A COMPARISON OF IMAGE QUALITY MEASURES FOR EVALUATING IMAGES

Dr. Abhimanyu Malik*

Assistant Professor, Department of Computer Science
CRA College, Sonipat, Haryana, India

Email ID: erabhimanyumalik@gmail.com

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Abstract

Picture quality Measures play main role in the picture processing of a kind. Main objective is to evaluate quality that applies to estimate operations and image processing techniques. In recent years, significant effort has been made to advance objective that links fit with objective human quality measures or subjective styles. In addition, results from the full reference (FR) approach, which was based on pixel-to-pixel error.

Paper Identification

**Corresponding Author*

1. INTRODUCTION

Image quality appraisal is a significant and difficult issue in image processing and computer vision that affects interests through a variety of applications, such as improving picture property and dynamic monitoring. Nevertheless, this area of study has been successful so far.

Picture distortion is a property of a picture that is valued for its quality. The area of computer vision and image processing that deals with quality evaluation is important. Compressed image area and estate enhancement methods are often used to lessen the amount of corruption in the filtered picture. It takes a certain criterion to determine how much an image has been corrupted during compression, which lowers the quality of the image.

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2. IMAGE QUALITY MEASUREMENT TECHNIQUES

There are two types of methodologies for estimating quality: subjective and objective.

2.1 Subjective Approaches

Subjective methods depend on human judgment. These methods are difficult, unpredictable in terms of time, and lack mechanization [2]. In every situation where images are being viewed by people, subjective methodologies can be used to gauge the standard of the viewable images. The difference of test images and the original picture in HSV-based measures is uniformly governed by the psychophysics of human vision and is based on visibility. Even so, they have significant drawbacks that make them challenging to achieve. A few examples include real-time applications, the inability to contain work within autonomous systems, and others. [2].

2.2 Objective Method

Every time we operate two photos in the intensity of the original and the damaged image, we use an objective technique to derive a number that represents the image quality. [3]

A kind of role in image processing can be performed using an objective picture quality metric. It may be used to instantly assess and modify image quality.. A network digital video server, for instance, might assess the video quality in order to allot resources and manage flow. Additionally, it can be used to refine the methods and parameter settings for image processing operations. an evaluation tool, for instance, can assist in the best design of pre filtering and bit giving algorithms in the encoder and of the best reconstruction, error cover up, and post filtering procedures in the decoder, for example, in a visual communication organization. It can be applied to conventional image processing techniques [4].

Three types of objective technique are categorized. The presence of the original picture is required for no-reference (NR), reduced-reference (RR), and full-reference (FR). That could be determined automatically by image quality [1].

2.2.1 (NR-IQA) No-Reference Image Quality Assessment

It is top-tier IQA technique that assesses picture quality without taking into account any specifications for an original photograph of the complementary scenery [5].

Given that they can be implemented in real applications, NR-IQA is crucial [5].

For problems with image processing, NR-IQA is a useful area to explore, with this method being the most intriguing of IQA's methods. There are numerous NR-IQA techniques. Methods of statistical features that provide knowledge about the caliber of visual images are extracted, and a score of a picture's caliber is estimated using these attributes [5].

2.2.2 (RR-IQA) Reduced-Reference Image Quality Assessment

As a comparison tool between NR and FR procedures, RR-IQA approaches are helpful. RR- IQA methods give a fix situation where the initial picture is only partially reachable [6]. These approaches just require a small amount of data from the original image found at the characteristic formula. Over an auxiliary link, some data is sent to the receiving region [7]. A basic set of characteristics (or parameters) from the original image is typically extracted by styles of this type, and these factors are then utilized with the damaged image to evaluate quality [6], according to the framework for RR- IQA depicted in figure (1).

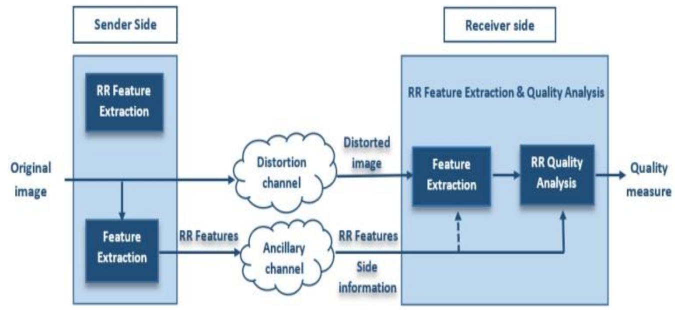

Figure 1. RR-IQA Framework [8]

2.2.3 (FR-IQA) Full-Reference Image Quality Assessment

At this point, the affected picture has been compared to the actual, unaltered image, which is often captured using a high-quality device. Figure (2) shows the diagram of the FR-IQA Framework [9].

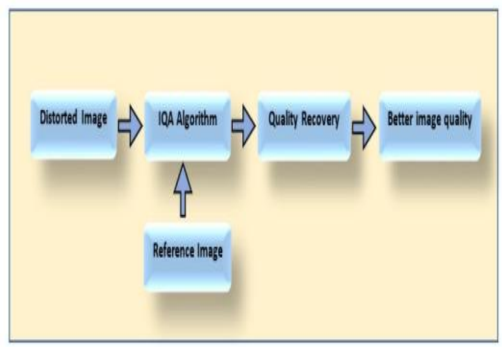

Figure 2. Full Reference Image Quality Assessment Framework [9]

Most articles give FR-IQA approaches that can be divided into the following major sets: First, the HVS must be considered, and second, any signal fidelity criteria must be considered [10].

2.2.3.1 (HVS) Human Visual System Based Measures

According to some, the best relationship between the objective measurements and the fundamental HVS pattern is achieved. By using an activation function at polar coordinates, Consign HVS is shown as a band pass filter [11].

$$H(\rho)=\begin{cases} 0.05e^{\rho^{0.554}} & \rho<7 \\ e^{-9\left[\left|\log_{10}\rho-\log_{10}9\right|\right]^{2.3}} & \rho\geq 7 \end{cases}$$

Whenever, u and v are the spatial frequencies

(= (u2 + v2)1/2). This filter performs pre-processing on both the original images and coded pictures to duplicate the (HVS) outcome. The (U) operator in (H1-H3) denotes the image processing step of multiplying the (DCT) of the picture by the spectral mask above and reverse (DCT) transforming.

There are three possible measures (H1, H2 and H3) for the multispectral images. In order to explain several perceptual phenomena, including orientation selectivity, contrast, colour, and colour contrast, the multiscale model

(H4) is also described. Starting with these channels, feature extraction is performed, and then an aggregate similarity criterion is created using a weighted linear mixture of the feature changes [11].

Human Visual System Based (HVS) Measures can be classed into sets:

1- **(SSIM) Structural Similarity Index**

The SSIM is a perceptual metrics that estimates the amount of time lost during data compression or transmission that result in image quality deterioration. Two images from the identical captured image are required for the FR measure: the actual picture and the modified picture. Typically, the transformed picture is compressed. For instance, it might be obtained by reading a JPEG image again after maintaining the original. SSIM has several applications in still photography but is well-accepted in the media business. According to [12], the SSIM is:

$$SSIM(f,g) = l(f,g)c(f,g)s(f,g)$$

Where:

$$\begin{cases} l(f,g) = \dfrac{2\mu_f\mu_g + C_1}{\mu_f^2 + \mu_g^2 + C_1} \\ c(f,g) = \dfrac{2\sigma_f\sigma_g + C_2}{\sigma_f^2 + \sigma_g^2 + C_2} \\ s(f,g) = \dfrac{\sigma_{fg} + C_3}{\sigma_f\sigma_g + C_3} \end{cases}$$

The Imatest Image Processing portion, which has various capabilities not present in the SSIM, is where SSIM is overly computed. For instance, it can employ common image degradations like blur, noise, and flare before using signal processing techniques like tone mapping, bilateral filtering, and unsharp mask that are frequently used to enhance photos [4].

2- DSSIM: Structural Dissimilarity Metric / Differential SSIM

It compares photos and assigns a similarity score that is close to what a human decision maker would use. The SSIM procedure serves as its foundation, but it is improved by the addition of multi-scale processing and support for alpha channels and colour.

Although structural dissimilarity (DSSIM) may be obtained from SSIM, it fails to establish a distance measure and does not necessarily satisfy the triangle inequality. As per [13], it is [13]:

$$DSSIM(x, y) = 1/\,(1 - SSIM(x, y))$$

3- Mean Structural Similarity Index Metric (MSSIM)

It is SSIM and defined as [13]:

$$MSSIM(X,Y) = \frac{1}{M}\sum_{l=1}^{M} SSIM(xl, yl)$$

All photos, regardless of quality, share a similar mean square error (MSE) in relation to the source image. The performance of MSSIM is a far better indicator of image quality.

1- (MSE) Mean Square Error

It is the best popular and straightforward version for a full reference measure and it is determined by multiplying the linked quantity's maximum signal-to-noise ratio by the squared intensity variation of pixels for both damaged and original images [14].

The most widely used IQA destination is MSE. The values that are closest to zero are better because it is a FR measure. The mistake is occurring at this second moment. The mean squared error is mixed with the destiny's variance and bias. In the case of an unbiased estimator, the MSE is the deviation of the desired. It contains the same measurement components, like square of that which is calculated as variance. The MSE displays the Root Mean Square Error (RMSE), which can also sometimes call as the variance's standard deviation [14].

MSD of an estimator can also be determined using the MSE. The operation for measuring an invisible quantity of a picture is referred to as an estimator. The mean of the square of errors, or MSD or MSE, is the measurement. The distinction between the estimator's & the results as deducted is the error. When taking into account the predictable calculation of the squared error loss or squared loss [14], it is a function of risk.

MSE among two images for example g (n, m) and gˆ (n, m) is identified like [14]:

$$MSE = \frac{1}{MN}\sum_{n=0}^{M}\sum_{m=1}^{N}\left[\hat{g}(n,m)-g(n,m)\right]^2$$

From this, we will calculate that MSE is an action of absolute error [14].

2- (PSNR) Peak Signal to Noise Ratio

This idiom appears to compare the strength of a signal, which is the most likely power, with the strength of damaging noise, which affects the statement's quality. The PSNR is typically displayed using a logarithmic decibel scale as many signals have a very vast dynamic array (the proportion among the big and small attainable variable quantity's values). The PSNR is expressed mathematically as follows [1]:

$$PSNR=20\log_{10}\left(\frac{MAX_f}{\sqrt{MSE}}\right)$$

MAXf: The utmost signal value that occurs at original image

3- (PMSE) Peak Mean Square Error

The most common forms of PSNR and MSE employed in FR-IQA are simple form. They have the advantage of being simple and quick to execute. On the flip side, they calculate the error signal quickly and precisely. Greater values by MSE indicate less similarity to the original image than bigger values by PSNR indicate. As indicated by [13]:

$$PMSE = \frac{1}{MN} \times \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j)-y(i,j))^2}{(MAX(x(i,j)))^2}$$

4- (MD) Maximum Difference

It is greatest of the error value that is deviation among original and test signal [3]. It is given as:

$$MD=MAX|x(i,j)-y(i,j)|$$

5- (AD) Average Difference

It gives average for adjustment concerning treated and original image. it is given as [15]:

$$AD = \frac{1}{mn}\sum_{i=1}^{m}\sum_{i=1}^{n}[A(i,j) - B(i,j)]$$

3. CONCLUSION

There are a number of objective compute methods for image quality under development. The two finest public objective valuation approaches are the Peak Signal-to-Noise Ratio and the Mean Squared Error. The MSE, SNR, and PSNR are quickly computed. However, these evaluation techniques are not always the best choice, especially if an evaluation will be made in addition to the human perception of the image's brilliance. Despite costing more than MSE and PSNR, SSIM is more accurate and trustworthy. The MSE, PSNR, and RMSE quantitatively calculate de-noising processes.

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