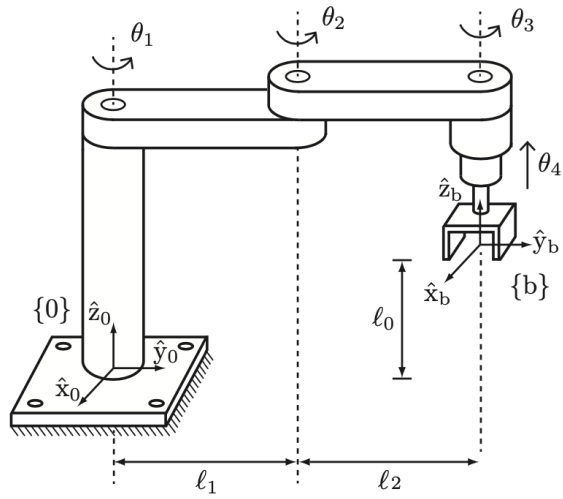
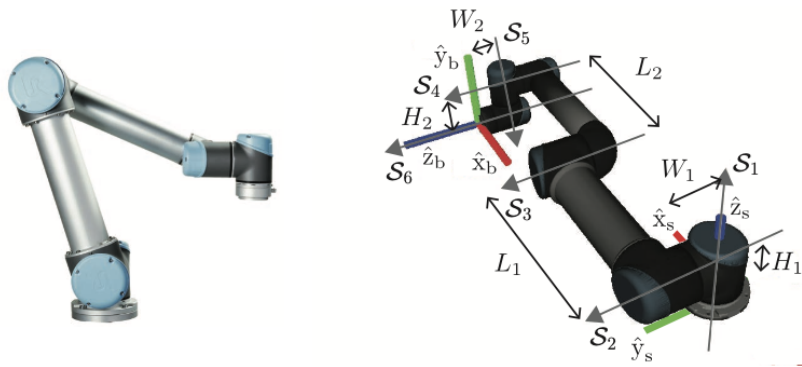


**exercise 4.2** RRRP, Find  $M$ ,  $S_i$  and  $B_i$  ?



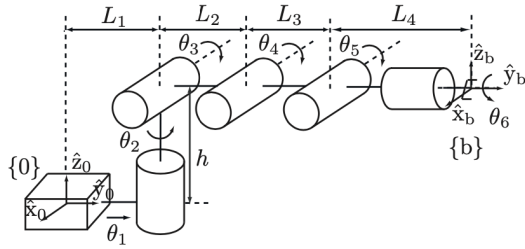
**Figure 4.12:** An RRRP SCARA robot for performing pick-and-place operations.

**exercise 4.5** UR5, Find  $\mathcal{B}_i$  ?



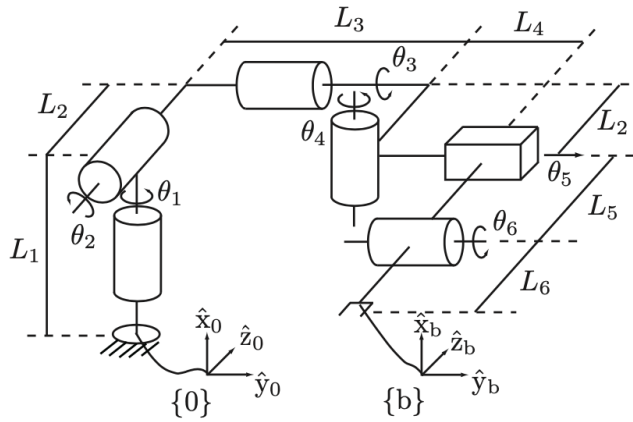
**Figure 4.6:** (Left) Universal Robots' UR5 6R robot arm. (Right) Shown at its zero position. Positive rotations about the axes indicated are given by the usual right-hand rule.  $W_1$  is the distance along the  $\hat{y}_s$ -direction between the anti-parallel axes of joints 1 and 5.  $W_1 = 109$  mm,  $W_2 = 82$  mm,  $L_1 = 425$  mm,  $L_2 = 392$  mm,  $H_1 = 89$  mm,  $H_2 = 95$  mm.

**exercise 4.7** PRRRRR, Find  $M$ ,  $S_i$  and  $\mathcal{B}_i$  ?



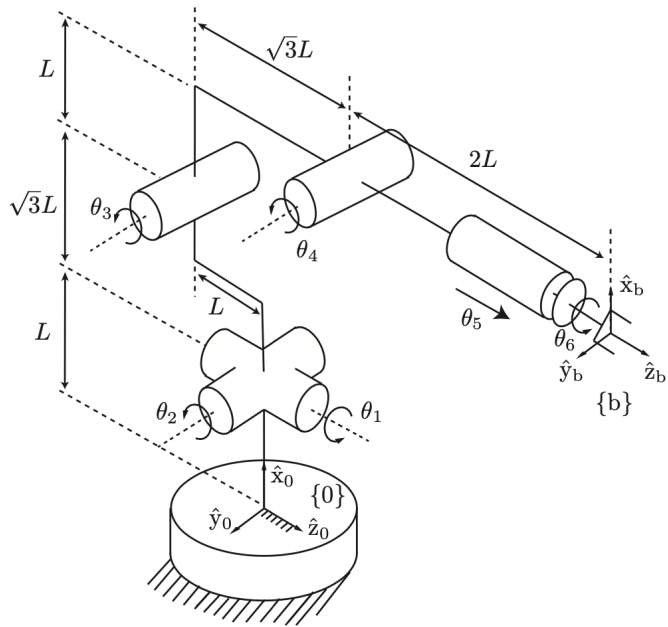
**Figure 4.13:** A PRRRRR spatial open chain at its zero configuration.

**exercise 4.8** RRRRPR, Find  $M$ ,  $S_i$  and  $\mathcal{B}_i$  ?



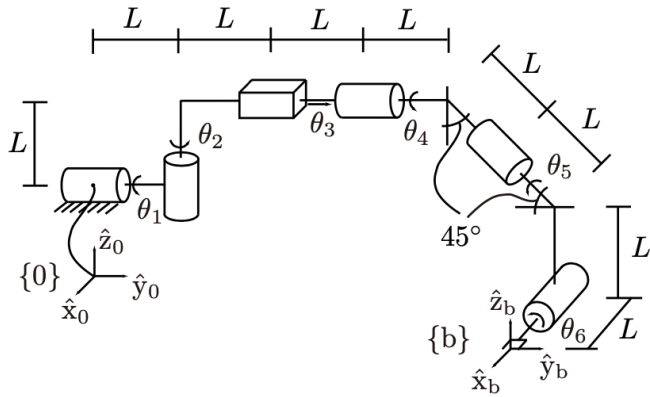
**Figure 4.14:** A spatial RRRRPR open chain.

**exercise 4.10** URRPR, Find  $M$ ,  $S_i$  and  $\mathcal{B}_i$  ?



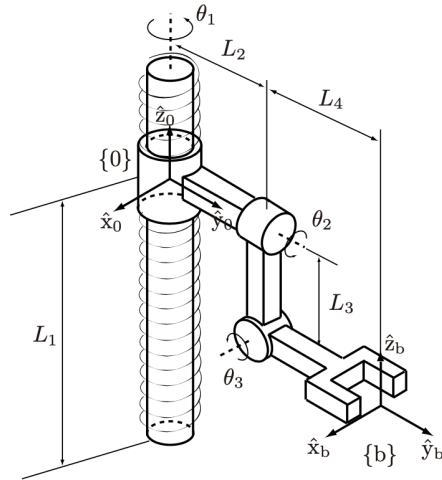
**Figure 4.16:** A URRPR spatial open-chain robot.

**exercise 4.12** RRPRRR, Find  $M$ ,  $S_i$  and  $\mathcal{B}_i$  ?



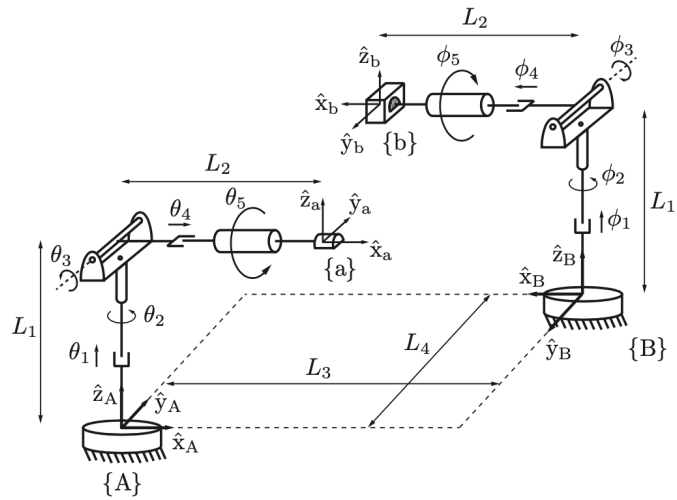
**Figure 4.18:** An RRPRRR spatial open chain.

**exercise 4.15** HRR, Find  $M$ ,  $\mathcal{S}_i$  and  $\mathcal{B}_i$  ?



**Figure 4.21:** HRR robot. The pitch of the screw joint is denoted by  $h$ .

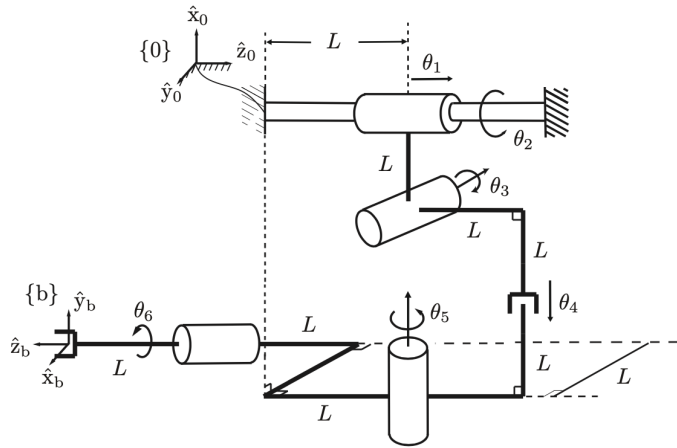
**exercise 4.18** Two PUPR, Find  $M$  ?



**Figure 4.23:** Two PUPR open chains.



**exercise 4.20** PRRPRR, Find  $M$ , and combined  $S_i$  and  $\mathcal{B}_i$  ?



**Figure 4.25:** A spatial PRRPRR open chain.