Mechanics of Mechanisms and Machines (cod. 80514)

December 20, 2024

Name and Surname: Matriculation number:

Exercise 1
Find the location of the axis and the pitch of the following twist $\xi = (1, 0, 0, \frac{\sqrt{3}}{2}, 0, -\frac{9}{2})$ m.

Exercise 2
Find the screw that intersect the y-axis at a point P generated by the 2-system shown in Figure 1.

Exercise 3
Given two helicoidal joints both of pitch h, one along x-axis and one along z-axis (both passing trought the origin of the reference frame) 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 the two pitches are different. How do points (1) and (2) above change?

Exercise 4
Given the following manipulator (see Figure 2).

1. find its Direct Kinematic (DK) using the Product-of-Exponential formula by referring to the global reference S. Show the matrices you get after the exponentiation of the twists;
2. check the results found at point 1 using local frames and the Adjoint map.

Exercise 5
Summarise the relationship between $SE(3)$ and $se(3)$. Then, describe the effect of the Adjoint map on the twists space. Feel free to help yourself with schematic representation (use maximum one face of an A4-paper).

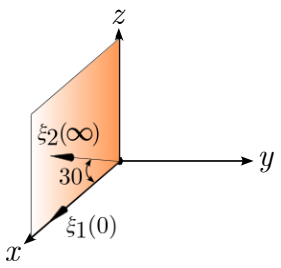

Figure 1

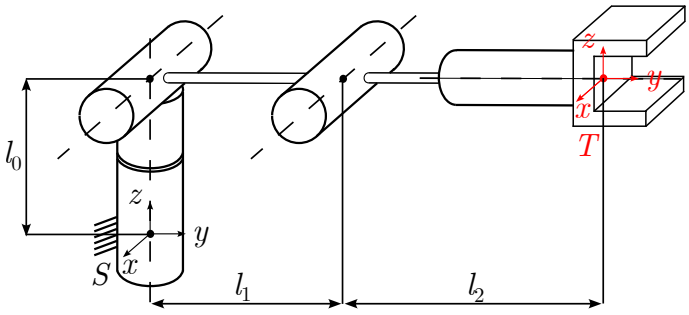

Figure 2

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