Universidad de Monterrey
School of Engineering and Technologies

Homework 04: Homogeneous transformations applied to two collaborative robotic arms

Course: Robotics

Lecturer: Dr Andrés Hernández Gutiérrez

Learning objectives

In this assignment, you will apply multiple homogeneous transformation to two collaborative robotic arms to compute the position of their corresponding end effectors with respect to different coordinate frames.

Problem statement

Figure 1 shows two robotic arms working together in a collaborative environment. In order to effectively perform their tasks, the end effector of each robot needs to know its position measured with respect to a similar coordinate frame.

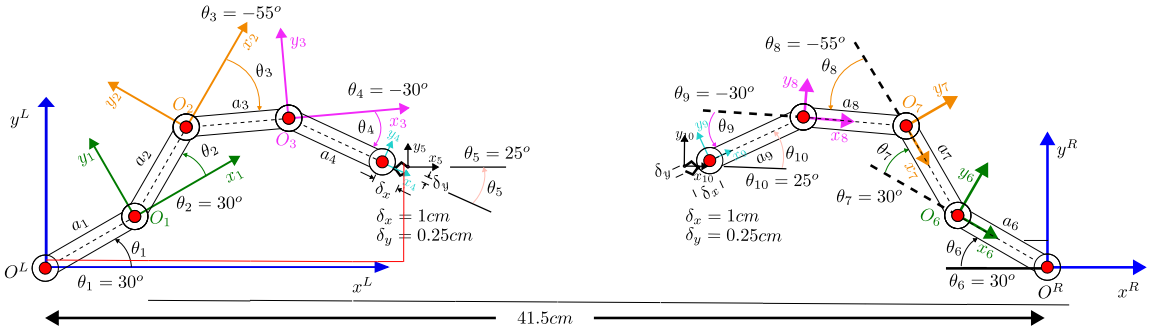

Figure 1: Robotic arms working on a collaborative environment.

Grading criteria and Submission guidelines

To complete this assignment, respond the following:

If $a_1 = a_2 = a_3 = a_4 = a_6 = a_7 = a_8 = a_9 = 4cm$:

1.
   - (12.5pts) Find T_5^L: This is the homogeneous transformation matrix that measures the position of the top tip of the left end effector with respect to the coordinate frame $x^L O^L y^L$.

```
[[ 1.00000000e+00 -1.48741681e-17  1.40860739e+01]
 [-2.97483363e-17  1.00000000e+00  3.92621022e+00]
 [ 0.00000000e+00  0.00000000e+00  1.00000000e+00]]
```

Figure 2: Transformation matrix T_5^L

   - (12.5pts) Using T_5^L, find the position of the top tip of the left end effector with respect to the coordinate frame $x^L O^L y^L$.

```
[[14.08607391]
 [ 3.92621022]
 [ 1.        ]]
```

Figure 3: Position of the top tip of the left end effector with respect to $x^L O^L y^L$

2.
   - (12.5pts) Find T_{10}^R: This is the homogeneous transformation matrix that measures the position of the top tip of the right end effector with respect to the coordinate frame $x^R O^R y^R$.

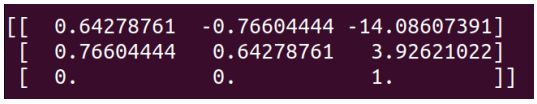

Figure 4: Transformation matrix T_{10}^{R}

- (12.5pts) Using T_{10}^{R}, find the position of the top tip of the right end effector with respect to the coordinate frame $x^{R}O^{R}y^{R}$.

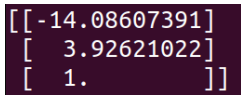

Figure 5: Position of the top tip of the right end effector with respect to $x^{R}O^{R}y^{R}$

3. - (12.5pts) Find T_{R}^{L}: This is the homogeneous transformation matrix that measures the position of the right coordinate frame $x^{R}O^{R}y^{R}$ with respect to $x^{L}O^{L}y^{L}$.

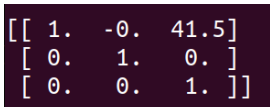

Figure 6: Transformation matrix T_{R}^{L}

- (12.5pts) Using T_{R}^{L}, find the position of the right coordinate frame $x^{R}O^{R}y^{R}$ with respect to $x^{L}O^{L}y^{L}$.

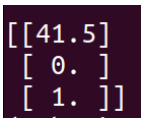

Figure 7: Position of $x^{R}O^{R}y^{R}$ with respect to $x^{L}O^{L}y^{L}$.

4. (20pts) Elaborate a technical report that clearly shows in detail the procedure needed to obtain each of the above homogeneous transformations as well as the requested positions.

5. (5pts) Add your personal conclusions to your technical report.

When finished, submit your document to Blackboard as a single PDF file.

Happy learning! - Andrés
"Knowing is not enough; we must apply. Willing is not enough; we must do" - J. W. von Goethe