Digital twins for automation and collaborative robots
A.Y. 2022/23
Assignment #09

Prepare the solution to the assignment as a script named as `labXX_NameSurname_ddmmyy.m`. Use the format suggested in Assignment #01. Keep in the same folder the function files that you will develop in this assignment. If necessary, you can reuse some functions from previous assigments.

1. Write the function `J_scara(q)` that evaluates the geometric Jacobian for the Adept 600 Cobra/eCobra robot (see assignment #7) as a 4×4 matrix. The function takes as input a vector $\mathbf{q}$ that includes the four joint positions as a single vector. Suggestion: use the homogeneous transformation matrices ${}^0_1\mathbf{T}$, ${}^0_2\mathbf{T}$, ${}^0_3\mathbf{T}$, ${}^0_4\mathbf{T}$ to evaluate the vectors $\hat{\mathbf{z}}_i$, $\mathbf{P}_i$, $\mathbf{P}$. You can use Matlab's function `cross(a,b)` to compute the cross product between vectors `a` and `b`.

2. Write, in the main script, the code needed to test the function `J_scara(q)`, by evaluating the end-effector speed $\dot{\mathbf{x}}$ (as a 4×1 vector) for:

$$\mathbf{q} = \begin{bmatrix} .1 \\ .2 \\ .15 \\ .3 \end{bmatrix}; \qquad \dot{\mathbf{q}} = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix};$$

3. **Optional:** Display graphically the Cartesian components of the speed of the end-effector as a vector (or a line) whose base is located on the end-effector of the robot (i.e. on point $\mathbf{P}$).