A STEREOSCOPIC IMAGE QUALITY ASSESSMENT BASED ON METRICS MULTI-SCALE STRUCTURAL SIMILARITY INDEX AND UNIVERSAL QUALITY INDEX

[1]Dr.I.Santi Prabha,M.Tech,Ph.D
[1]Professor, UCEK&RECTOR,Dept. Of E.C.E
Jawaharlal Nehru Technological University,
Kakinada, A.P

[2]Balla.Lakshmi Sameeramani
[2]PG Scholar,Dept. Of E.C.E
Jawaharlal Nehru Technological University,
Kakinada, A.P

Abstract—The human visual system pays attention to salient regions while perceiving an image. In this paper, we estimated an quality of an stereoscopic image using metrics. For this assessment, a method is used, a systematic approach for depth saliency estimation, called Salient Edges with respect to Depth perception (SED) which localizes the depth-salient edges in an S3D image.This concept evaluates the quality of the stereo image pair (2D) and the depth pair individually and pools these scores to arrive at the overall score.

Further, this project is enhanced by improving the quality of query image by determining universal quality index (UQI) and multi-scale structural similarity (MS-SSIM) metrics. Based on the objective score the image quality assessment will be performed. We perform a comprehensive evaluation of our metric on publicly available Middlebury S3D IQA database. The proposed metric shows competitive performance of the Middlebury database with state-of-the-art performance. The proposed method is implemented in MATLAB software.

Keywords —Stereoscopic images, Disparity map, Image quality assessment, FRSIQA, SED map, UQI, MS-SSIM.

I.INTRODUCTION

Stereoscopic 3D imaging is nowadays a wide-spread and affordable means to achieve a convincing game or movie experience. The human visual system (HVS) uses a combination of different perceptual cues to estimate spatial layout from 3D images. Different from common luminance imaging, stereo 3D display technology provides additional binocular disparity cues. An extensive body of work has investigated various static properties of binocular stereo content, such as manipulation and editing to achieve viewing comfort both in terms of technical requirements as well as in faithful perceptual modelling. We propose a universal quality index and multi-scale structural similarity index metrics on novel

FRSIQA algorithm that relies on edges that contribute to depth saliency in S3D images using an approach for estimating depth salient edges that we call Salient Edges with respect to Depth perception (SED).We demonstrate competitive performance of proposed metrics over a Middlebury of S3D IQA database.

The paper is organized as follows; Section II describes FRSIQA algorithm. Section III describes SED map.Section IV describes the proposed work. Section V results and discussion and Section VI Concludes the paper.

II. FRSIQA ALGORITHM

FRSIQA is an objective quality assessment algorithm which uses full S3D content for an image quality assessment ([1],[2],[3],[4],[5],[6]).several methods like Traditional approaches to FRSIQA include weighted averaging of the 2D IQA scores of left and right images (with and without explicit depth information use), cyclopean image based methods, statistical model based techniques, to name a few. We propose a novel FRSIQA algorithm that relies on edges that contribute to depth saliency in S3D images. Sameeulla Khan [7] proposed an FRSIQA algorithm based on visual saliency and gradient magnitude. Though our proposed approach is similar to this work we bring out the better quality assessment in our work..

III. SED map

In most of the methods in the literature, S3D visual saliency is proposed by combining 2D saliency with depth cues ([8] and [9]). The salient regions may include objects and surface areas in addition to depth information. In this paper, we followed the sameeulla khan [7] approach for depth saliency, where we localize our depth salient region as edges. We claim that when viewing an S3D image, only a subset of image edges contribute to depth perception. We describe those edges as Salient Edges with respect to Depth perception (SED). Our claim is scientifically supported by [12]. In [10], Gillam et al. conducted subjective studies and concluded that change in disparity values (i.e., disparity edges) as the primary stimulus for stereopsis (i.e., depth perception). In [11], Gillam et al. again conducted subjective studies and prove that the presence of unmatched regions (i.e., occlusions) actually facilitates initiation of stereopsis rather than retardation. These unmatched regions are only found at depth discontinuities (disparity edges). These depth-salient edges (SED) are then used to refine the image quality estimates obtained from gradient features of the component 2D images.

IV PROPOSED WORK

(a)Universal image Quality Index(UQI):

A Universal image quality index is used which is easy to calculate and applicable to various image processing applications. Instead of using traditional error summation methods, the proposed index is designed by modeling any image distortion as a combination of three factors: loss of correlation, luminance distortion and contrast distortion. Universal quality index is mathematically defined and performs significantly better than the widely used distortion metric mean squared error [4]. Let X={xi|i=1,2,……..,N} and Y={yi|i=1,2,……..,N}be the original and test image signals respectively. The proposed quality image index is defined as

$$Q = \frac{4\sigma_{xy}\bar{x}\bar{y}}{(\sigma_x^2 + \sigma_y^2)[(\bar{x})^2 + (\bar{y})^2]},$$

where

$$\bar{x} = \frac{1}{N}\sum_{i=1}^{N} x_i, \quad \bar{y} = \frac{1}{N}\sum_{i=1}^{N} y_i,$$

$$\sigma_x^2 = \frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2, \quad \sigma_y^2 = \frac{1}{N-1}\sum_{i=1}^{N}(y_i - \bar{y})^2,$$

$$\sigma_{xy} = \frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})(y_i - \bar{y}).$$

The dynamic range of Q is [-1,1]. The best value 1 is achieved if and only if yi=xi for all i=1,2,…..,N. the lowest value of -1 occurs $y_i = 2\bar{x} - x_i$ when for all i=1,2,….N. The definition of Q is a product of three components.

(b)Multi-scale Structural Similarity Index Measure (MS-SSIM):

The perceivability of image subtleties depends the sampling density of the image signal, the good ways from the image plane to the onlooker, and the perceptual capacity of the spectator's visual framework. By and by, the abstract assessment of a given image differs when these variables change. A single-scale strategy as depicted in the past segment might be proper just for explicit settings.

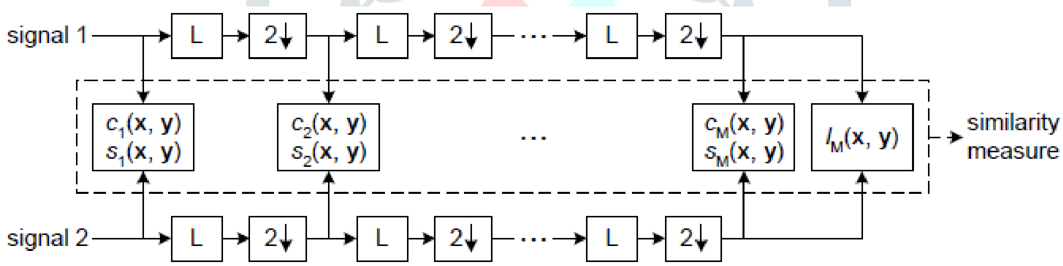


Fig. 1. Multi-scale structural similarity measurement system. L: low-pass filtering; 2 : down sampling by 2.

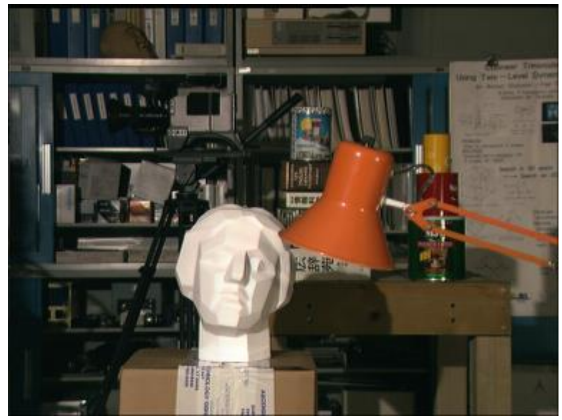
Multi-scale technique is an advantageous method to consolidate image subtleties at various goals. We propose a multi-scale SSIM strategy for image quality appraisal whose framework graph is represented in Fig. 1. Taking the reference and mutilated image flag as the info, the framework iteratively applies a low-pass channel and downsamples the sifted image by a factor of 2. We file the first image as Scale 1, and the most astounding scale as Scale M, which is gotten after M − 1 emphasess. At the j-th scale, the complexity examination (2) and the structure correlation (3) are determined and meant as cj (x, y) and sj (x, y), separately. The luminance examination (1) is figured distinctly at Scale M and is signified as lM(x, y). The general SSIM assessment is gotten by joining the estimation at various scales utilizing

$$\text{SSIM}(\mathbf{x},\mathbf{y}) = [l_M(\mathbf{x},\mathbf{y})]^{\alpha_M} \cdot \prod_{j=1}^{M}[c_j(\mathbf{x},\mathbf{y})]^{\beta_j}[s_j(\mathbf{x},\mathbf{y})]^{\gamma_j}$$

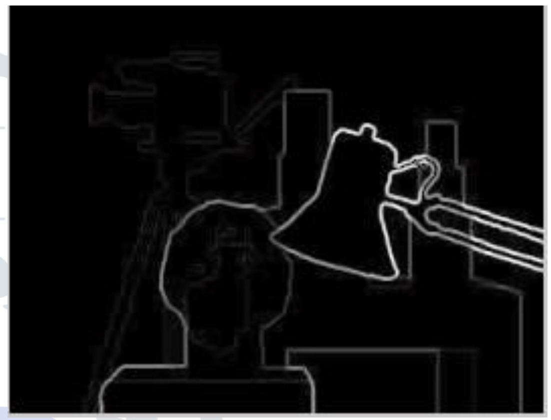
This multiscale SSIM index definition satisfies the three conditions given in the last section. It also includes the single-scale method as a special case. In particular, a single-scale implementation for Scale M applies the iterative filtering and downsampling procedure up to Scale M and only the exponents αM, βM and γM are given nonzero values. To simplify parameter selection, we let $\alpha j=\beta j=\gamma j$ for all P j's. In addition, we normalize the cross-scale settings such that M j=1 $\gamma j=1$. This makes different parameter settings (including all single-scale and multi-scale settings) comparable. The remaining job is to determine the relative values across different scales. Reasonably, this ought to be identified with the contrast sensitivity function (CSF) of the HVS , which expresses that the human visual sensitivity crests at center frequencies (around 4 cycles for every level of visual point) and diminishes along both high-and low-recurrence bearings. Be that as it may, CSF can't be directly used to determine the parameters in our framework since it is regularly estimated at the perceivability threshold level utilizing rearranged improvements (sinusoids), yet our motivation is to think about the nature of complex organized images at noticeable distortion levels.

V. RESULTS AND DISCUSSION

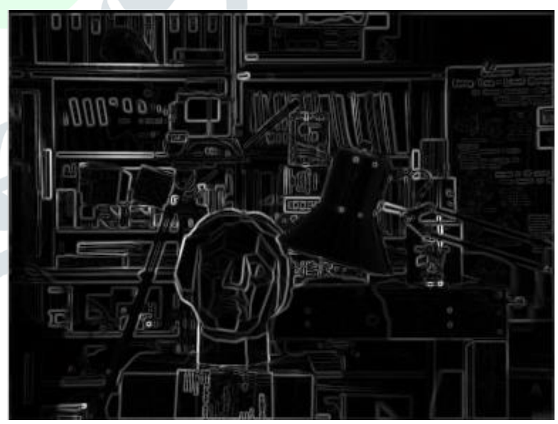
In order to verify the operational effectiveness of the proposed approach, the proposed stereoscopic image enhancement approach of developed, implemented and tested in the matlab environment and the simulation results are presented as follows.



(a) left view



(b) Gradient magnitude of GT Dmap



(c) Gradient magnitude of Est Dmap

(d) SED map

Fig2:Tsukubha image from middlebury database

We demonstrate the efficiency of SED maps and its application to FRSIQA. Fig.2 shows our SED results over the Middlebury stereo database.GT Dmap are not available for the all databases. Hence we need to work with the Est Dmap,but relying on the edges of the Est Dmap will not suffice for identifying edges contributing to depth perception. To overcome with the problems of Est Dmaps we worked with the SED map of the image which enhances the important edges alone.

Table I compares our approach with tsukuba of middlebury database. These table suggest that the proposed metric gives the better quality score while comparing with structural similarity index metrix. While comparing both ,multi-scale structural similarity index gave the better image quality assessment when compared with the structural similarity index and universal quality index.

TABLE I:

SIQA comparision with middlebury database

DATEBASE:**TSUKUBA**						
S. No	**Method**	**PLCC**	**SROCC**	**SSIM**	**UQI**	**MS-SSIM**
1	Lin	0.7079	0.6435	0.7634	0.7014	0.7894
2	Benoit	0.9100	-	0.8427	0.8243	0.8934
3	Voo(Only JP2K)	0.9083	0.9230	0.8613	0.8332	0.8669
4	Khan[13]	0.8504	0.8413	0.8455	0.8516	0.8749
5	Khan[50]	0.8143	0.7893	0.8113	0.8314	0.8841
6	Khan[20]	0.7224	0.6506	0.7234	0.8217	0.9102
7	Shao[18]	0.9355	0.9391	0.8142	0.8275	0.8791

8	Bensalma[60]	0.9545	0.9401	0.8524	0.8361	0.8642
9	Bensalma[54]	0.9560	0.9513	0.8234	0.8726	0.8112
10	**Existing**	**0.9177**	**0.9068**	**0.8677**	**0.8728**	**0.8936**
11	**Proposed**	**0.967754**	**0.9531**	**0.9833**	**0.9498**	**0.9869**

VI. CONCLUSION

We presented an approach for identifying the depth-salient edges in an image that we called Salient Edges with respect to Depth perception (SED). We demonstrated the advantages of the SED maps over using estimated disparity maps. Further, we proposed an FRSIQA algorithm that showcases the utility of the proposed SED method. In our FRSIQA algorithm, we proposed that S3D image quality can be assessed as a combination of image saliency and depth saliency. For image saliency we used a conventional 2D salient technique but for depth saliency we relied on SED maps. The image and depth quality scores were combined to give our overall FRSIQA score. We evaluated the performance of our algorithm on middlebury S3D image databases and showed that the proposed method has consistent performance on all of them. The proposed metrics gives the better quality score while comparing with structural similarity index metric. While comparing both ,multi-scale structural similarity index gave the better image quality assessment when compared with the structural similarity index and universal quality index.We believe that SED maps have utility in a wide range of applications including image compression, FR stereo video quality assessment (FRSVQA) etc. As future work, we plan to address the problem of FRVSQA.

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