Robotics
Problem Sheet 5

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Notes

The homework serves as preparation for the exams. It is strongly recommended that you solve them before the given deadline - but you do not need to hand them in. Feel free to work on the problems as a group - this is even recommended.

1 Problem

Given the planar (2D) robot arm from figure 1 with 3 DoF:

- a rotational joint in the origin of the world frame with DoF α_1,
- followed by a fixed link of length $l_1 = 10$ with rotational joint at its end with DoF α_2,
- and a prismatic joint linked to it with the DoF l_2 with $l_2 \in [5, 10]$, which is co-aligned with l_1 for $\alpha_2 = 0^o$ (see figure 1, right).

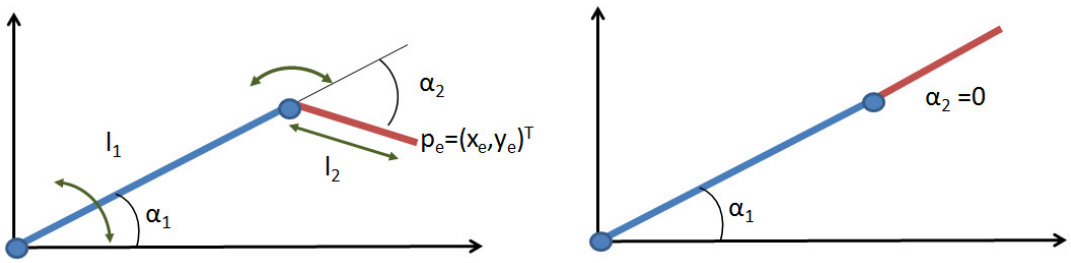

Figure 1: A planar robot arm with 3 DoF. The alignment of the prismatic joint l_2 for $\alpha_2 = 0^o$ is shown on the right.

Provide the forward kinematics for the position $p_e = (x_e, y_e)$ of the end-effector of this robot.

2 Problem

Take the robot's forward kinematics from the previous problem.

- Find the related Jacobian matrix J.
- Which options do you know to compute the pseudo-inverse J^+ of J, and when are they applicable?
- Given the goal position $p_e(n_g) = (5, 10)$ and the starting DoF values $\alpha_1(0) = 90^o, \alpha_2(0) = 0^o, l_2(0) = 8$, formulate the numerical IK with a) Newton's method, respectively b) Gradient descent.
- How can we formulate the IK problem if the full pose $p'_e = (x_e, y_e, \theta_e)$ is to be found?