynamic Range to Low Dynamic Range. Hence direct evaluation using image processing role is not applicable. Thus to balance, two local patches x‘and y‘are taken from the HDR and tone mapped image correspondingly.

Tone mapping should provide drastic contrast reduction from scene values to displayable ranges while preserving the image details. In recent years several tone mapping methods have been developed. We can classify these methods into two broad categories, the global tone mapping and the local tone mapping. The global tone mapping technology uses a single invariant tone mapping function for all pixels in the image, but the local tone mapping technology uses different tone mapping functions for different pixels in the image. The local tone mapping technology adapts the mapping functions to local pixel statistics and local pixel contexts. Global tone mapping is simpler to implement but is easier to lose details. Local tone mapping can save details but it is difficult in computation

4.3 Iterative Algorithm

An iterative algorithm executes steps in iterations. It aims to find consecutiveguess in progression to reach anexplanation. They are most usually used in linear programs where large information of variables isconcerned. In computational mathematics, an iterative technique is anarithmeticalprocess that generates a series of improving estimated solutions for a class of harms. A preciseaccomplishment of an iterative method, including the termination criteria, is an algorithm of the iterative process. An iterative method is called convergent if the equivalent succession converges for given preliminary approximations. An accurate lyprecise junction investigation of an iterative method is generally performed; however, heuristic-based iterative methods are moreovergeneral. In the problems of finding the root of an equation (or anexplanation of anarrangement of equations), an iterative method uses an earlyconjecture to makeconsecutive approximations to ananswer.

In contrast, direct methods effort to explain the difficulty by a finite series of operations. In the deficiency of rounding errors, direct methods would bring an exact clarification (like solving a linear scheme of equations by Gaussian elimination). Iterative methods are frequently the only option for nonlinear equations. However, iterative methods are regularly practical even for linear harms involving a large amount of variables (sometimes of the regulate of millions), where direct methods would be prohibitively costly (and in some cases impossible) even with the best offered computing control.

5. EXPERIMENT AND RESULT

5.1 Mean Squared Error (MSE)

MSE denotes the power of the deformation, *i.e.*, the difference linking the situation and test images. MSE value can be considered using the following equation:

$$MSE = \frac{1}{WH}\sum_{j-1}^{H}\sum_{i-1}^{W}(I_{nf}(i,j) - I_m(i,j))^2$$

MSE is often transformed to peak-signal-to-noise ratio (PSNR). PSNR is the ratio of utmostpromising power of a signal and power of alteration, and it is designed by

$$PSNR = 10\log\left(\frac{D^2}{MSE}\right)$$

Where D denotes the energeticcollection of pixel intensities, *e.g.*, for an 8 bits/pixel image we have 255 $= D$ MSE possesses some uniqueness that makes it a widely used recital determines in the field of signal processing. Following are several of these individuality. It is aneasy, computationally economicaltechnique.It has anactually clear sense, *i.e.*, it is anordinarysystem of important thepower of an error indication. Since MSE satisfies properties like convexity, regularity, anddifferentiability, it is measured as an excellent determine in optimization applications. It is measured as a gathering, *i.e.*, it is expansively used for optimization and estimation in a wide choice of signal dispensation applications.

5.2 Structural Similarity Index (SSIM)

The SSIM algorithm assumes that HVS is extremelymodified for extracting structural information from a sight. Therefore, this algorithm attempts to reproduction the structural in sequence of an image. The SSIM algorithm is based on the information that pixels of a usualpictureshow strong dependencies and these dependencies carry useful in turn about the arrangement of a prospect. Therefore, a technique that is capable of measuring structural information change can provide a good estimate of professed image deformation. The SSIM algorithm defines image deprivation as supposedmodify in structural in sequence

$$SSIM(I_{ref}, I_{tst}) = [l(I_{ref}, I_{tst})]^{\alpha} [c(I_{ref}, I_{tst})]^{\beta} [s(I_{ref}, I_{tst})]^{\gamma}$$

The SSIM algorithm performs correspondencequantity in three steps: luminance comparison, contrast comparison, and structure comparison

Figure 3: Output Results

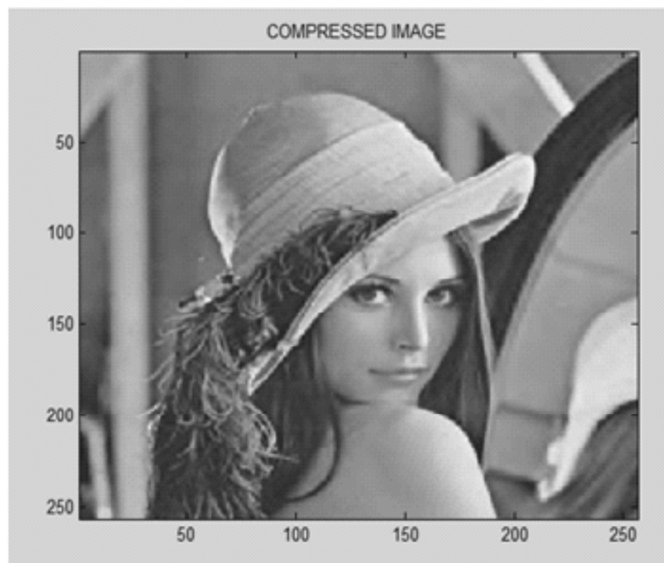

Figure 4: Compressed Image

Figure 5: Decompressed Image

6. CONCLUSION

Quality assessment of high dynamic range satisfied poses new challenges with admiration to the usefulness of well-established consistency metrics, which have mortal used for frequenttime in numerous low dynamic range dispensationresponsibilities. The scene-referred scenery of HDR images entails that those metrics, such as the fashionable PSNR or SSIM, cannot be used on relative luminance standards, and therefore, new metrics based on atruthfulcalculation of the human visual structure such as the HDR-VDP have been planned. At the same instance, it has been conjectured but not methodically proved that, under some proper perceptual linearization of HDR principles, metrics used for the LDR can be absolute to higher dynamic range. Anindividual study to gain a better insight of the subject. We have focused on backward-compatible HDR image density, which is at present an active topic as established by the JPEG XT consistency initiative. Our analyses on accessible arithmetic and structural metrics, computed using dissimilar perceptual linearization encodings show that these quality actions can do as good as or even better than the multifarious HDR-VDP. At the same time, they do not need delicate calibration events.

REFERENCES

[1] Banterle, F., Ledda, P., Debattista, K., and Chalmers, A., "Inverse tone mapping," *in [Proceedings of the 4th International Conference on Computer Graphics and Interactive Techniques in Australasia and Southeast Asia], GRAPHITE '06*, 349–356, *ACM, New York, NY, USA*, 2006.

[2] Richter, T., "On the standardization of the JPEG XT image compression," *in [Picture Coding Symposium (PCS)]*, 37–40, 2013.

[3] Mai, Z., Mansour, H., Mantiuk, R., Nasiopoulos, P., and Ward, R. Heidrich, W., "Optimizing a tone curve for backward-compatible high dynamic range image and video compression," *IEEE Trans. on Image Processing* **20**, 1558–1571, 2011.

[4] Wang, Z., Bovik, A., Sheikh, H., and Simoncelli, E., "Image quality assessment: from error visibility to structural similarity," *IEEE Transactions on Image Processing* **13(4)**, 600–612, 2004.

[5] Huynh-Thu, Q. and Ghanbari, M., "Scope of validity of PSNR in image/video quality assessment," *Electronics Letters* **44**, 800–801, 2008.

[6] Zhang, Y., Naccari, M., Agrafiotis, D., Mrak, M., and Bull, D., "High dynamic range video compression by intensity dependent spatial quantization in HEVC," *in [Picture Coding Symposium]*, 353-356, 2013.

[7] Mantiuk, R., Daly, S., Myszkowski, K., and Seidel, H.-P., "Predicting visible differences in high dynamic range images-model and its calibration," *in [Human Vision and Electronic Imaging X, IS&T/SPIE's 17th Annual Symposium on Electronic Imaging*], *Rogowitz, B. E., Pappas, T. N., and Daly, S. J., eds*., **5666**, 204–214, 2005.

[8] Mantiuk, R., Kim, K., Rempel, A., and Heidrich, W., "HDR-VDP-2: a calibrated visual metric for visibility and quality predictions in all luminance conditions," *in [ACM Trans. on Graphics]*, **30(4)**, 40, ACM, 2011.

[9] Aydýn, T. O., Mantiuk, R., and Seidel, H.-P., "Extending quality metrics to full luminance range images," *in [Electronic Imaging 2008]*, 68060B–68060B, *International Society for Optics and Photonics*, 2008.

[10] Koz, A. and Dufaux, F., "Methods for improving the tone mapping for backward compatible high dynamic range image and video coding," *Signal Processing: Image Communication* 29, 2013.

[11] Lubin, J., "A visual discrimination model for imaging system design and evaluation," *Vision models for target detection and recognition* **2**, 245–357, 1995.

[12] Daly, S., "The visible differences predictor: an algorithm for the assessment of image fidelity," *in [Digital images and human vision]*, 179–206, MIT Press, 1993.

[13] Winkler, S., [Digital video quality: vision models and metrics], *John Wiley & Sons* , 2005.

[14] Miyahara, M., Kotani, K., and Algazi, V., "Objective picture quality scale (PQS) for image coding," *IEEE Transactions on Communications* **46(9)**, 1215–1226, 1998.

[15] Watson, A. B., "Dctune: A technique for visual optimization of dct quantization matrices for individual images," *in [Sid International Symposium Digest of Technical Papers]*,24, 946–946, *SOCIETY FOR INFORMATION DISPLAY*, 1993.

[16] Wang, Z., Simoncelli, E., and Bovik, A., “Multiscale structural similarity for image quality assessment,” *in [Proc. 37th Asilomar Conference on Signals, Systems and Computers]*, **2**, 1398–1402, 2004.

[17] Sheikh, H. and Bovik, A., “Image information and visual quality,” *IEEE Transactions on Image Processing* **15(2)**, 430–444, 2006.

[18] Sheikh, H., Sabir, M., and Bovik, A., “A statistical evaluation of recent full reference image quality assessment algorithms,” *IEEE Transactions on Image Processing* **15**, 3440–3451, 2006.

[19] Narwaria, M., Da Silva, M., Le Callet, P., and Pepion, R., “On improving the pooling in HDR-VDP-2 towards better HDR perceptual quality assessment,” *in [IS&T/SPIE Electronic Imaging]*, 90140N–90140N, *International Society for Optics and Photonics*, 2014.

[20] De Simone, F., Goldmann, L., Lee, J., and Ebrahimi, T., “Performance analysis of VP8 image and video compression based on subjective evaluations,” *in [SPIE Optics and Photonics, Applications of Digital Image Processing XXXIV]*, *International Society for Optics and Photonics* 2011.