

# **Project 1 Report**

## **PRR Robot Simulation**

**Team '); DROP DATABASE \*;--**

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## T-Matrices & Forward Kinematics

Since the robot simulation was stated to be a PRR robot, we knew that only the last two links would be moving at an angle, and the first link would be a translation. From this we could see that the first link would have one variable for the translation. The second link, or link 1, would look like the Identity matrix with the exception of the length of the first segment which was defined to be 150. Solving for link 2 would be slightly more difficult as we needed to account for the angle of rotation. We used the rotation matrix for the Z axis as it would provide the rotation in only the XY plane since the robot will only be working in a 2-D space. The matrix for link 2 also needed to account for the length of the second segment, defined to be 100. The last link would be solved for using the same method as for link 2, where we used the rotation matrix for the Z axis. Again, we also had to account for the length of the last segment, defined to be 75.

There are 4 T matrices.

The T-matrix for Link 0 is as follows.  $x$  is the displacement. This starts us off in vertical position.

|   |    |   |     |
|---|----|---|-----|
| 0 | -1 | 0 | 0   |
| 1 | 0  | 0 | 0   |
| 0 | 0  | 1 | $x$ |
| 0 | 0  | 0 | 1   |

The T-matrix for link 1 is as follows, since the joint-base doesn't rotate.

|   |   |   |     |
|---|---|---|-----|
| 1 | 0 | 0 | 150 |
| 0 | 1 | 0 | 0   |
| 0 | 0 | 1 | 0   |
| 0 | 0 | 0 | 1   |

The T-matrix for link 2 is as follows.  $\theta_1$  is the angle.

|                  |                   |   |     |
|------------------|-------------------|---|-----|
| $\cos(\theta_1)$ | $-\sin(\theta_1)$ | 0 | 100 |
| $\sin(\theta_1)$ | $\cos(\theta_1)$  | 0 | 0   |
| 0                | 0                 | 1 | 0   |
| 0                | 0                 | 0 | 1   |

The T-matrix for link 3 is as follows.  $\theta_2$  is the angle.

|                  |                   |   |    |
|------------------|-------------------|---|----|
| $\cos(\theta_2)$ | $-\sin(\theta_2)$ | 0 | 75 |
| $\sin(\theta_2)$ | $\cos(\theta_2)$  | 0 | 0  |
| 0                | 0                 | 1 | 0  |
| 0                | 0                 | 0 | 1  |

## **Typos**

The typos were found as follows:

If you label the Euler angles 1-12, the corresponding fixed angle matrices are ordered 6, 4, 5, 2, 3, 1, 7-12. The inconsistency lies in matrix number 6 in terms  $a_{22}$  and  $a_{23}$ . The first argument in the addition are negative in the Euler angle sets and positive in the fixed angle sets. The error is in the fixed angle formula and they should be negative, not vice-versa.