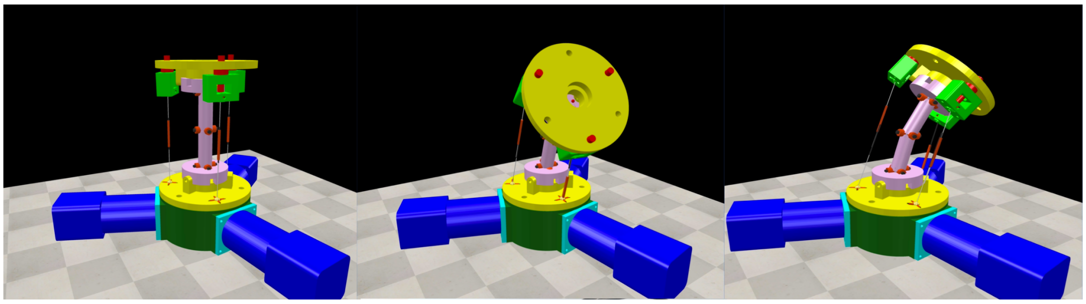
ROBT 501 Robot Manipulation and Mobility Project 2022

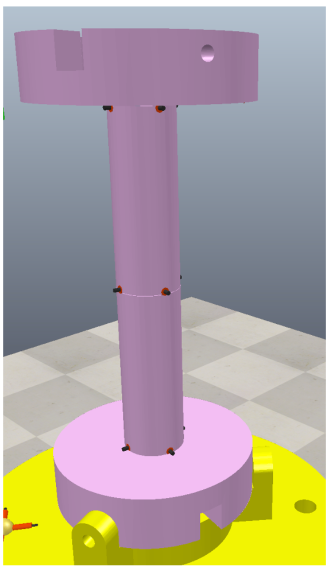
Direct and Inverse Kinematics for a serial/parallel manipulator using Screw Theory
(Presentation due on Monday or Wednesday 21st and 23rd of November 16:30-15:45, Report due on Sunday 27th of November 22:00)

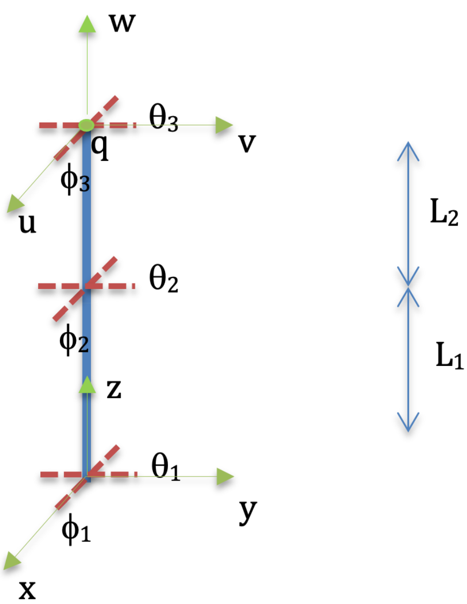
Requirements:
- You can do the project alone or in couple (MAX 2 students, NO exception)
- Finalize a report in Latex or Word where all the steps are reported together with the commented models and obtained results (plots, pictures, videos).
- Choose the date when you want to present (excel file in Moodle), only three time slots available per day.

Goals: The goal of this project is to formalize the direct and inverse kinematics of a manipulator using the successive screw displacements method and parallel manipulator theory.



The central leg of the robot consists of a sequence of three universal joints which axis are aligned.





The three tendons are displaced on a circle at 120 deg, and when the robot is in its home position (vertical), they are at a distance **d** from the center of the central leg while their initial length is l1+l2.

1) At first formalize the FK and IK only considering the central leg and using **Screw Theory**. Assume a simplified model for the robot where the links cannot collide, and give as target input for the IK a position (q_x,q_y,q_z) and a suitable orientation (notice that the robot can rotate only in the pitch-yaw axes).
2) Solve for the IK of the overall parallel manipulator, thus find the length of the three tendons that let to achieve a reachable pose (obtained in the step before from the FK of the central leg).
3) Simulate the robot using a ball-and-stick model in Python, Matlab, or Scilab. If you use Python or Matlab, to plot the links and frames you can use the function quiver3(.,.,.,.) that prints lines with different colors and thickness in a 3D space. If you are familiar with CoppeliaSim we can provide you with the model, however you need to prepare the code that allow to control it yourself (e.g., using Matlab or Python API)
4) Prepare a presentation with formulas, pictures and videos that explain clearly your results (each presentation is min **15 min and max 20 min**).
5) After each presentation the audience may ask you questions.