

Full Reference Image Quality Metrics and their Performance

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Abstract—This paper mainly aims to study the performance of objective assessment methods of image quality. It take into consideration the correlations between each objective assessment and the subjective assessment in order to determine objective test performance. Three objective assessment methods used in this study are the Structural Similarity (SSIM) index, the Peak Signal-to-Noise Ratio (PSNR) and the Mean Squared Error (MSE) calculating algorithm. The resulting data indicate what type of objective assessment was most suitable for which type of impairment imposed upon an image. This is clarified using the Pearson Correlation Coefficient as described in the paper. As an overall, SSIM index had the best correlation characteristics to the subjective assessment, followed by the MSE calculating algorithm. From this study, a better understanding of the requirements for developing an efficient image quality assessment method was gained.

Keywords—Image Quality Metrics, PSNR, SSIM, MSE

1. INTRODUCTION

Image quality analysis is the science of analysing, then comparing the characteristics and features of an image with reference to original image of predetermined/preset standards [1]. Depending on the existence of reference images, there are three categories of image quality metrics (IQMs); full-reference (FR), reduced reference (RR) and non reference (NR).

The objective method is unbiased and automated. It provides a result that is faithful to all assigned parameters. The subjective method requires the use of human discretion to decide the level of the image's quality. This method is subject to bias in the form of the tester's taste and preferences. However, the result of a subjective analysis is very often a more trusted method as it is only natural for people to judge with their own eyes. The demerit of subjective assessment is time and labour consuming while the demerit of objective assessment is that it may not be reliable [1].

Most digital image analysis processes try to simulate the human visual cortex as it is a known fact that the human eye

remains a very superior judge of image quality. For example, if the computer saying the image is of a good quality but a human saying it is of a bad quality, the image will most likely be scrapped. Therefore, the computer's reliability and accuracy will be considered low if there is a poor correlation between its results and the human eye's judgment.

Image quality analysis measures should be employed to determine the usability of images after they have undergone any kind of manipulation, for example, compression, transmission or conversion [2]. Therefore, studying the various approaches to image quality analysis will provide information on what method of image quality assessment can be efficiently employed under which circumstances. Available IQMs are developed based on color appearance, blurs assessment, wavelet, pixels comparison, hue and saturation and etc [3-7]. Among the available metrics, PSNR, MSE and SSIM are widely accepted and applied [3]. However, there are not much effort had made to equally compared this three metrics [8-10].

The scope of the paper is to determine correlations between objective and subjective image quality analysis results. This paper aims to verify which method has the best correlation characteristics with subjective assessment. In order to achieve that, a number of objective assessments will be conducted and compared to a corresponding subjective assessment. The subjective assessment will become a standard or benchmark of the actual quality of the image. Thus, all objective tests that are performed can be evaluated fairly. The results should reflect the validity of the objective test considering the time needed to conduct it and its practicality. The objectives of this research are;

- a. To design assessments to be conducted and analyze the results to investigate the correlation characteristics between objective image quality analysis and subjective image quality analysis.
- b. To determine the best method of image analysis in certain circumstances based upon conditions and parameters.