Introduction to Robotics - project for the final evaluation
Corso di Laurea Magistrale in Ingegneria Informatica
Medical Image Analysis and Applications (MAIA), academic year 2017/2018
professor: Gianluca Antonelli

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

Link	a_i [m]	α_i [rad]	d_i [m]	θ_i [rad]
1	0	$\pi/2$	0.3105	θ_1
2	0	$-\pi/2$	0	θ_2
3	0	$\pi/2$	0.400	θ_3
4	0	$-\pi/2$	0	θ_4
5	0	$\pi/2$	0.4	θ_5
6	0	$-\pi/2$	0	θ_6
7	0	0	0.078	θ_7

The candidate is required to design an Inverse Kinematic controller to emulate a screwing movement:

- the initial e.e. position is $\boldsymbol{p}_A = \begin{bmatrix} 0.65 & 0 & 0.4 \end{bmatrix}^{\text{T}}$
- the initial orientation is such that the e.e. approach vector is aligned with $\hat{\boldsymbol{x}} = \begin{bmatrix} 1 & -1 & 0 \end{bmatrix}^{\text{T}}$
- the e.e. is required to advance 5 cm in the direction of $\hat{\boldsymbol{x}}$ while rotating 4π rad

The candidate should:

- set the sampling time to $T = 1\,\text{ms}$ and an appropriate final time
- use the axis angle to define the desired orientation and the quaternions to feedback i
- assign a trapezoidal velocity profile to the e.e angular 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 $\approx 20\,\text{minutes} + 10\,\text{minutes}$ of questions
- use the preferred presentation medium (LaTeX, power point, open office, ...)
- bring the code to eventually discuss implementation details