Spatial Operations

Single Pixel Operations

Alter the intensity of its pixels individually.

$$s = T(z)$$

↳ operation

Geometric Transformations

Modify spatial arrangement of images. Consists of following

1. Spatial transformation of coordinates ex//
2. Intensity interpolation that assigns intensity values to spatially transformed pixels.

Transformation coordinates can be expressed as:

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = T \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} t_{11} & t_{12} \\ t_{21} & t_{22} \end{bmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

↓ pixel coord. in transformed image

↓ these values determine the type of operation

↳ pixel coordinates in original image

ex// $(x', y') = (x/2, y/2)$ → shrinks the original image by half.

Affine Transformations

→ Scaling
→ Translation
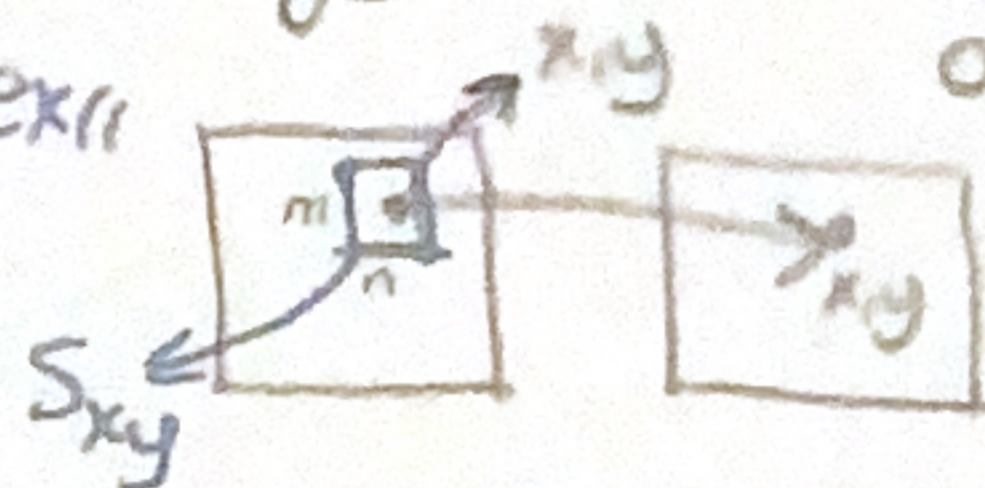→ Rotation } geometric ops
→ Sheer

Neighborhood Operations

S_{xy} → set of coordinates of a nbrd

ex// Compute the average value of the pixels in the input image with coordinates in the set S_{xy} → Burs

$$g(x,y) = \frac{1}{mn} \sum f(r,c)$$

↓ generated image

↓ row & col coordinate of pixels in S_{xy}

ex// Identity → $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Scaling → $\begin{bmatrix} c_x & 0 & 0 \\ 0 & c_y & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Rotation → $\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$