Image Enhancement

Image enhancement belongs to image preprocessing methods.

Objective of image enhancement – process:

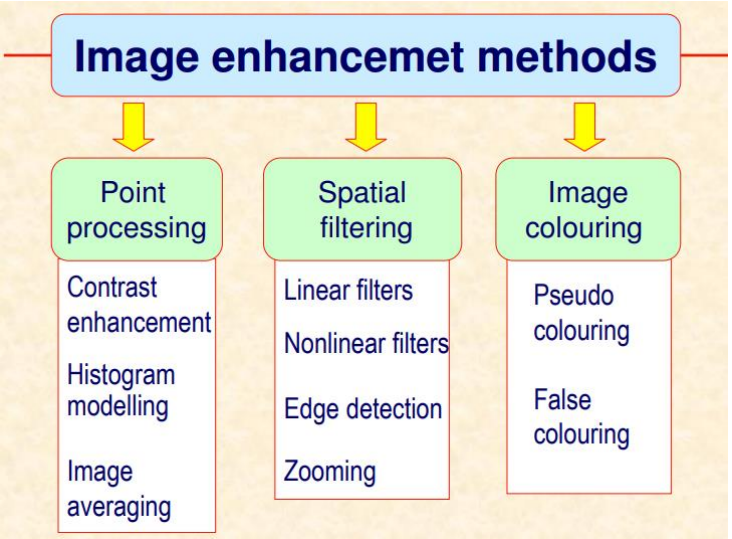
*The principal objective of image enhancement is to process a given image so that the result is more suitable than the original image for a specific application.

*It sharpens image features such as edges, boundaries, or contrast to make a graphic display more helpful for display and analysis.

*The enhancement doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily.

*The greatest difficulty in image enhancement is quantifying the criterion for enhancement.

* Image enhancement methods can be based on either spatial or frequency domain techniques.



Simple intensity transformation:

1-Image negatives:

Negatives of digital images are useful in numerous applications, such as displaying medical images and photographing.

Transform function T : g(x,y)=L-f(x,y), where L is the max. intensity.

2-Contrast stretching:

Low-contrast images can result from poor illumination, lack of dynamic range in the image sensor. The idea behind contrast stretching is to increase the dynamic range of the gray levels in the image being processed.

3-Compression of dynamic range:

An effective way to compress the dynamic range of pixel values is to perform the following intensity transformation function: $s = c \log(1+|r|)$ where c is a scaling constant, and the logarithm function performs the desired compression.

4-Gray-level slicing:

Highlighting a specific range of gray levels in an image often is desired. Applications include enhancing features such as masses of water in satellite imagery and enhancing flaws in x-ray images.

Brightness $$J = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N} f(i,j)$$

Contrast $$C = \sqrt{\frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}[f(i,j)-J]^2}$$

M, N – image dimensions
f(*i,j*) – gray level value at (*i,j*)

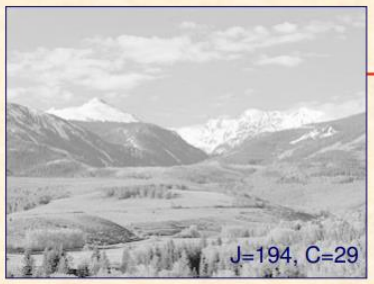


Image histogram

Image **brightness** and **contrast** influence image subjective quality perception

Histogram processing:

*The histogram of a digital image with gray levels in the range [0,L-1] is a discrete function $p(r_k)=n_k/n$, where r_k is the kth gray level, n_k is the number of pixels in the image with that gray level, n is the total number of pixels in the image, and k=0,1..L-1.

* $P(r_k)$ gives an estimate of the probability of occurrence of gray level r_k.

*The shape of the histogram of an image gives us useful information about the possibility for contrast enhancement.

* A histogram of a narrow shape indicates little dynamic range and thus corresponds to an image having low contrast.