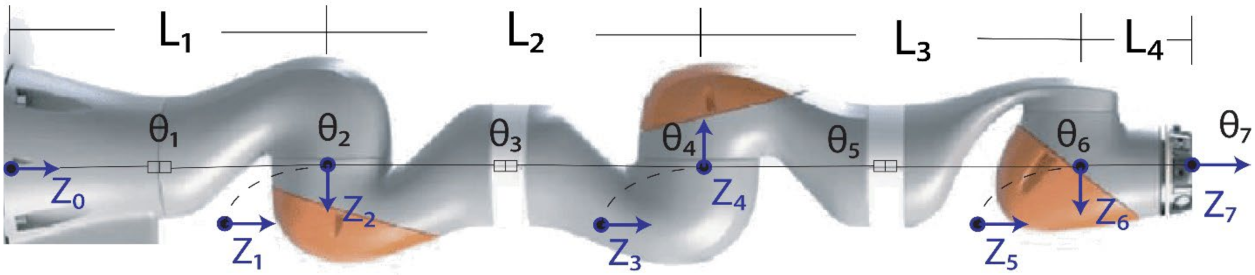
Medical Robotics Project Winter Semester 2022-2023



For the above given robot-axis configuration it holds:

L1 = 360mm, L2= 420mm, L3= 400mm, L4=126mm.

$\theta 1_{min}$= $\theta 3_{min}$= $\theta 5_{min}$= -$\theta 1_{max}$= -$\theta 3_{max}$= -$\theta 5_{max}$= 169 degrees.

$\theta 2_{min}$= $\theta 4_{min}$= $\theta 6_{min}$= -$\theta 2_{max}$= -$\theta 4_{max}$= -$\theta 6_{max}$= -119 degrees.

$\theta 7_{min}$= - $\theta 7_{max}$ = -174 degrees.

Axis X_0 points **inwards** to the screen. (A.k.a: origin of the axis is at origin of Z_0 and its direction is "away" from you).

Tasks:

1. Assign 3-axis coordinate systems for each joint and derive the corresponding Denavit-Hartenberg parameters. Use: https://www.youtube.com/watch?v=rA9tm0gTln8
2. Compute analytically the transformation matrices $A_{i-1}^{i},\ i = 1, \dots, 7$.
3. Compute analytically the transformation matrix A_0^7.
4. Solve the inverse kinematics problem $A_0^7 \rightarrow [\theta_1, \dots, \theta_7]$.
5. Compute in a computational manner the workspace of the robot. It is anticipated to provide a 3D-mapping of the points that the end-effector can reach.
6. Using (4) assume a straight line of your choice in 3D space and assume 5 points equally distributed on that line at Euclidean distance of more or equal to 1cm. Compute the joint angle space set for the robot's end-effector to reach the assumed 5 points.

   Note: All task solutions should be included in the report explaining the process followed. Matlab, Python or C++ code for validating the results must be included in a .zip folder alongside your report. Teams of no more than 2 persons are advised and allowed.