Homework 4

Hide Assignment Information

Instructions

5.4, 5.8, 5.11, 5.13, 5.16, 5.20

5.4 [8] Prove that singularities in the force domain exist at the same configurations as singularities in the position domain.

5.8 [18] General mechanisms sometimes have certain configurations, called "isotropic points," where the columns of the Jacobian become orthogonal and of equal magnitude [7]. For the two-link manipulator of Example 5.3, find out if any isotropic points exist. *Hint:* Is there a requirement on l_1 and l_2?

5.11 [14] Given

$$ {}^{A}_{B}T = \begin{bmatrix} 0.866 & -0.500 & 0.000 & 10.0 \\ 0.500 & 0.866 & 0.000 & 0.0 \\ 0.000 & 0.000 & 1.000 & 5.0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, $$

if the velocity vector at the origin of $\{A\}$ is

$$ {}^{A}v = \begin{bmatrix} 0.0 \\ 2.0 \\ -3.0 \\ 1.414 \\ 1.414 \\ 0.0 \end{bmatrix}, $$

find the 6×1 velocity vector with reference point the origin of $\{B\}$.

5.13 [9] A certain two-link manipulator has the following Jacobian:

$$^0J(\Theta) = \begin{bmatrix} -l_1 s_1 - l_2 s_{12} & -l_2 s_{12} \\ l_1 c_1 + l_2 c_{12} & l_2 c_{12} \end{bmatrix}.$$

Ignoring gravity, what are the joint torques required in order that the manipulator will apply a static force vector $^0F = 10\hat{X}_0$?

5.16 [20] A $3R$ manipulator has kinematics that correspond exactly to the set of Z–Y–Z Euler angles (i.e., the forward kinematics are given by (2.72) with $\alpha = \theta_1$, $\beta = \theta_2$, and $\gamma = \theta_3$). Give the Jacobian relating joint velocities to the angular velocity of the final link.

5.20 [20] Explain what might be meant by the statement: "An n-DOF manipulator at a singularity can be treated as a redundant manipulator in a space of dimensionality $n - 1$."

Due on Nov 20, 2023 11:59 PM

Submit Assignment

Files to submit *

(0) file(s) to submit

After uploading, you must click Submit to complete the submission.

Add a File Record Audio Record Video

Comments

Submit Cancel