

Homework 1

CSCI 3302 :: Introduction to Robotics

1. What are the mechanical degrees of freedom options for buying a Kinova Gen3 Robotic arm? What advantage does one option have over the other? Which do you think is more expensive?

Flyer: https://www.kinovarobotics.com/sites/default/files/OP-Gen3-Generic_V1_0.pdf

2. What are the independent environmental degrees of freedom for orientable robots on the X-Y plane?

3. (a) Calculate the angle between vectors $(0.966, 0.2588, 0)^T$ and $(-0.2588, 0.966, 0)^T$.

(b) Provide a third vector that forms a unit-length coordinate system with the other two.

4. (a) Write out the entries of a rotation matrix ${}^A_B R$ assuming basis vectors X_A, Y_A, Z_A , and X_B, Y_B, Z_B .

(b) Express ${}^B X = [0, 1, 0]^T$ in frame {A}.

(c) Write out the entries of rotation matrix ${}^B_A R$.

5. Consider a tricycle with two independent standard wheels in the rear and a steerable, actuated front-wheel. Assume r to be the radius of the front wheel and l to be the distance between the front and rear axle. Chose a suitable coordinate system, use ϕ as the steering wheel angle, and $\dot{\omega}$ as angular velocity (only the front-wheel is driven). Provide the forward kinematics equations for the tricycle.



6. A robot using a local coordinate frame B detects an object Q at position $(8, -4)$. In coordinate frame A , the robot shows odometry readings of $(6, 2, 2.26893)$. Using a homogenous transform, find the position of Q in coordinate frame A .

