

Exercise 1

Yiwei Ye

Steps:

1. To find the coordinates of the origin of A seen from B:

- We constructed a rotation matrix R_{AB} using the 30-degree angle between frame A's x-axis and frame B's y-axis.
- The rotation matrix R_{AB} is:

$$R_{AB} = \begin{bmatrix} \cos(30 \text{ degrees}) & \sin(30 \text{ degrees}) \\ -\sin(30 \text{ degrees}) & \cos(30 \text{ degrees}) \end{bmatrix}$$

- Using the coordinates of point p in both frames, we found the translation vector t_{AB} so that when we rotate point p from A and add t_{AB} , we get its coordinates in B.
- The coordinates of the origin of A seen from B are the negative of t_{AB} , which are approximately (7.10, 1.46).

2. To find the coordinates of the origin of B seen from A:

- We used the inverse of the rotation matrix R_{AB} , which is its transpose R_{BA} , because rotation matrices are orthogonal.
- The origin of B seen from A is found by rotating the negative of t_{AB} by R_{BA} .
- The coordinates of the origin of B seen from A are approximately (5.42, 4.82).

3. To find the coordinates of a point p expressed in A if $B_q = (3, 1)$:

- We applied the inverse rotation matrix R_{BA} to the given coordinates of point q in frame B.
- We then added the origin of B as seen from A to this rotated vector to find the coordinates in frame A.
- The coordinates of point q expressed in A are approximately (7.51, 7.18).

In conclusion:

1. Coordinates of the origin of A seen from B:

The translation vector t_{AB} was calculated using the given point coordinates in both frames A and B, and considering the rotation due to a 30-degree angle.

The coordinates of the origin of A as seen from B were found to be approximately (7.10, 1.46).

2. Coordinates of the origin of B seen from A:

Using the inverse transformation (the transpose of the rotation matrix), we found the coordinates of the origin of B as seen from A to be approximately (5.42, 4.82).

3. Coordinates of point p expressed in A if $B_q = (3, 1)$:

For point q with known coordinates in frame B, we applied the inverse rotation and translation to find its coordinates in frame A, resulting in approximately (7.51, 7.18).