**Introduction to Robotics - project for the final evaluation**

Corso di Laurea Magistrale in Ingegneria Informatica

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Assuming the Kuka LWR characterized by the Denavit-Hartenberg table given below and $d_0 = 0.3105\,\mathrm{m}$

| Link | $a_i$ [m] | $\alpha_i$ [rad] | $d_i$ [m] | $\theta_i$ [rad] |
|---|---|---|---|---|
| 1 | 0 | $\pi/2$ | 0.3105 | $\theta_1$ |
| 2 | 0 | $-\pi/2$ | 0 | $\theta_2$ |
| 3 | 0 | $\pi/2$ | 0.400 | $\theta_3$ |
| 4 | 0 | $-\pi/2$ | 0 | $\theta_4$ |
| 5 | 0 | $\pi/2$ | 0.4 | $\theta_5$ |
| 6 | 0 | $-\pi/2$ | 0 | $\theta_6$ |
| 7 | 0 | 0 | 0.078 | $\theta_7$ |

The candidate is required to design an Inverse Kinematic controller to move the end-effector from the position $\boldsymbol{p}_A = \begin{bmatrix} -0.55 & -0.32 & 0.31 \end{bmatrix}^{\mathrm{T}}$ to the position $\boldsymbol{p}_B = \begin{bmatrix} -0.55 & 0.32 & 0.25 \end{bmatrix}^{\mathrm{T}}$. The movement should be repeated 3 times by control:

- the position-only without exploiting the redundancy
- the position and the orientation without exploiting the redundancy (desired orientation equal to the initial one)
- the position and the orientation avoiding an obstacle put in $\boldsymbol{p}_O = \begin{bmatrix} -0.55 & 0 & 0.2 \end{bmatrix}^{\mathrm{T}}$ (desired orientation equal to the initial one)

The candidate should:

- set the sampling time to $T = 1\,\mathrm{ms}$ and an appropriate final time
- use the quaternions to feedback the orientation
- implement a trapezoidal velocity profile for the e.e. velocity
- connect MATLAB to V-REP to visualize the animation
- at the end of the simulation plot all the variables (joint positions and velocities, e.e.-related quantities, metrics with and without the optimization) with proper unit measures

In the presentation of the results it is required to

- consider a presentation time of $\approx 20\,\mathrm{minutes} + 10\,\mathrm{minutes}$ of questions
- use the preferred presentation medium (LaTeX, power point, open office, ...)
- bring the code to eventually discuss implementation details