CSE4227 Digital Image Processing

Chapter 8 – **Image Fidelity Criteria in Image Compression**

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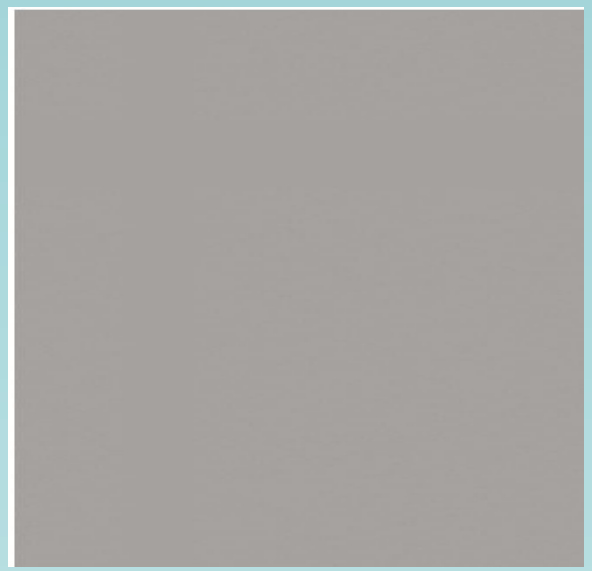
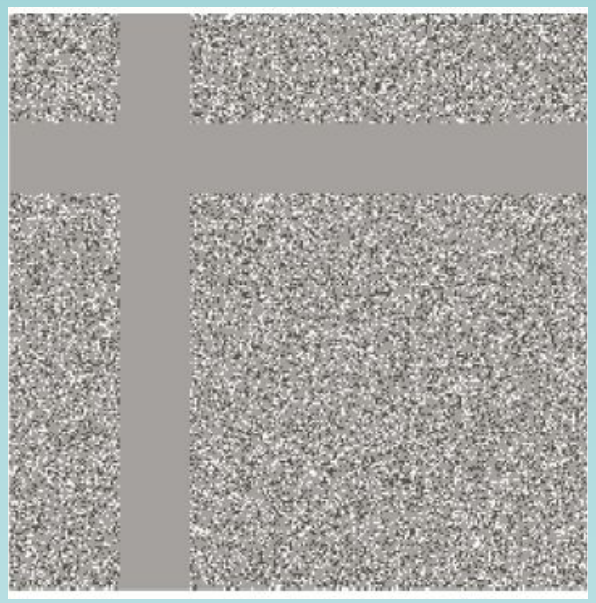
Topics :

- What is fidelity?
- Types of Fidelity criteria

Assessment of loss





removal of irrelevant information removes useful *invisible* information, too

Assessment of loss

Information is lost in many other compression techniques : *Lossy compression*

HOW to Assess the loss???

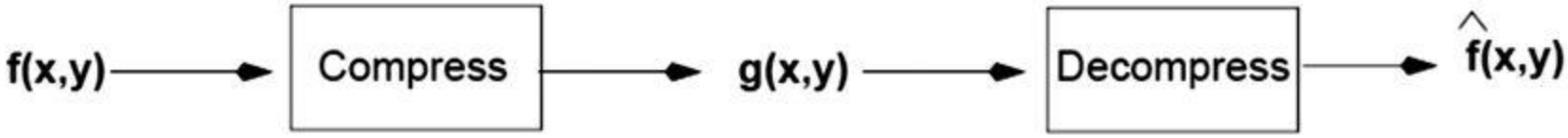
Fidelity Criteria :-

- Fidelity: The degree of exactness with which something is copied or reproduced called Fidelity.
- To determine exactly what information is important ,and able to measure image quality, we need to define image fidelity criteria.

Fidelity criteria can be divided into classes

1. Objective Fidelity Criteria
2. Subjective Fidelity Criteria

Fidelity Criteria



$$\hat{f}(x,y) = f(x,y) + e(x,y)$$

- How close is $f(x,y)$ to $\hat{f}(x,y)$?
- Criteria
  - **Subjective**: based on human observers
  - **Objective**: mathematically defined criteria

1.Objective fidelity Criteria:

- When the level of information loss can be expressed as a function of the original or input image and the compressed and subsequently decompressed output image is said to be based on an Objective fidelity criteria.

Objective fidelity Criteria Cont…

Let $f(x,y)$ denote an estimate approximation of $\hat{f}(x,y)$ that results from compressing and subsequently decompressing the input. For any value of x and y, the error e(x,y) between $f(x,y)$ and $\hat{f}(x,y)$ can be defined as;

$$e(x,y) = \hat{f}(x,y) - f(x,y)$$

So that the total error between the two images is,

$$\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}[\hat{f}(x,y) - f(x,y)]$$

Root Mean Square Error

- Where the images are of size M×N.
- The root mean square e_{rms} between $f(x,y)$ and $\hat{f}(x,y)$ then is the square root of the squared error averaged over the M× N array or;

$$e_{rms} = \left[\frac{1}{MN} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} [\hat{f}(x,y) - f(x,y)]^2 \right]^{1/2}$$

The smaller the value of root mean square, the better the compressed image represents the original image.

Class Work

- Supposed a 3x3 of 3 bits image [1,4,3,5,2,3,4,2,1] is compressed by a Lossy Compression Technique; after the de-compression, image becomes as [3,6,5,7,4,5,6,4,3]. Calculate the Root Mean Square Error as fidelity criteria.

Signal-to-Noise Ratio, SNR_{ms}

- A closely related objective fidelity criterion is the mean-square signal-to-noise ratio of the compressed-decompressed image.
- If f^ (x, y) is considered to be the sum of the original image f(x, y) and a noise signal e(x, y), the mean-square signal-to-noise ratio of the output image, denoted SNR_{rms}, is

$$SNR_{\text{ms}} = \frac{\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}\hat{f}(x,y)^2}{\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}[\hat{f}(x,y) - f(x,y)]^2}.$$

A large number of ***SNR*** implies a better image.

2.Subjective Criteria :

- Measuring image quality by the subjective evaluations of a human observer is often more appropriate since most decompressed images are ultimately viewed by human beings. This can be accomplished by showing a decompressed image to a viewers and averaging their evaluations. An example of a rating scale is shown in the following table. The evaluations are said to be based on subjective fidelity criteria.

Fidelity criteria, subjective (qualitative)

TABLE 8.2
Rating scale of the Television Allocations Study Organization. (Frendendall and Behrend.)

Value	Rating	Description
1	Excellent	An image of extremely high quality, as good as you could desire.
2	Fine	An image of high quality, providing enjoyable viewing. Interference is not objectionable.
3	Passable	An image of acceptable quality. Interference is not objectionable.
4	Marginal	An image of poor quality; you wish you could improve it. Interference is somewhat objectionable.
5	Inferior	A very poor image, but you could watch it. Objectionable interference is definitely present.
6	Unusable	An image so bad that you could not watch it.

Reference :

- Digital Image Processing by Rafafel C.Gonzalez.

  Source : Dept. Library
- Computer Imaging (Digital Image Analysis And Processing) By Scott E Umbaugh

  Source : google book