

Question 3

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Choose two reference points where the pixel coordinates can be identified clearly in both MATLAB (u, v) and the corresponding graph coordinates (x_{graph} , y_{graph}).

Scaling Factors

The **scaling factor** for the x-axis and y-axis can be calculated as follows:

$$S_x = \frac{x2_{graph} - x1_{graph}}{u2 - u1} \quad (1)$$

$$S_y = \frac{y2_{graph} - y1_{graph}}{v2 - v1} \quad (2)$$

Translation Offsets

The **translation offsets** account for the difference in origins between the two coordinate systems. Translation offsets for x and y can be calculated as:

$$T_x = x1_{graph} - S_x \times u1 \quad (3)$$

$$T_y = y1_{graph} - S_y \times v1 \quad (4)$$

Transformation Equations

This equation applies the scaling factor and the translation offset to convert a MATLAB y-coordinate v to the graph's coordinate system y, and MATLAB x-coordinate u to the graph's coordinate system x. The transformation from (u, v) to the graph's coordinates (x, y)

$$x = S_x \times u + T_x \quad (5)$$

$$y = S_y \times v + T_y \quad (6)$$

Example

Suppose the reference points in MATLAB and graph coordinate systems are:

- $P1_{matlab} = (u1, v1) = (607, 198)$
- $P1_{graph} = (x1, y1) = (0, 550)$

- $P2_{\text{matlab}} = (u2, v2) = (475, 604)$
- $P2_{\text{graph}} = (x2, y2) = (-10, 580)$

$$S_x = \frac{-10 - 0}{475 - 607} = 0.0757575757576 \quad (7)$$

$$S_y = \frac{580 - 550}{604 - 198} = 0.0738916256158 \quad (8)$$

$$T_x = 0 - S_x \times 607 = -45.9848484849 \quad (9)$$

$$T_y = 550 - S_y \times 198 = 535.369458128 \quad (10)$$

$$x = S_x \times u + T_x = 0.0757575757576 \times u - 45.9848484849 \quad (11)$$

$$y = S_y \times v + T_y = 0.0738916256158 \times v + 535.369458128 \quad (12)$$

test points: $(u, v) = (544, 1303)$
output: $(x, y) = (-4.77272727277, 631.650246305)$