Exercise 2

Yiwei Ye

1. **Affine Expression from C to B**:

Let's begin with the first task: deriving the affine expression that allows us to relate a vector originally in *C* to *B*. We'll convert the quaternion to a rotation matrix, combine it with the translation vector *OBC*, and create the affine transformation matrix. Then we can proceed to express the vector from *C* to *B*, and subsequently from *C* to *A*, using the transformations

The affine transformation matrix that allows us to relate a vector originally in frame *C* to frame *B* is:

Affine Transformation Matrix from C to B:

[

[0.376, -0.926, -0.0025, -3],

[-0.785, -0.318, -0.531, 1],

[0.492, 0.202, -0.847, -2],

[0, 0, 0, 1]

]

This matrix combines a rotation matrix, calculated from the given quaternion, with a translation vector O_BC. With this affine matrix, vectors defined in frame C can be transformed to frame B.

2. **Affine Expression from *C* to *A***:

Affine Transformation Matrix from C to A:

[

[0.249, 0.868, -0.429, 3.562],

[-0.918, 0.070, -0.391, 3.347],

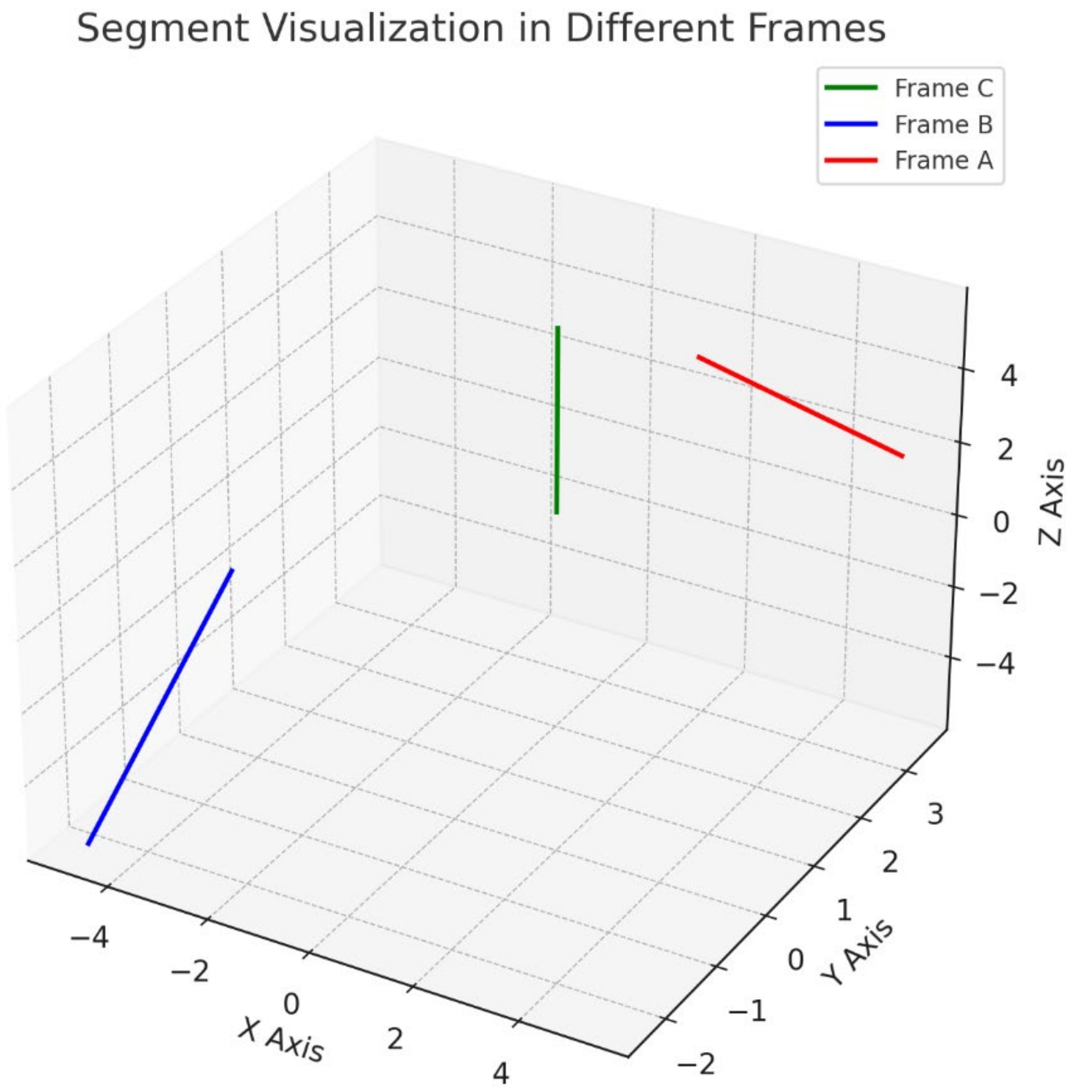
[-0.309, 0.491, 0.814, 0.859],

[0, 0, 0, 1]

]

This matrix is the result of composing the affine transformation from *C* to *B* with the affine transformation from *B* to *A*, incorporating both rotation and translation components. With this matrix, vectors defined in frame *C* can be transformed to frame *A*.

3. 3D plot of Vector Cv1 and Cv2:



The 3D plot above visualizes the segment formed by vectors *Cv*1 and *Cv*2 in different reference frames:

- In frame *C*, the segment is shown in green.
- The same segment as seen in frame *B* is depicted in blue.
- Lastly, the segment as viewed from frame *A* is represented in red.

This visualization helps illustrate how the segment's position and orientation appear different when transformed into the various reference frames according to the affine transformations we calculated earlier.