

# A SURVEY ON TONE MAPPED IMAGE QUALITY INDEX

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**Abstract** - We present a survey on converting HDR image (High dynamic range) into a LDR (low dynamic range) images using tone mapping operators. In this paper various methods have been analyzed, based on the accuracy of the image. We can see that the human visual system can detect more colors than computer graphics, one of them being the analysis of high dynamic range images. It identifies more colors than ordinary computers. If we want to display these HDR image on our computers, then it has to be converted to an LDR image. The LDR images are directly navigated in space. During the conversion of HDR to LDR various problems like, distortion, noise, accuracy, brightness and sometimes structural fidelity are not maintained. To solve these problems we are considering three tone mapping factors, like inverse tone mapping, noise estimation and quality assessment.

**Key Words:** Tone mapping operators, Noise estimation, Accuracy, Human Visual system and Quality assessment.

## 1.INTRODUCTION

Vision is the most essential part of our senses, so it is not surprising that images play the important role in human perception. Human Visual System (HVS) is an extremely evolved part of the nervous system that interprets the information from visible light to enable us to see. Although the complex HVS that constitutes considerable part of the brain excellently carries out visual tasks, it has its specific features, sometimes referred to as HVS limitations. Since outputs of computer graphics and digital image processing methods are observed by human subjects, such methods can and have to reflect the features of the HVS to generate perceptually correct and plausible images and to improve the performance. The knowledge of the HVS usually takes the form of computational models and these models can be incorporated at various areas of computer graphics and

digital image processing. The fields where the utilization of HVS models becomes particularly beneficial and which we concern ourselves with in this thesis are image quality assessment, high dynamic range tone mapping, and color image to grayscale conversions. However, human beings have a limitation to the visual band of the electromagnetic (EM) spectrum; covers almost the entire EM spectrum. Digital image processing covers a wide and varied field of applications. The main aim of Image Quality Assessment (IQA) is to computationally predict human perceptions of image quality. Classical metrics, like Root Mean Squared (RMS) error, are not adequate to the comparison of images, because human beings poorly predict the differences between the images. Image quality assessment is very practical in various imaging applications. The main domains of IQA lie in the areas of monitoring of image quality, benchmarking of imaging applications, and optimizing algorithms and their parameter settings. However, image quality metrics have successfully been applied also to image database retrievals, to the evaluation of the perceptual impact of different rendering algorithms, to the perception-guided rendering of animations, etc. High Dynamic Range (HDR) images are becoming widespread in many imaging areas thanks to the uniquely high range of values and the high numerical precision. One may acquire an HDR image synthetically by means of a specialized HDR camera, or using series of ordinary images captured with varying exposure by a consumer-level digital camera. Since an HDR image can comprise of vast range of luminances the challenge is how to display it on devices with limited Dynamic Range (LDR). This problem is called an HDR tone mapping.

In this paper we have surveyed on various types of tone mapping methods. Section II of this paper deals with literature survey and Section III conclusion of the paper.

## 2. LITERATURE SURVEY

To convert an HDR image into a LDR image tone mapping is used, but during TM processing some information is lost. In order to preserve the lost information digital water marking [1] is used. The commercial value is greatly diminished when

the tone mapped images loses its high quality and, therefore, watermark loss could be afforded. Since the major challenges in high dynamic image compression are its quality preservation, HDR image can comprise of vast range of luminance. The challenge is how to display it on devices with limited LDR. This problem is called an HDR tone mapping [2].

Hojatollah Yeganeh et.al SSIM [3] technique is used which provide image quality to LDR images. Since HDR displays are limited, the HDR images are displayed on LDR images, for this purpose tone mapping operators are used. SSIM, provide image quality and is computationally efficient. But calibration and special polling is yet a great challenge.

To overcome the above mentioned SSIM method problems we use the structural fidelity and statistical naturalness (which we had already discussed) and had come up with TMQI, [4] which can be used for natural images only.

In order to improve the brightness of an image a statistical derivation is used [5]. An automatic tone mapping algorithm can be used to produce global and local images of LDR image. This method provides high brightness and contrast to images. This is an automatic approach. Therefore manual tuning parameters are of less importance.

A blind quality metric [6] is constructed based on varying the darkness/brightness of original tone mapped images. IQA matrix is formed and based on this matrix the quality of the image is accessed.

Feature similarity index for tone-mapped images (FSITM) [7]. A proposed index compares the locally weighted mean phase angle map of a high dynamic range (HDR) to that of its associated tone-mapped image calculated using the output of the TMO method. This method is noise independent and robust. Therefore we can say that it is more efficient than TMQI. Later on TMQI and FSITM are combined to form a more accurate quality assessment model

The TMQI is then used to determine human judgment of image quality based on visual attention. A modified version of TMQI that is Saliency weighted Tone-Mapped Quality Index (STMQI) [8]. STMQI shows strong correlation with subjective evaluations of image quality, and achieves higher Spearman and Kendall rank-order correlation coefficients than that of the standard TMQI metric. Sophisticated measures of naturalness based on both global and local image statistics is stronger, but in the above discussed

method human decisions are not taken into consideration, which is a major drawback of this method.

Denosing of HDR images is of major concern that is while preserving the image brightness it is often seen that noise is seen in the converted image form. Especially, in low light images. A range kernel of a cross bilateral filter [9] is used to denoise the tone mapped image. If the noise distribution is unknown, it is automatically being estimated, assuming that the HDR image was produced taking an average of multiple exposures of RAW or JPEG compressed format. Quantitative and qualitative evaluation shows that this method is more effective than signal-dependent HDR denosing, and image-based denosing strategies that do not consider the noise in the original HDR image.

Inverse tone mapping is done to convert a low dynamic image into a high dynamic image [10]. We can see that most of the images are stored as low dynamic ones. In this paper reverse mapping of these images can be done by an approximation method like median cut method which is used to find high luminance and then we are applying an extended mapping to the luminance in high range. This method is known as inverse photographic tone reproduction operators. It provides better image quality than naïve algorithm. But the image quality is not good as expected.

An interesting result of the survey is that different testing methodologies are studied based on the image quality attributes, which can be evaluated without comparison to a real HDR reference.

### 3. CONCLUSIONS

The TMQI model allows for quantitative assessment of the quality of tone-mapped images using their accompanying HDR images as references. We have surveyed different types of tone mapping operations and features. Future development of this work is directed at accessing alternatively saliency measures towards image quality by improving the naturalness of converted HDR image according to human vision.

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