MESISI474624: Cobotics
Project work
Part-I

S.Venkateswaran
Assistant Professor: Mechatronics, ESILV/DVRC
swaminath.venkateswaran@devinci.fr

Information & Dates

1. The project will be an individual submission (no team work)
2. The deadline for the project is on 10/01/2025 (before 23h59) and you can find the submission link in DVL
3. Submissions received by email/Teams will not be considered and will be noted ZERO
4. A proper report alongside the MATLAB codes is expected.
5. The project is split in two parts however the final report/codes must combine both parts
6. Final submission can be a single zip file that can contain the PDF and the MATLAB codes
7. A discussion will be done during the last two TD sessions

Simplified version of the Stanford robot arm: The RRR configuration

The robot we studied during the evaluation was one of the simplified versions of the Stanford robotics arm. The Stanford robotic arm was designed and developed for understanding robot kinematics especially for educational purpose (`http://infolab.stanford.edu/pub/voy/museum/pictures/display/1-Robot.htm`). The base configuration of the Stanford arm can have one of the following configurations: RRR, RRP or RPR. By coupling a spherical wrist to one of these configurations, we can obtain a 6-DOF robot. You will be working on the RRR configuration for this project work. Part-I of the project work focuses on understanding a similar configuration of this RRR whose dimensions are provided in Figure 1. You have the MATLAB file **RRR3D.m**, which is a function at your disposition. Answer the following questions in your future report:

1. Explain the Direct & Inverse kinematics of this robot.
2. We know that the robot has three revolute joints, the limits are given as follows:
   - $\theta_1 \rightarrow [0, 2\pi]$
   - $\theta_2 \rightarrow [0, \pi]$
   - $\theta_3 \rightarrow [0, \pi]$

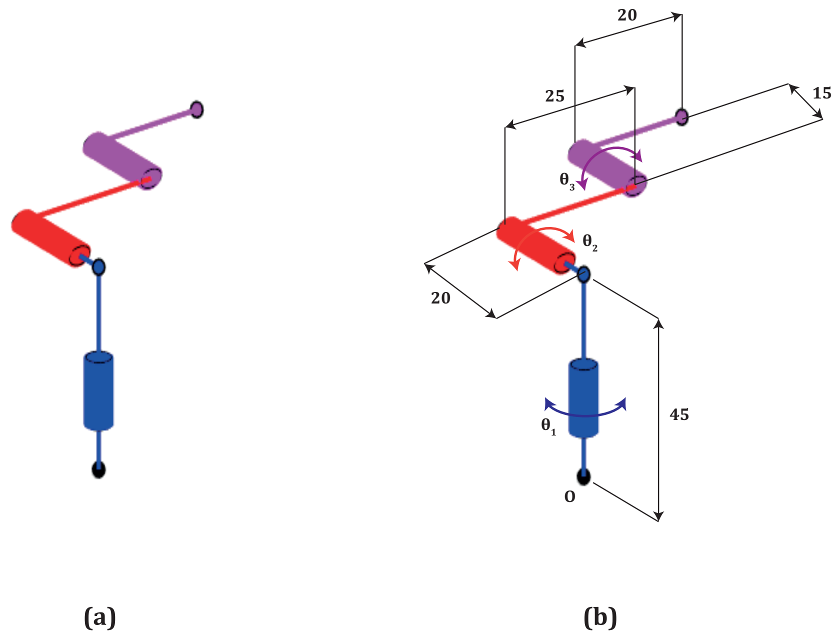

Figure 1: (a) Overview of the RRR robot, (b) Link dimensions

Generate and understand a first configuration of the robot within these limits using the function **RRR3D.m**. It is advisable to work on elbow-down configuration for the second and third revolute joints.

3. After generating the plot, try to fix the reference frames and local frames for the robot. Using these frames construct the Denavit-Hartenberg table.

4. For the input positions of question-3, generate the DH transformation matrix and validate the solutions to the Direct Kinematic Problem (DKP) with the plot. The function **DenaHart.m** must be used.

5. After validation of step-4, construct the Jacobian matrix for this robot. What will be the overall size of this matrix?

6. Consider that the robot is connected to a controller of frequency 3 Hz. Set a simulation time t_f of 15 seconds. Perform a joint-space simulation of your choice on this robot (Pay attention to the joint limits). Use the polynomial degree-5 equations that we employed in TD-3 to 6 to achieve this simulation.

7. Solve the inverse kinematic problem (IKP) for the robot

!! To be continued !!