**EVALUATION METRICS**

Evaluation metrics are quantitative tools used to evaluate the performance and quality of algorithms, models, and systems in image processing and computer vision. They are crucial for tasks like image compression, segmentation, and classification. They are also widely used in remote sensing to enhance the effectiveness of satellite or aerial imagery algorithms.

**Importance Of Evaluation Metrics:**

Evaluation metrics are standardized assessments of image quality that ensure consistent evaluation and fair comparison of different image processing methods. They help identify areas for improvement in image processing algorithms by highlighting specific aspects of quality loss or distortion. Evaluation metrics are crucial for applications like medical imaging and satellite imagery, where high fidelity is essential. If the image quality is not high, the metrics value can be used to refine the algorithm performance and iterate until the user reaches the expected output. Evaluation metrics do not increase image quality but measure and assess the quality of an image, providing insights into how well an image or processing algorithm performs. Enhancement of image quality is achieved through refining algorithms or processing techniques based on the feedback provided by these metrics. Image quality assessment (IQA) evaluates the quality of an image, particularly how closely it matches the original or intended image.

1. MSE(Mean Squared Error)
2. RMSE(Root Mean Squared Error)
3. PSNR(Peak Signal-to-Noise Ratio)
4. SSIM(Structural Similarity Index Measure)

**1. Mean Squared Error (MSE):**

The average squared difference between the values of two sets of data—an original image and its processed image, which is produced by using various algorithms and techniques—is measured by a metric called mean squared error, or MSE. By determining the degree to which the pixel values of one image differ from the corresponding pixel values of the other, it quantifies the inaccuracy between these two photographs.

**Analyzation:**

Higher MSE: shows a larger disparity between the raw and processed photos, indicating a higher degree of distortion or a worse quality image.

Lower MSE: shows less variation amongst the photos, which suggests better original content preservation or higher quality.

Therefore, we can conclude that there is less of a difference in image quality the lower the MSE number.

**2. Root Mean Squared Error (RMSE):**

A metric called Root Mean Squared Error (RMSE) is used to measure the average amount of mistakes between the original and forecasted values. It gauges how accurately an algorithm or model replicates the source data. Since RMSE gives error measurements in the same units as the original data, making it easier to read, it is frequently chosen over MSE. Because of the square root transformation, it is more sensitive to greater errors, which makes it easier to comprehend the effects of huge variances. While RMSE returns the error to its original units, making comparison and comprehension simpler, MSE provides the error in squared units.

**Analyzation:**

The processed image and the original image are identical if the RMSE is 0. Lower RMSE values are preferable in real-world situations since they show that the processed image is more similar to the original image.

**3. Peak Signal-to-Noise Ratio (PSNR):**

A statistic called Peak Signal-to-Noise Ratio (PSNR) is used to compare a compressed image's quality to that of its original counterpart. It calculates the ratio of an image's maximal potential power to the amount of corrupting noise that degrades the image's quality of representation. Higher PSNR values indicate greater image quality and less distortion. PSNR is measured in decibels (dB).

**Analyzation:**

Higher PSNR: shows improved image quality since the original and processed photos have less distortion or inaccuracy.

Lower PSNR: shows a lower quality image with more pronounced variances across the images.

**4. Structural Similarity Index Measure (SSIM):**

A metric called the Structural Similarity Index Measure (SSIM) compares an image's structural similarity to a reference image in order to assess the image's quality. SSIM is more in line with human visual perception than standard measures like Mean Squared Error (MSE) or Peak Signal-to-Noise Ratio (PSNR) since it takes structural information, brightness, and contrast fluctuations into account.

**Analyzation:**

The SSIM value is between -1 and 1. 1: Shows exact resemblance. 0: Shows no resemblance. Negative values: Show a difference in kind.