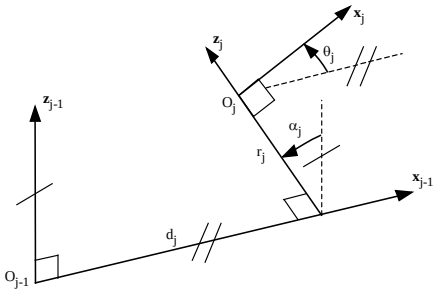
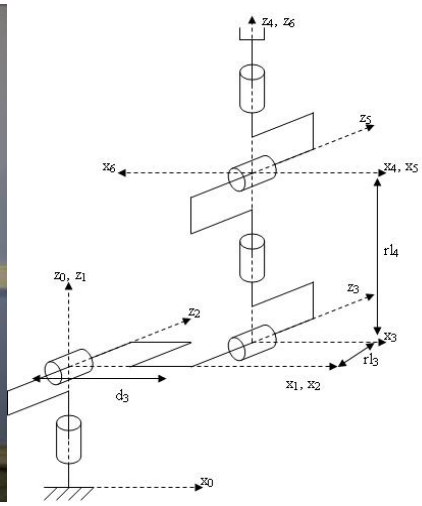
CASE STUDY: MODELLING OF THE TX40 ROBOT

The Stäubli TX-40 robot (Fig. 1) has a serial structure with six rotational joints. Its kinematics is defined using the modified Denavit and Hartenberg notation (MDH) (Khalil and Dombre 2002). In this notation, the link j fixed frame is defined such that the z_j axis is taken along joint j axis and the x_j axis is along the common normal between z_j and z_{j+1} (Fig. 1). The geometric parameters defining the robot frames are given in Table 1. The payload is denoted as the link 7. The parameter $\sigma_j = 0$, means that joint j is rotational, α_j and d_j parameterize the angle and distance between z_{j-1} and z_j along x_{j-1}, respectively, whereas θ_j and r_j parameterize the angle and distance between x_{j-1} and x_j along z_j, respectively. For link 7, $\sigma_j = 2$ means that the link 7 is fixed on the link 6.



The geometric parameters, simple open structure



Zero position with Staubli frames Zero position with MDH Frames

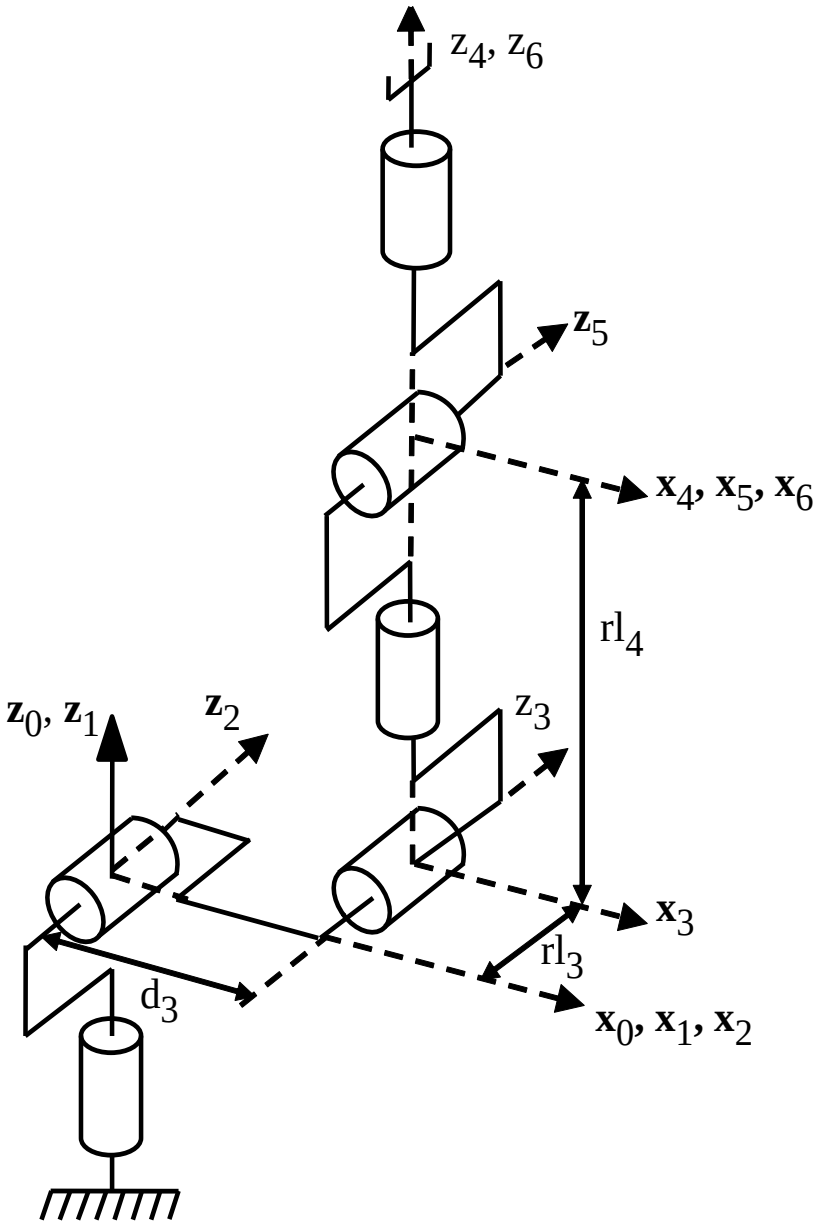
Fig. 1. Link frames of the TX-40 robot

Table 1 Geometric parameters of the TX-40 robot

j	σ_j	α_j	d_j	θ_j	r_j
1	0	0	0	q_1	0
2	0	-π/2	0	$q_2 - \pi/2$	0
3	0	0	$d3$ = 0.225m	$q_3 + \pi/2$	$rl3$ = 0.035m
4	0	π/2	0	q_4	$rl4$ = 0.225m
5	0	-π/2	0	q_5	0
6	0	π/2	0	$q_6 + \pi$	0
7	2	0	0	0	0

Since all the joints are rotational then θ_j is the joint position value q_j given by the CS8C controller of the TX-40 robot, except for joints 2, 3 and 6 where the MDH notation differs from the Staübli variables:

$\theta_2 = q_2 - \pi/2$, $\theta_3 = q_3 + \pi/2$, $\theta_6 = q_6 + \pi$


z_4, z_6
$\mathbf{z}_5$
$\mathbf{x}_4$, $\mathbf{x}_5$, $\mathbf{x}_6$
rl_4
$\mathbf{z}_0$, $\mathbf{z}_1$
$\mathbf{z}_2$
z_3
$\mathbf{x}_3$
rl_3
d_3
$\mathbf{x}_0$, $\mathbf{x}_1$, $\mathbf{x}_2$