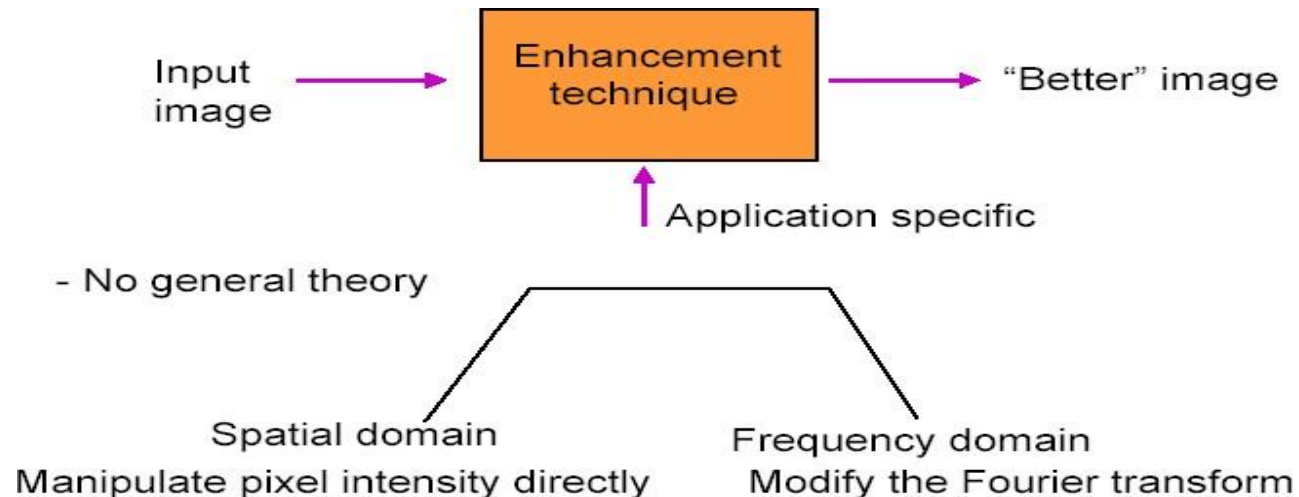


Image Processing and Computer Vision



Image Enhancement

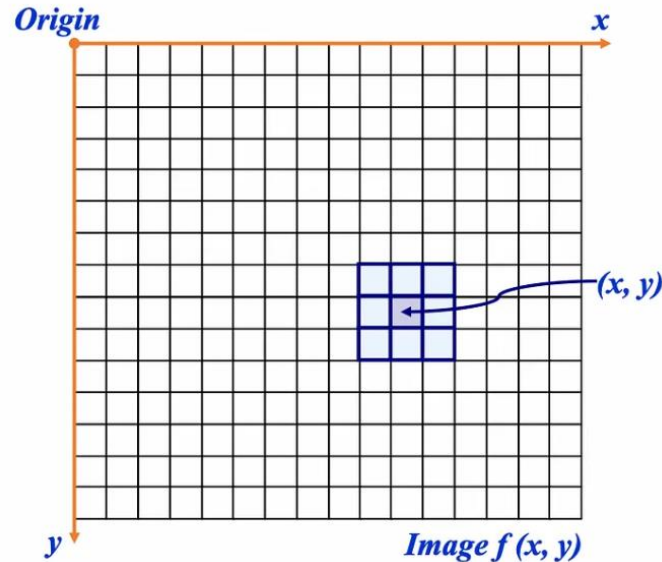
- Image enhancement techniques are designed to improve the quality of an image as perceived by a human being.
- **Image enhancement** is the process of making images more useful (such as making images more visually appealing, bringing out specific features, removing noise from images and highlighting interesting details in images).



Spatial and Frequency Domains

- **Spatial domain techniques** manipulates the pixels of an image directly. This process happens in the image's coordinate system, also known as the spatial domain.
- **Frequency domain techniques** transforms an image from the spatial domain to the frequency domain. In this process, Mathematical transformations (such as the Fourier transform) are used. The image can be modified by manipulating its frequency components.

Basic Spatial Domain Image Enhancement



Most spatial domain enhancement operations can be reduced to the form

$$g(x, y) = T[f(x, y)]$$

where $f(x, y)$ is the input image,

$g(x, y)$ is the processed image and

T is some operator defined over some neighbourhood of (x, y) .

Spatial Domain Image Enhancement Techniques

- Gray Level Transformation
- Histogram Equalization
- Spatial Filtering
- Edge Detection

Gray Level Transformation

- **Gray level transformation** allows the modification of pixel intensities by mapping input gray levels to various output levels, to achieve desired image enhancements. This mapping can easily be achieved through different mathematical functions.

Basic Gray Level Transformation Functions

- Here, T is a gray-level transformation function of the form:

$$s = T(r)$$

- Where, r and s - denote the gray level of $f(x, y)$ and $g(x, y)$ at any point (x, y) .

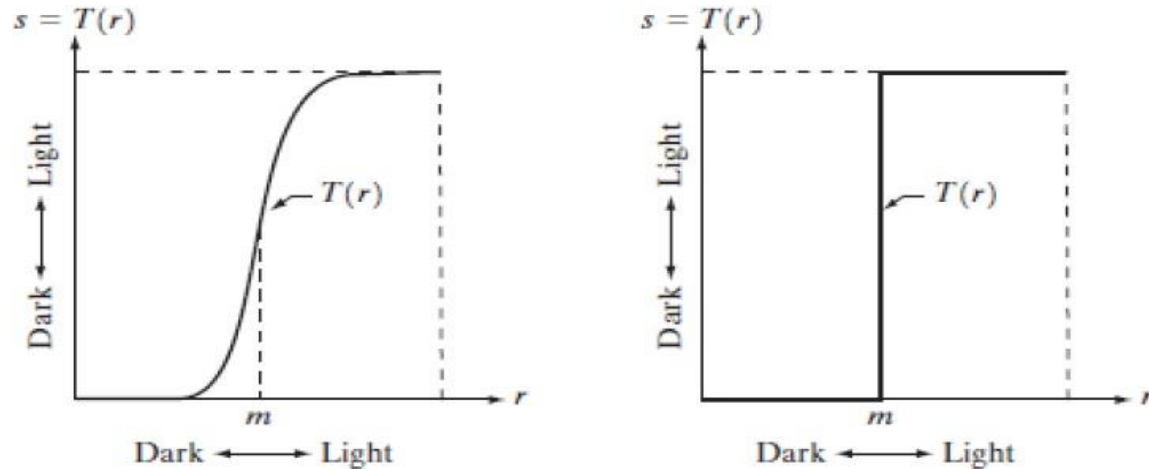


Figure a, b: Gray level transformation functions for contrast enhancement.

Image enhancement can be done through gray level transformations which are discussed below.

Types Of Gray-level Transformation

1. Linear (negative & Identity) transformation
2. Logarithmic (log & inverse) transformations
3. Power law(n^{th} & n^{th} root) transformations
4. Piecewise-Linear transformation functions

Linear transformation

1. Image Negative:-

- The negative of an image with gray levels in the range $[0, L-1]$ is obtained by using the negative transformation.

$$S = L - 1 - r$$

Where r = gray level value at pixel (x,y)

L is the largest gray level consists in the image

Linear transformation

- i. If $r=0, S = L - 1$
- ii. If $r=L - 1, S = 0$

