ROBT 501 Robot Manipulation and Mobility Project 2023

Direct and Inverse Kinematics for a serial manipulator using Screw Theory

(Presentation due on Monday or Wednesday 20th and 22nd of November 16:30-17:30, Report due on Sunday 26th of November 22:00)

Requirements:

- You can work on the project in groups of up to a maximum of three students (minimum 2 students per group, **no exceptions**).
- Please select a date for your presentation (via an Excel file in Moodle). There are only five time slots available per day.

Goals: The aim of this project is to formalize a closed-form solution for both the Direct and Inverse Kinematics (IK) of the KUKA LBR 4+ robot, which is available in CoppeliaSim. This will be accomplished using the Successive Screw Displacements Method.

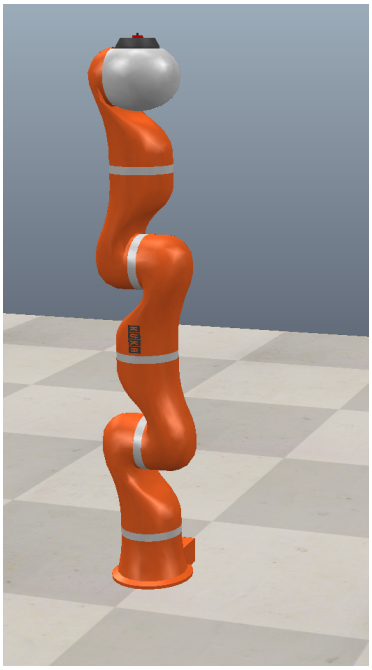


Figure 2: Home Position of the Robot KUKA LBR+.

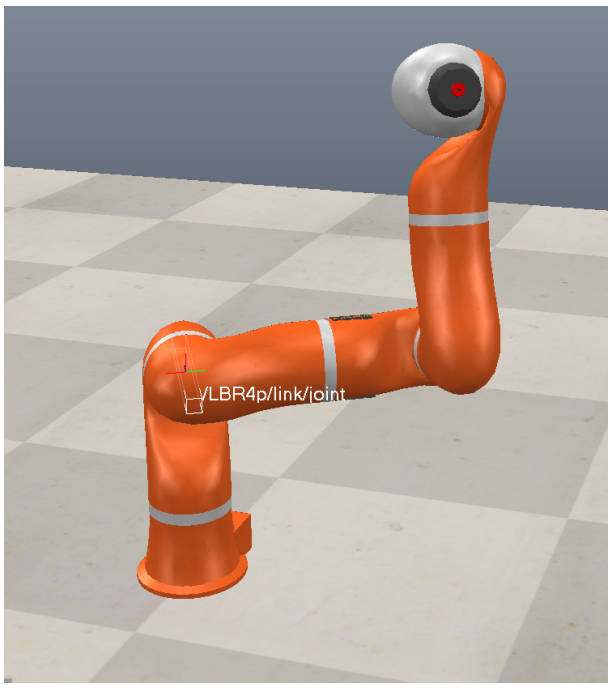
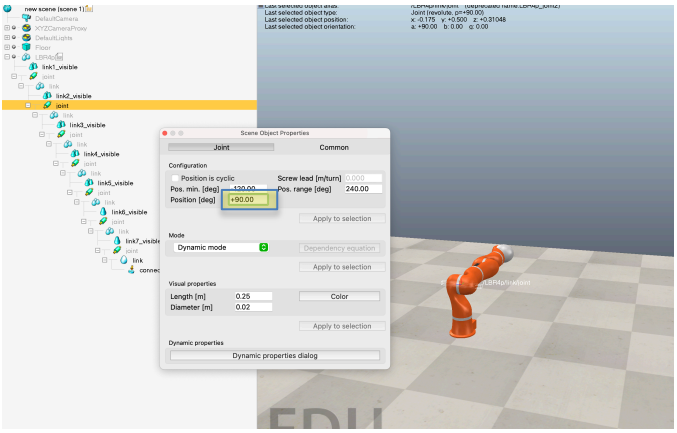


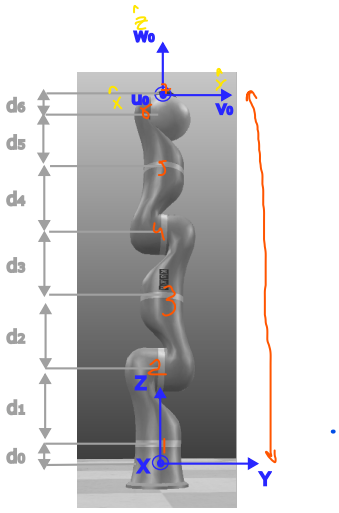
Figure 1: Example of displacement, Theta2=+90 deg, Theta4=-90 deg.

Project Main STEPS:

1) Install the Edu version of CoppeliaSim on your PC: https://www.coppeliarobotics.com/
2) Familiarize yourself with the motion capability of this robot using the CoppeliaSim simulation environment, e.g., moving the robot joint by joint.



3) Using the Screw Displacement Method and using the parameters (link lengths) and the frames **as indicated and named** in the following scheme, formalize the Forward Kinematics (FK) according to the notation adopted during the lectures.



4) Solve the IK using one of the methods covered in this course. You may want to refer to the book "Robot Analysis" and independently study the topic before it is fully reviewed during the lectures.

5) Test the solutions for FK and IK using the model available in CoppeliaSim. You may also systematically test the solutions using a combination of Python or Matlab and the CoppeliaSim environment, where you can connect to the model using the provided API.

6) Prepare a presentation with formulas, images, and videos that clearly explain your results (each presentation should last for 15 minutes).

7) After each presentation, the audience may ask you questions.

8) Prepare a comprehensive final report using LaTeX or Word to document all the steps, including annotated models and the results obtained, which should encompass plots, images, and videos (separate files).