Mechanics of Mechanisms and Machines (cod. 80514)

December 3, 2024

Name and Surname: Matriculation number:

Exercise 1 (4pt)
Given two points $A, B \in \mathbb{R}^3$. Find the associated twist coordinates and compute its pitch and $\mathbf{r}$ vector identifying the twist location with respect to the origin O of the reference frame. $OA = (0, 2, 2)$ m, $OA = (0, 4, 4)$ m.

Exercise 2 (8pt)
Given two revolute joints, one along x-axis (passing trought the origin of the reference frame) and one parallel to the y-axis intersecting the z-axis at distance $d_z = 10$ cm from the origin, find:

1. dimension of the twist and wrench space $\mathcal{T}, \mathcal{W}$;
2. explicit set of generators of the wrench space $\mathcal{W}$;
3. draw the serial chain with mechanical joints as described;
4. assume now that $d_z = 0$ cm and add a prismatic joint along x-axis. How do points (1) and (2) above change?

Exercise 3 (10pt)
Given the following manipulator (see Figure 1) find its Direct Kinematic (DK) using the Product-of-Exponential (PoE) formula explicitly (show the matrices you get after the exponentiation of the twists).

Exercise 4 (10pt)
Explain the role of the exponential matrix. Feel free to help yourself with schematic representation (use maximum one face of an A4-paper).

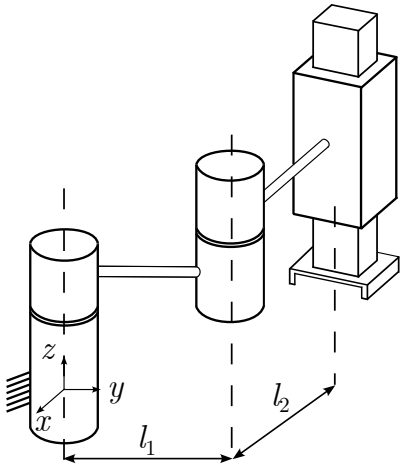

Figure 1: schematic representation of the manipulator.

Total scoring: /32pt **Total time 110 minutes.**
*Being neat is a strong requirement for the evaluation (especially for Exercise 4).