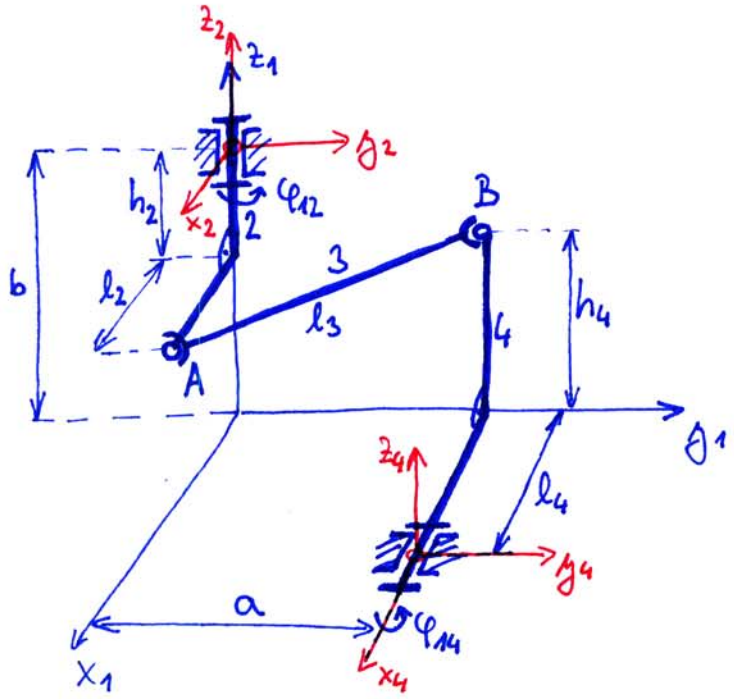


DOFs:

$i = 6(4-1) - 2_{rot}\cdot 5 - 2_{sph}\cdot 3 = 18-10-6 = 2$ DOFs

2 − 1 parasitic rotation of "3" → 1 DOF

Coordinates:

$$s = [\varphi_{12}, \varphi_{14}]^T$$

2 coordinates − 1 DOF → 1 constraint

Constraints:

$$|\underline{r}_{1A} - \underline{r}_{1B}| = l_3 \qquad \left((x_A-x_B)^2+(y_A-y_B)^2+(z_A-z_B)^2 = l_3^2\right)$$

$$\underline{r}_{1A} = \underline{\overline{T}}_{12}\cdot \underline{r}_{2A} \qquad \underline{r}_{1B} = \underline{\overline{T}}_{14}\cdot \underline{r}_{4B}$$

$$\underline{\overline{T}}_{12} = \underline{\overline{T}}_z(b)\,\underline{\overline{T}}_{\varphi_z}(\varphi_{12}) \qquad \underline{\overline{T}}_{14} = \underline{\overline{T}}_x(l_4)\,\underline{\overline{T}}_y(a)\,\underline{\overline{T}}_{\varphi_x}(\varphi_{14})$$

$$\underline{r}_{2A} = \begin{bmatrix} l_2 \\ 0 \\ -h_2 \\ 1 \end{bmatrix} \qquad \underline{r}_{4B} = \begin{bmatrix} -l_4 \\ 0 \\ h_4 \\ 1 \end{bmatrix}$$