EE183 // LAB 1

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1. Introduction

In this lab, we model a chair with 4 joints with end effector being the headrest. A simplified model schematic of the robot is shown below,

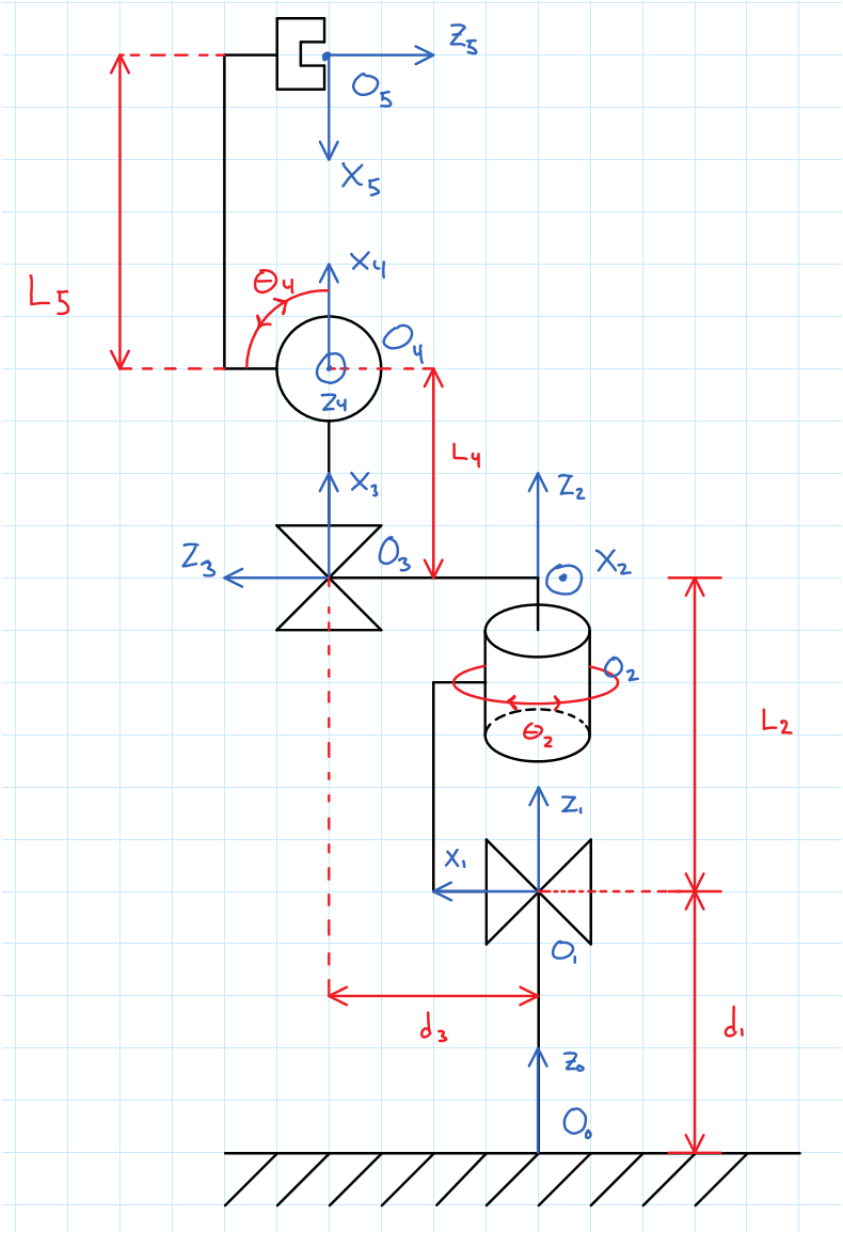

FIGURE 1. Schematic of the model

According the the schematic, from bottom to top, a prismatic joint is responsible for the height of the seat (along z_1). A revolute joint right above it rotate the chair about the z_2 so that person sitting on turn their body around their environment. Another prismatic joint moves along z_3 axis adjust how far back the backpanel is. Next, a revolute joint rotating about z_4 is responsible for adjusting the back angle the person want to sit at.

Lastly, we chose the end effector to be the headrest of the chair whose positional state changes if any of the above joint variable changes.

This linkage has 4 degree of freedom, namely translation along z and x, and rotational about z and y in the O_o world reference. The ultimate goal of this linkage is to position the headrest (in turn the back and orientation of the whole chair) in the most comfortable position for the human sitting on it.

A simple case scenario in words is describe below: A human sitting on this chair facing the $-x_0$ direction wants to sit facing forward, while wants to sit higher and lean his back a little bit to the back. Intuitively, if we are to do it, this would translate to the operation on the joint:

(1) joint 2 rotates about z_2 by 90 degrees
(2) joint 1 moves along z_1 by q_1 mm
(3) joint 4 rotates along z_4 by q_4 degrees.

2. Method

Based off the schematic in figure 1, we computed the Denavit–Hartenberg parameters, as shown in the following table,

i	α_{i-1}	a_{i-1}	d_i	θ_i
1	0	0	d_1	0
2	0	0	L_2	θ_2+90
3	90	0	d_3	90
4	90	L_4	0	θ_4
5	90	L_5	0	180

Table 1. D-H parameters

where $\vec{q} = \begin{bmatrix} d1 \\ \theta_2 \\ d_3 \\ \theta_4 \end{bmatrix}$ and $L2 = 450; L4 = 100; L5 = 600$