Homework Assignment 3

Dynamics Of Non Linear Robotic Systems

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Task 1:

Derive FK equations for the robot depicted in figure 1. Use θ_1, θ_2, d_3 as joint space variables, p_x, p_y, p_z as operational space variables. Parameters d_1, a_2 are known (assign them some positive values for succeeding tasks).

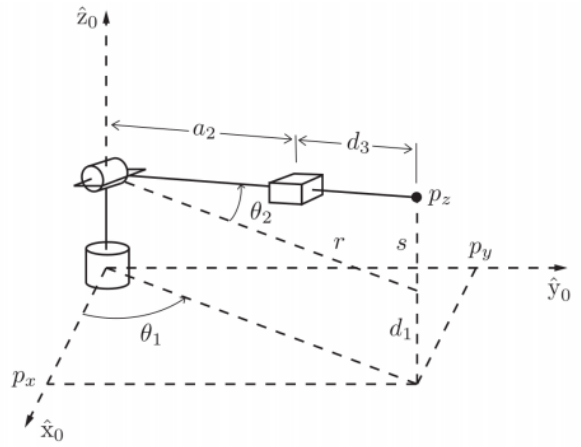

Figure 1: RRP robot.

Task 2

Derive IK equations.

Task 3:

Compute the manipulator Jacobian for representation of linear and angular velocity of point $\mathbf{p}$.

- Use classical approach (partial derivatives).
- Use geometric approach (cross products).

Task 4:

Analyze the Jacobian for singularities. Characterize each singular configuration if any.

Task 5:

Compute the velocity of the tool frame when joint variables are changing with time as follows:
$\theta_1(t) = sin(t)$, $\theta_2(t) = cos(2t)$, $d_3(t) = sin(3t)$.

Add some fancy graphs showing evolution of all variables

Task 6:

Let tool coordinates changing with time as follows:
$p_x(t) = 2a_2 sin(t)$, $p_y(t) = 2a_2 cos(2t)$, $p_z(t) = d_1 sin(3t)$

Determine a feasible joint trajectory for this tool trajectory.

- Use IK solution.
- Use inverse differential kinematics approach. Consider only linear velocity part of Jacobian.