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

Take the planar arm from **PS03, Problem 1** with a rotational joint and a prismatic joint linked to it with the DoF α and l (Fig.1).

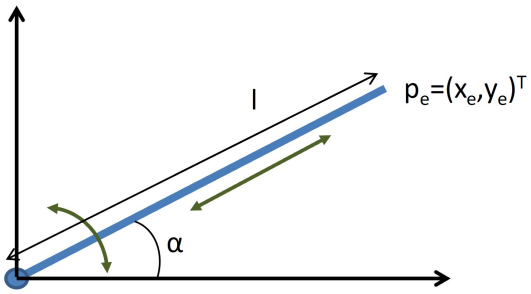

Figure 1: A planar robot arm with a rotational and a prismatic joint.

Use its forward kinematics to find

- the proper Jacobian matrix, respectively
- the numerical approximation of the Jacobian at point (1,2) with $\delta = 0.1$

as basis for inverse kinematics.

2 Problem

Take the planar arm from **PS03, Problem 2** with its three DoF α_1, α_2 and l_2 (Fig.2).

Use its FK to derive the related Jacobian matrix J.

3 Problem

Take the Jacobian J from the previous problem 2. Which options do you know to compute the pseudo-inverse J^+ of J, and when are they applicable?

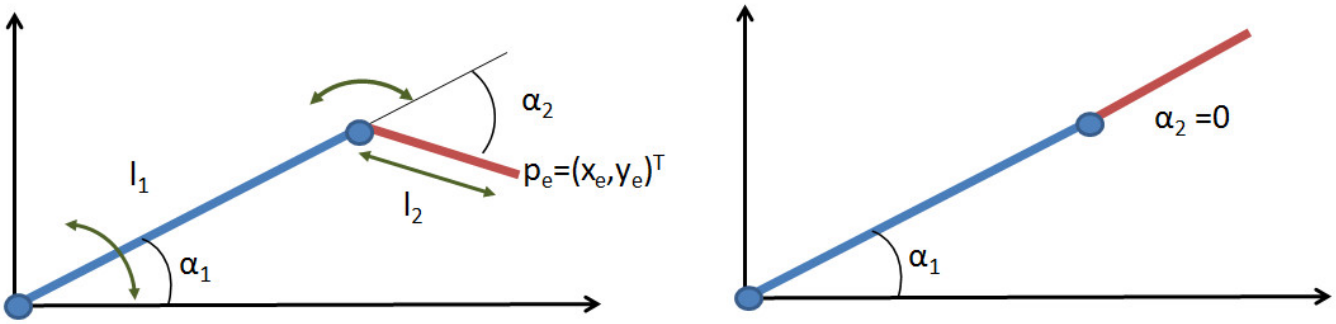

Figure 2: A planar robot arm with 3 DoF. The alignment of the prismatic joint l_2 for $\alpha_2 = 0^o$ is shown on the right.

4 Problem

Take the arm, its FK, and the related pseudo-inverse of the Jacobian J^+ from the previous problems 2 and 3. Given the target position $p_t = (5, 10)^T$ 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.