Image Transformations

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Image transformations are fundamental operations in image processing that alter the spatial arrangement or appearance of pixels within an image. This document illustrates several common transformations, including translation, rotation, scaling, and shearing, using basic techniques.

1 Transformations

Consider an example image (Fig. 1) that we will transform using different techniques:

Figure 1: Original Image

Translation

Translation shifts the image by a certain amount in both the horizontal and vertical directions. The translation operation is defined as:

$$T_x = x + \Delta x$$
$$T_y = y + \Delta y$$

where (x, y) are the original pixel coordinates, and $(\Delta x, \Delta y)$ are the translation amounts.

Rotation

Rotation rotates the image by a specified angle. The rotation transformation can be represented by a rotation matrix:

$$x' = x\cos\theta - y\sin\theta$$
$$y' = x\sin\theta + y\cos\theta$$

where (x, y) are the original pixel coordinates, (x', y') are the rotated coordinates, and θ is the rotation angle.

Shearing

Shearing distorts the image by shifting pixels in one direction relative to the other direction. The shearing transformation can be defined as:

$$x' = x + \alpha \cdot y$$
$$y' = y$$

where (x, y) are the original pixel coordinates, (x', y') are the sheared coordinates, and α is the shearing factor.

Scaling

Scaling resizes the image along the horizontal and vertical axes. Scaling can be represented by scaling factors s_x and s_y:

$$x' = s_x \cdot x$$
$$y' = s_y \cdot y$$

where (x, y) are the original pixel coordinates, and (x', y') are the scaled coordinates.

2 Results

Image transformations are essential techniques for altering the appearance of images to suit various needs. Whether it's for correcting perspective, adjusting size, or creating artistic effects, these transformations play a significant role in image processing.

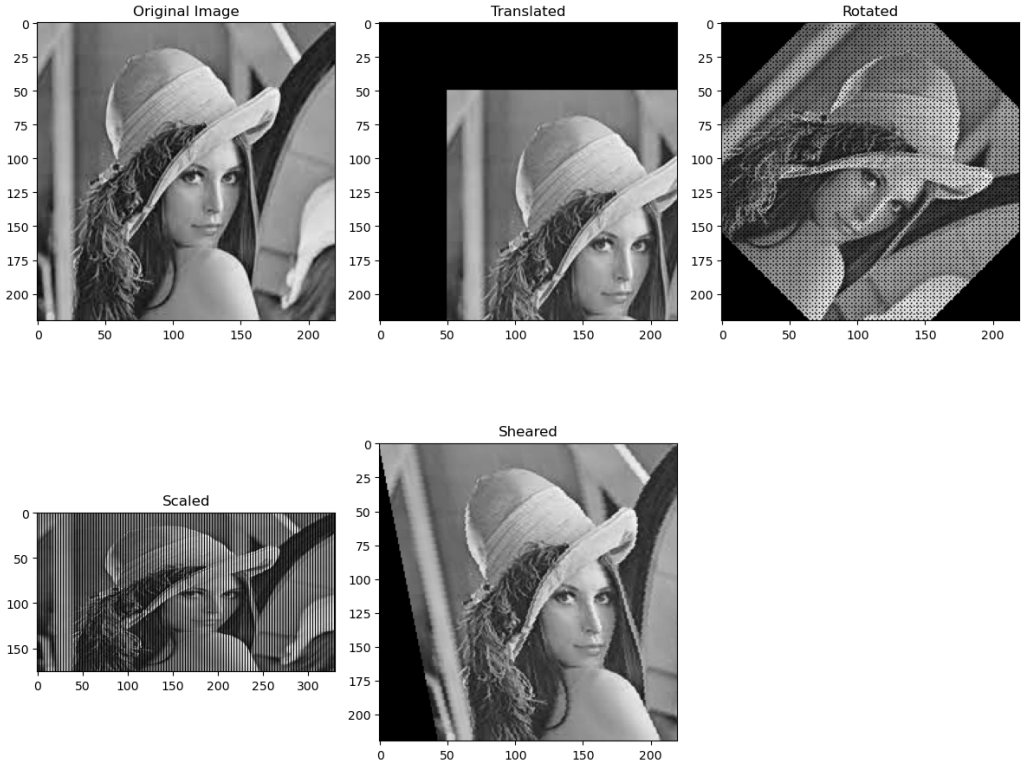

Figure 2: Image Transformations