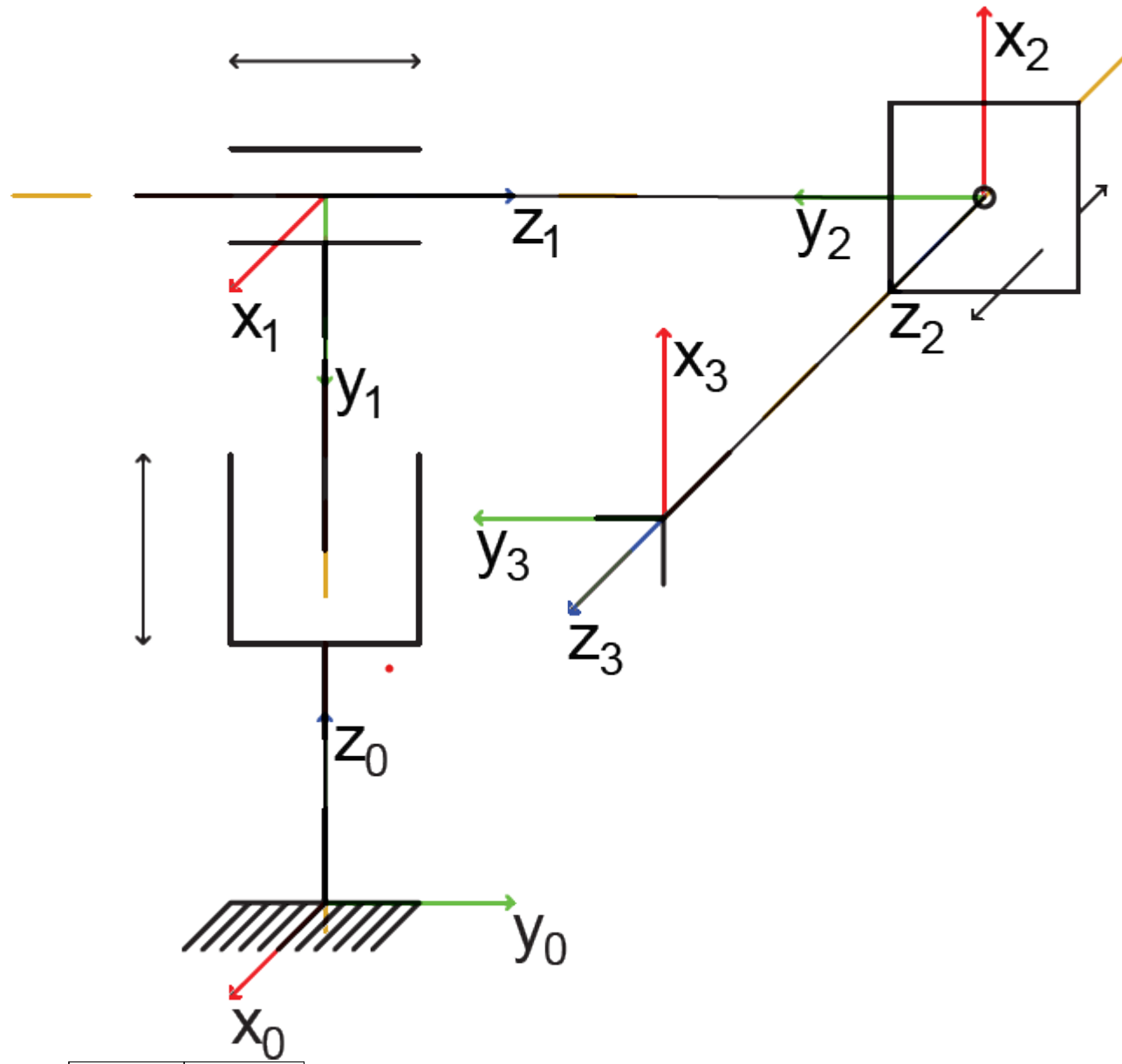


Cinematiche Dirette Robot

Alfano Emanuele
Badalamenti Filippo
Vitti Gabriele

1 novembre 2019

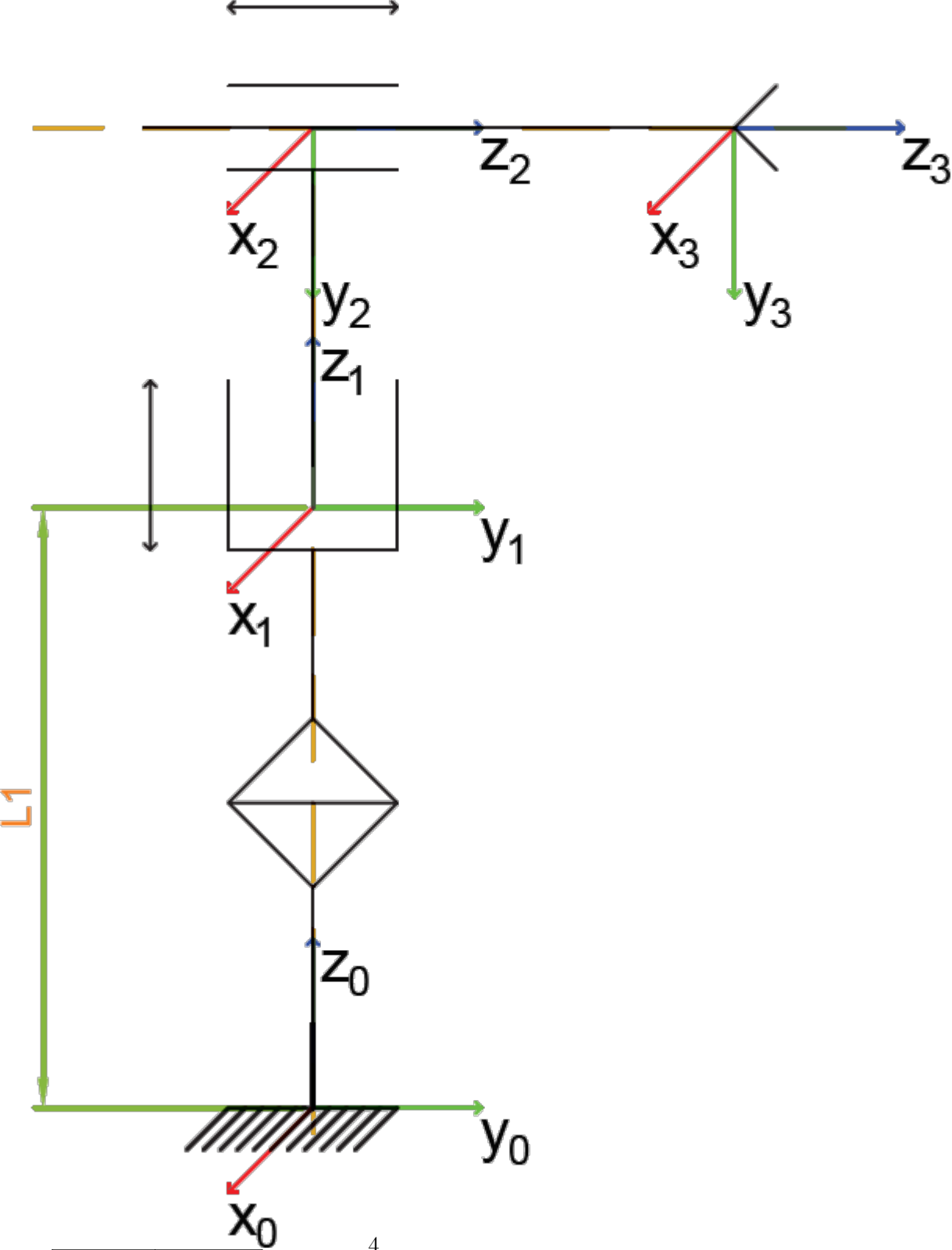
Cartesiano



	$A_z(\theta, d)$		$A_x(\alpha, a)$	
R_1	0	q_1	$-\frac{\pi}{2}$	0
R_2	$-\frac{\pi}{2}$	q_2	$-\frac{\pi}{2}$	0
R_3	0	q_3	0	0

$$\begin{pmatrix} 0 & 0 & 1 & q_3 \\ 0 & -1 & 0 & q_2 \\ 1 & 0 & 0 & q_1 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

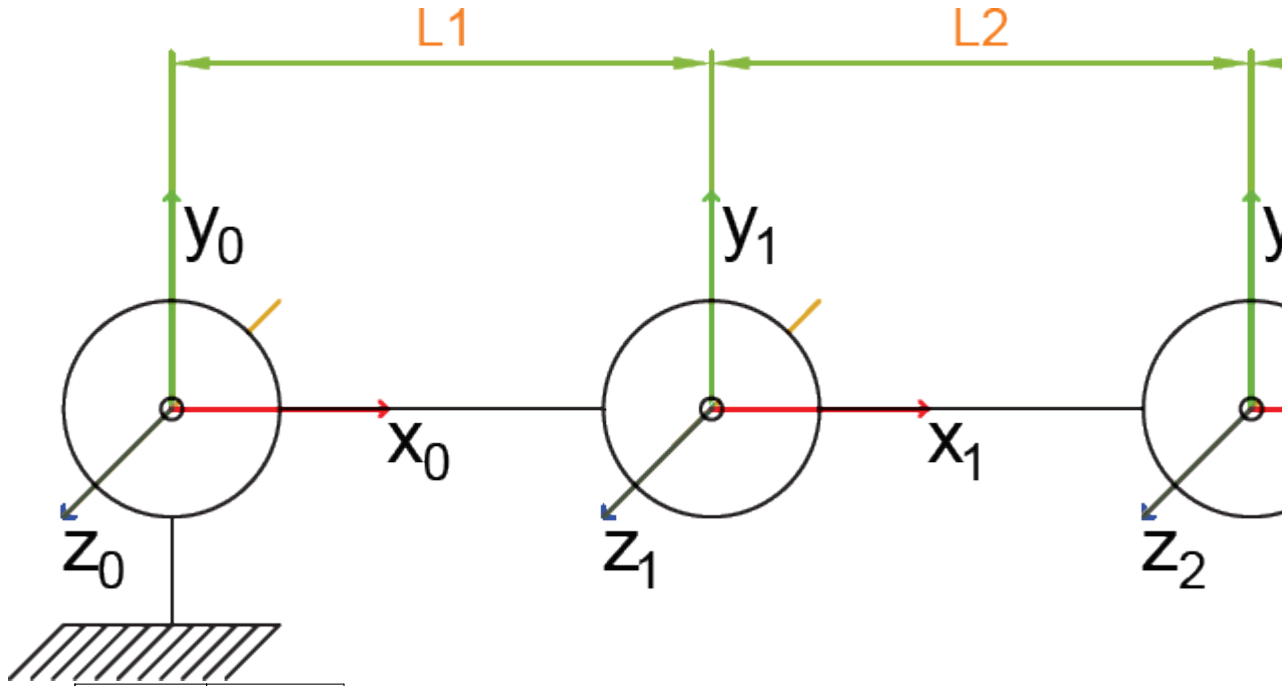
Cilindrico



	$A_z(\theta, d)$			$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1	
R_2	q_2	0	0	D_2	
R_3	q_3	0	0	D_3	

$$\begin{pmatrix} \cos q_1 & 0 & -\sin q_1 & -\sin q_1 q_3 \\ \sin q_1 & 0 & \cos q_1 & \cos q_1 q_3 \\ 0 & 1 & 0 & 0 \end{pmatrix}$$

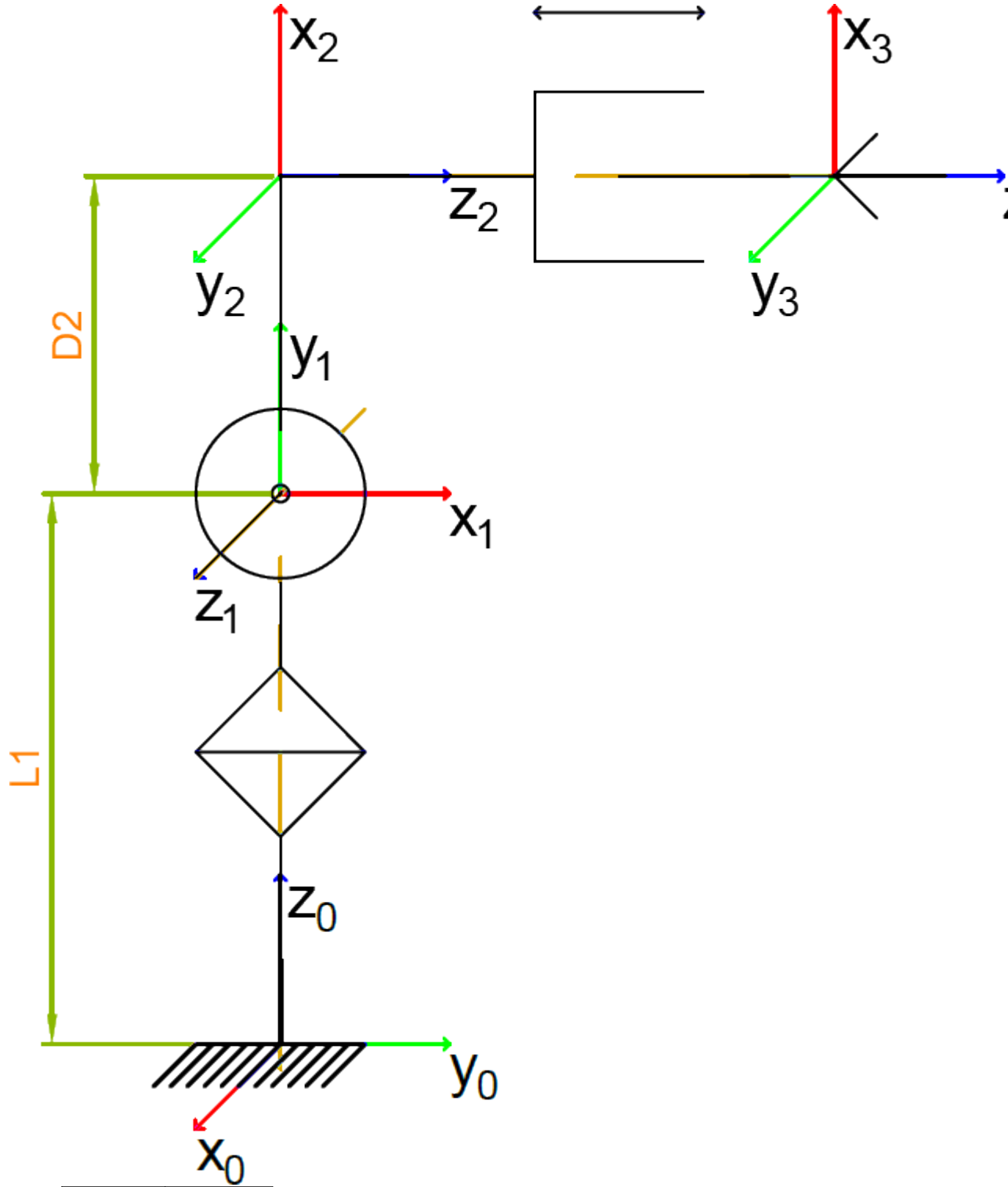
RRR Planare



	$A_z(\theta, d)$			$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1	
R_2	q_2	0	0	D_2	
R_3	q_3	0	0	D_3	

$$\begin{pmatrix} -(\cos q_1 \sin q_2 \sin q_3 + \sin q_1 \cos q_2 \sin q_3 + \sin q_1 \sin q_2 \cos q_3 - \cos q_1 \cos q_2 \cos q_3) & \sin q_1 \sin q_2 \\ -(\sin q_1 \sin q_2 \sin q_3 - \cos q_1 \cos q_2 \sin q_3 - \cos q_1 \sin q_2 \cos q_3 - \sin q_1 \cos q_2 \cos q_3) & -(\cos q_1 \sin q_2 \\ 0 & \\ 0 & \end{pmatrix}$$

Sferico 1

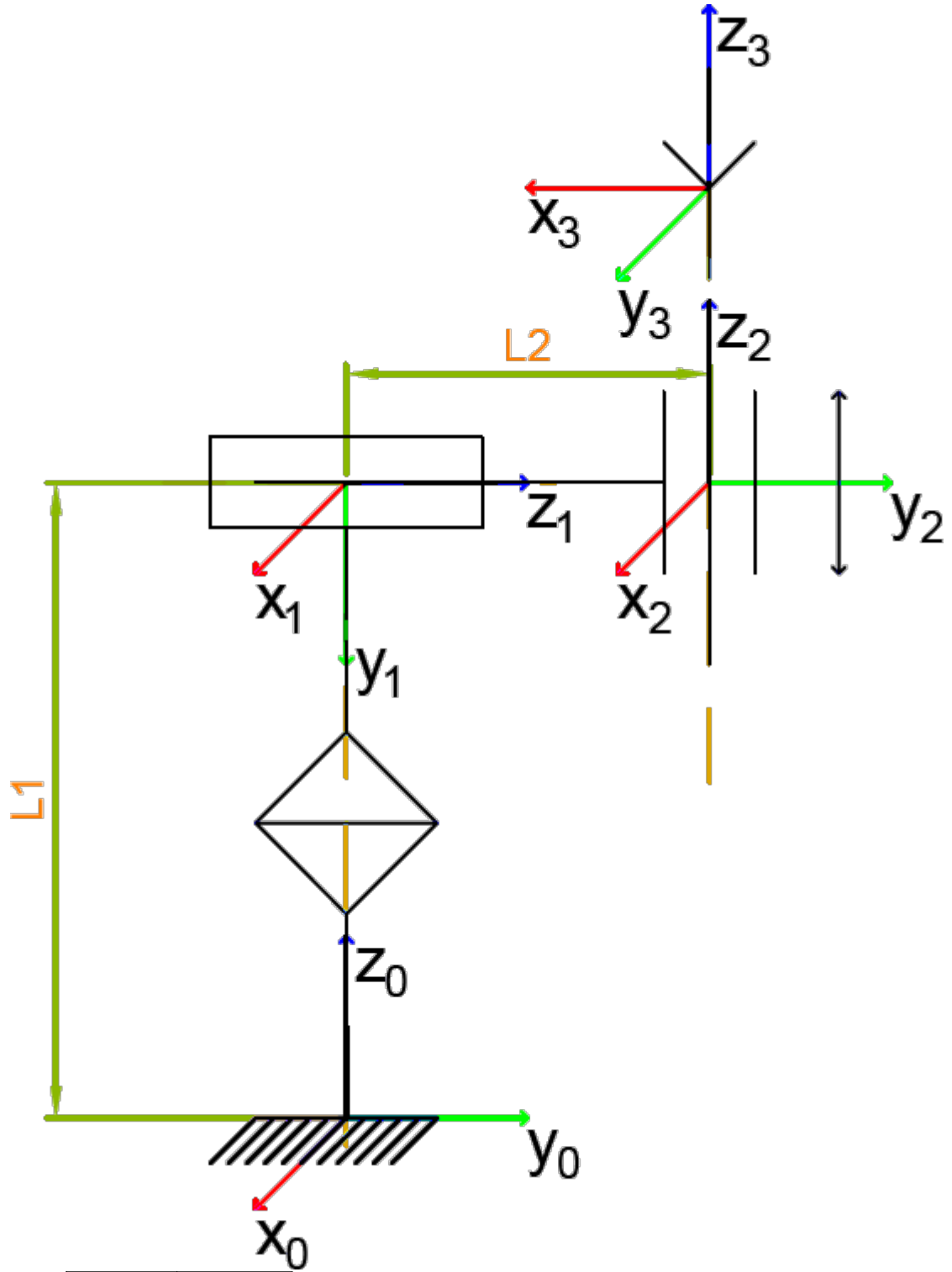


	$A_z(\theta, d)$		$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1
R_2	q_2	0	0	D_2
R_3	q_3	0	0	D_3

6

$$\begin{pmatrix} \cos q_1 \cos q_2 & \sin q_1 & \cos q_1 \sin q_2 & \cos q_1 (\sin q_2 q_3 + D_2 \cos q_2) \\ \sin q_1 \cos q_2 & -\cos q_1 & \sin q_1 \sin q_2 & \sin q_1 (\sin q_2 q_3 + D_2 \cos q_2) \\ \sin q_2 & 0 & -\cos q_2 & -(\cos q_2 q_3 - D_2 \sin q_2 - L_1) \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Sferico di Stanford

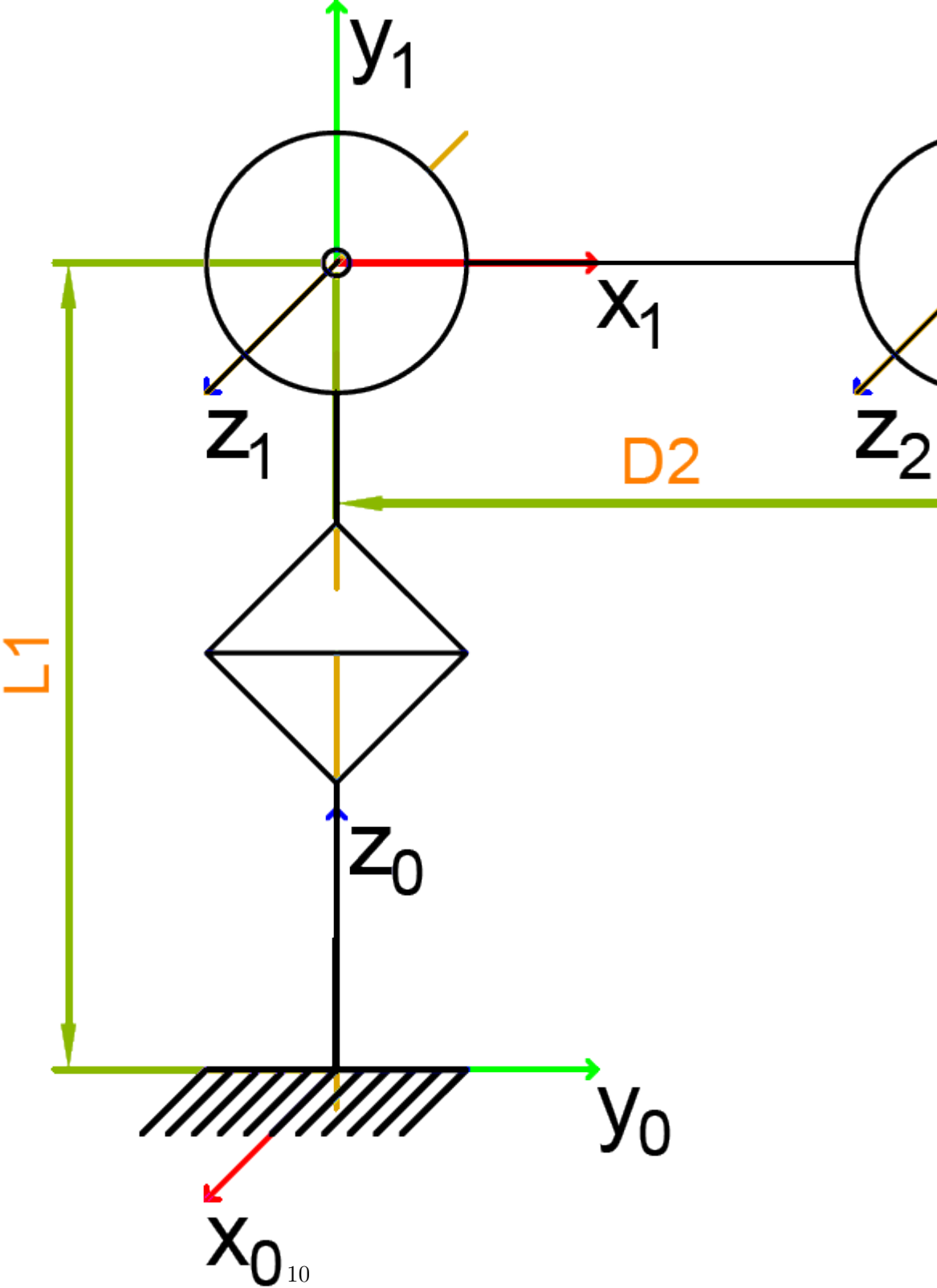


	$A_z(\theta, d)$		$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1
R_2	q_2	0	0	D_2
R_3	q_3	0	0	D_3

8

$$\begin{pmatrix} \sin q_1 & \cos q_1 \cos q_2 & \cos q_1 \sin q_2 & \cos q_1 \sin q_2 q_3 - L_2 \sin q_1 \\ -\cos q_1 & \sin q_1 \cos q_2 & \sin q_1 \sin q_2 & \sin q_1 \sin q_2 q_3 + L_2 \cos q_1 \\ 0 & -\sin q_2 & \cos q_2 & \cos q_2 q_3 + L_1 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

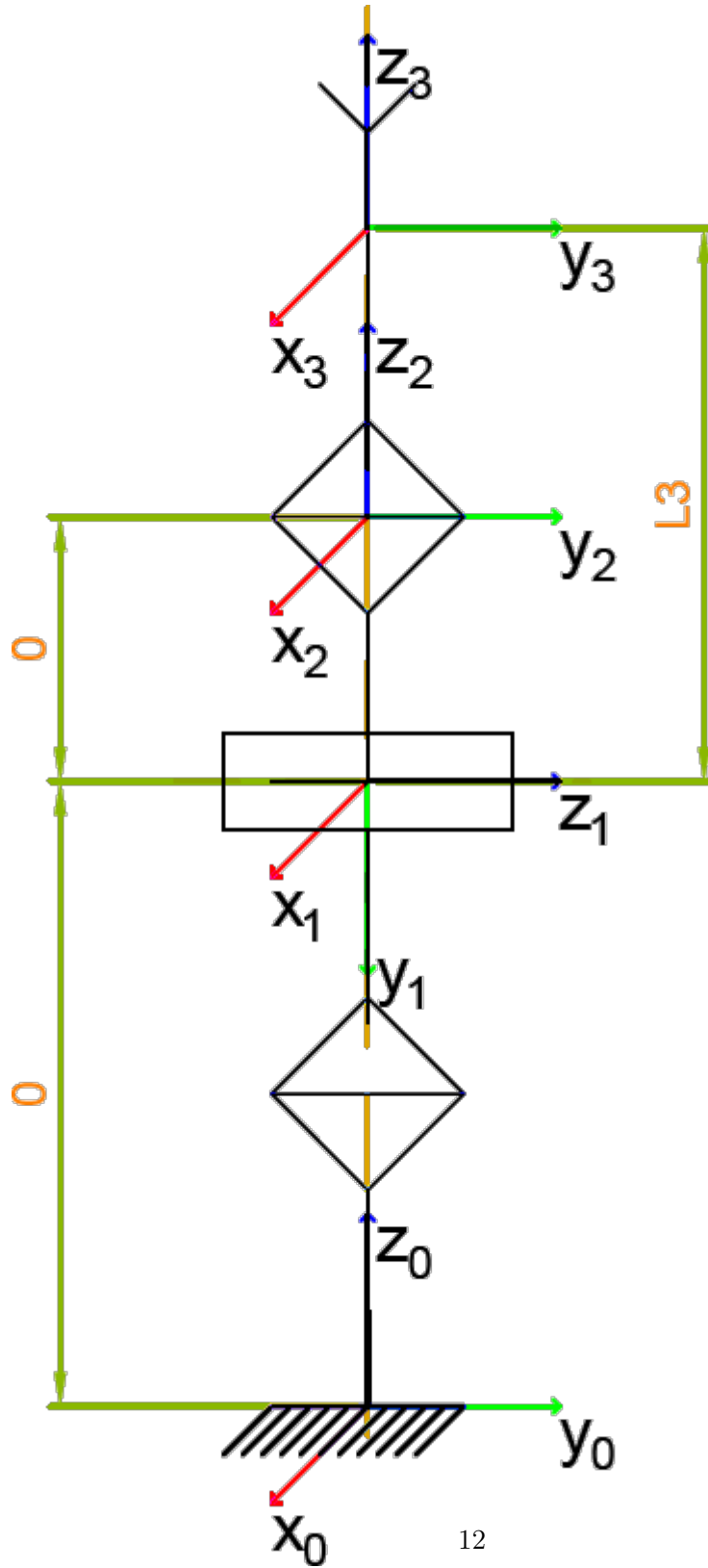
Antropomorfo



		$A_z(\theta, d)$		$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1	
R_2	q_2	0	0	D_2	
R_3	q_3	0	0	D_3	

$$\begin{pmatrix} -\cos q_1 (\sin q_2 \sin q_3 - \cos q_2 \cos q_3) & -\cos q_1 (\cos q_2 \sin q_3 + \sin q_2 \cos q_3) & \sin q_1 & -\cos q_1 (D_3 \sin q_2 \sin q_3 - \cos q_2 \cos q_3) \\ -\sin q_1 (\sin q_2 \sin q_3 - \cos q_2 \cos q_3) & -\sin q_1 (\cos q_2 \sin q_3 + \sin q_2 \cos q_3) & -\cos q_1 & -\sin q_1 (D_3 \sin q_2 \sin q_3 - \cos q_2 \cos q_3) \end{pmatrix}$$

Polso Sferico

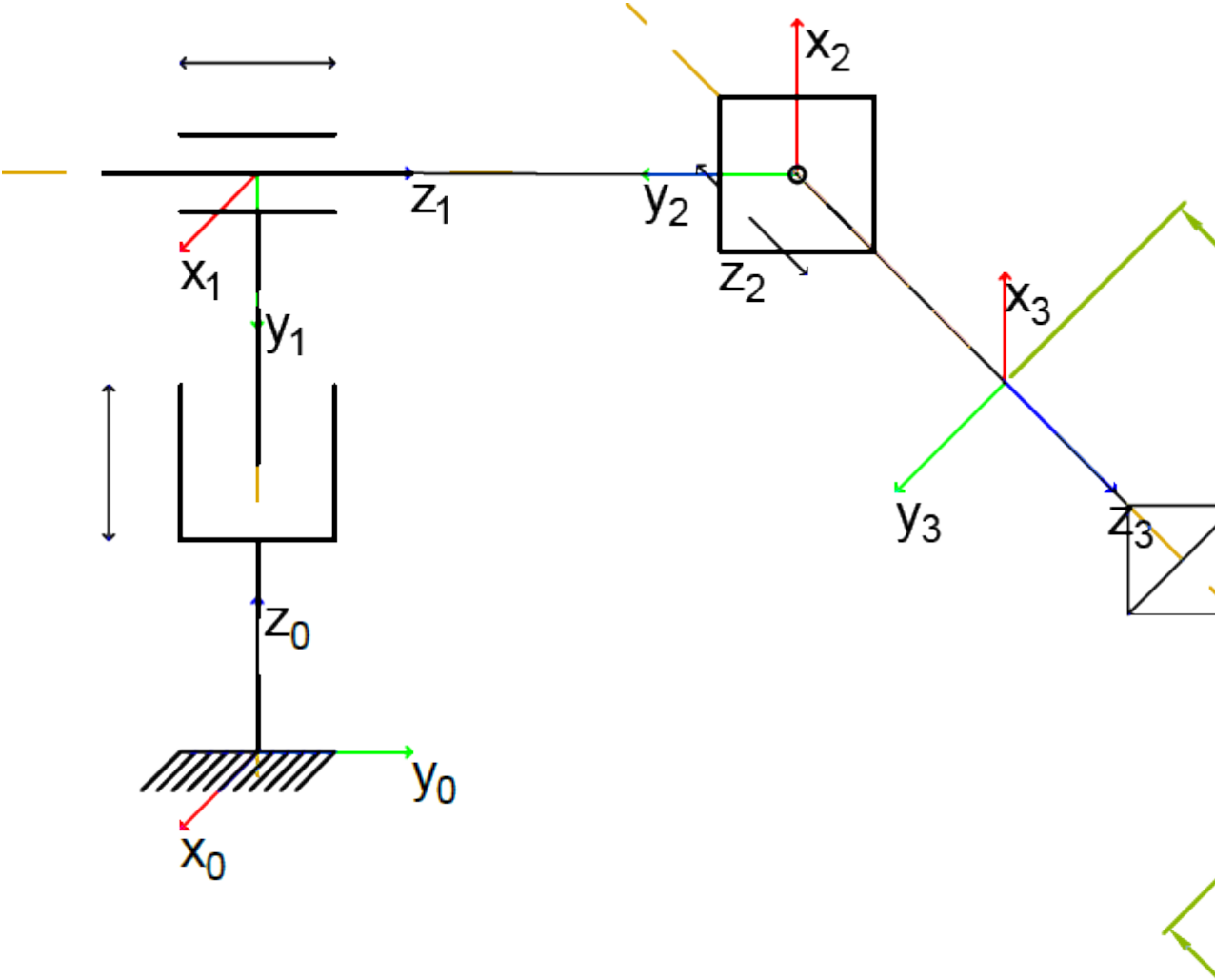


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	$A_z(\theta, d)$		$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1
R_2	q_2	0	0	D_2
R_3	q_3	0	0	D_3

$$\begin{pmatrix} \cos_{q_4} \cos_{q_5} \cos_{q_6} - \sin_{q_4} \sin_{q_6} & -\cos_{q_4} \cos_{q_5} \sin_{q_6} - \sin_{q_4} \cos_{q_6} & \cos_{q_4} \sin_{q_5} & L_6 \cos_{q_4} \sin_{q_5} \\ \cos_{q_4} \sin_{q_6} + \sin_{q_4} \cos_{q_6} & \cos_{q_4} \cos_{q_6} - \sin_{q_4} \sin_{q_6} & \sin_{q_4} \sin_{q_5} & L_6 \sin_{q_4} \sin_{q_5} \\ & -\sin_{q_5} \cos_{q_6} & \sin_{q_5} \sin_{q_6} & L_6 \cos_{q_5} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

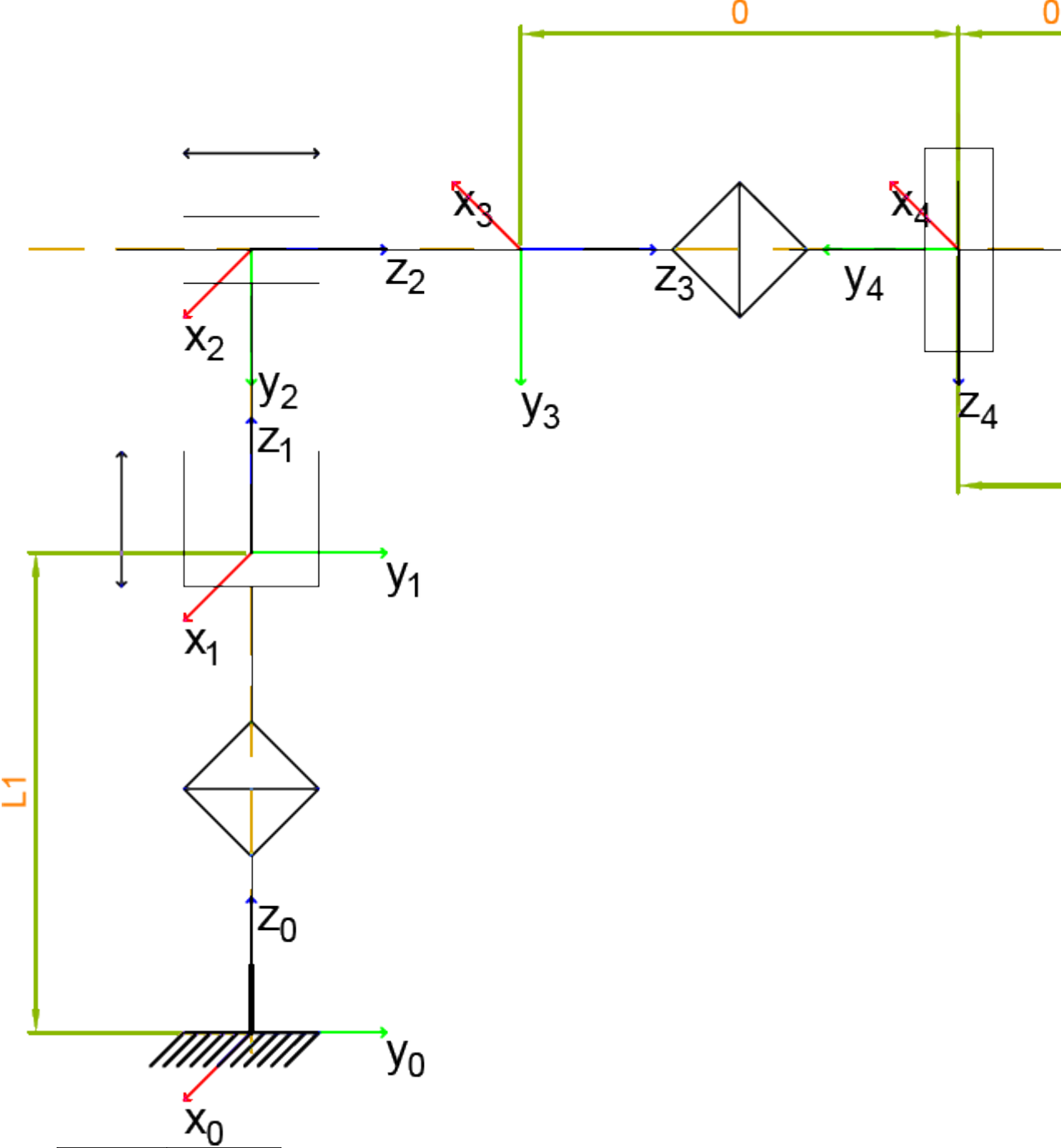
Cartesiano con Polso



		$A_z(\theta, d)$	$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1
R_2	q_2	0	0	D_2
R_3	q_3	0	0	D_3

$$\begin{pmatrix} -\sin q_5 \cos q_6 & \sin q_5 \sin q_6 & \cos q_5 & L_6 \\ -(\cos q_4 \sin q_6 + \sin q_4 \cos q_5 \cos q_6) & \sin q_4 \cos q_5 \sin q_6 - \cos q_4 \cos q_6 & -\sin q_4 \sin q_5 & -(L_6 \cos q_5) \\ -(\sin q_4 \sin q_6 - \cos q_4 \cos q_5 \cos q_6) & -(\cos q_4 \cos q_5 \sin q_6 + \sin q_4 \cos q_6) & \cos q_4 \sin q_5 & L_6 \sin q_5 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

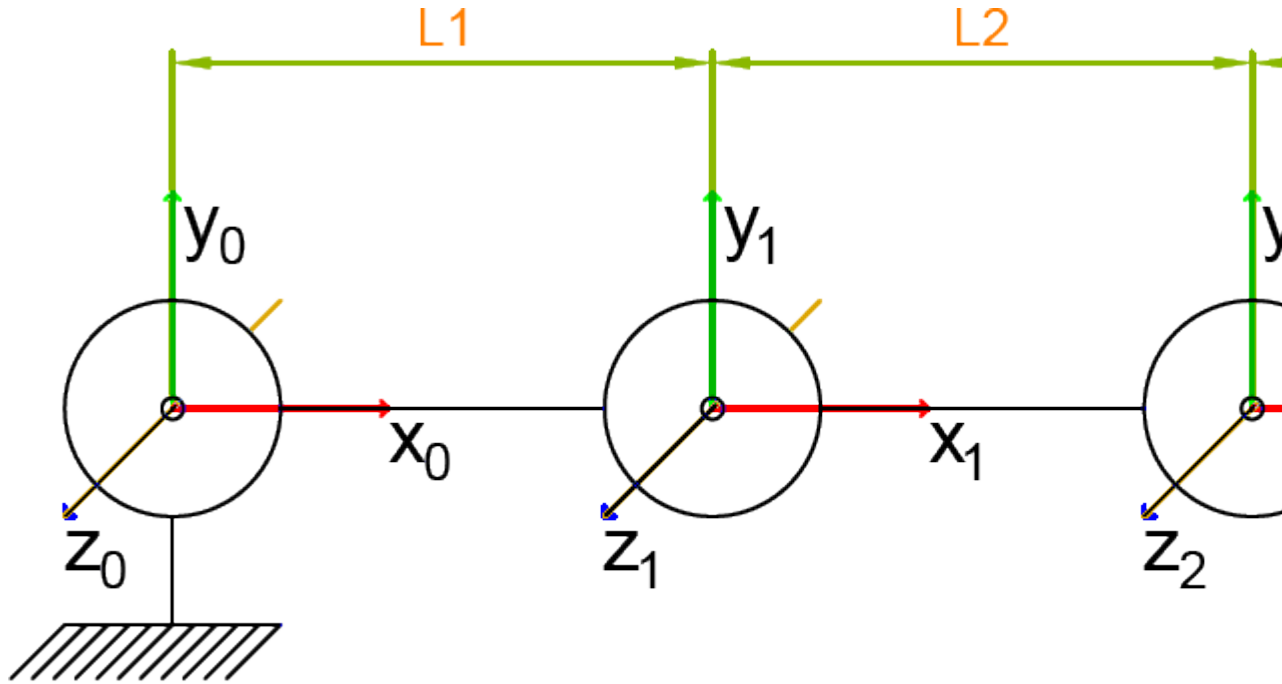
Cilindrico con Polso



	$A_z(\theta, d)$		$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1
R_2	q_2	0	0	D_2
R_3	q_3	0	0	D_3

$$\begin{pmatrix} -(\cos q_1 \sin q_4 \sin q_6 - \sin q_1 \sin q_5 \cos q_6 - \cos q_1 \cos q_4 \cos q_5 \cos q_6) & -(\sin q_1 \sin q_5 \sin q_6 + \cos q_1 \sin q_4 \sin q_6 - \sin q_1 \cos q_4 \cos q_5 \cos q_6) \\ -(\sin q_1 \sin q_4 \sin q_6 + \cos q_1 \sin q_5 \cos q_6 - \sin q_1 \cos q_4 \cos q_5 \cos q_6) & \cos q_1 \sin q_5 \sin q_6 - \sin q_1 \cos q_4 \cos q_5 \cos q_6 \\ -(\cos q_4 \sin q_6 + \sin q_4 \cos q_5 \cos q_6) & \sin q_4 \cos q_5 \cos q_6 \end{pmatrix}$$

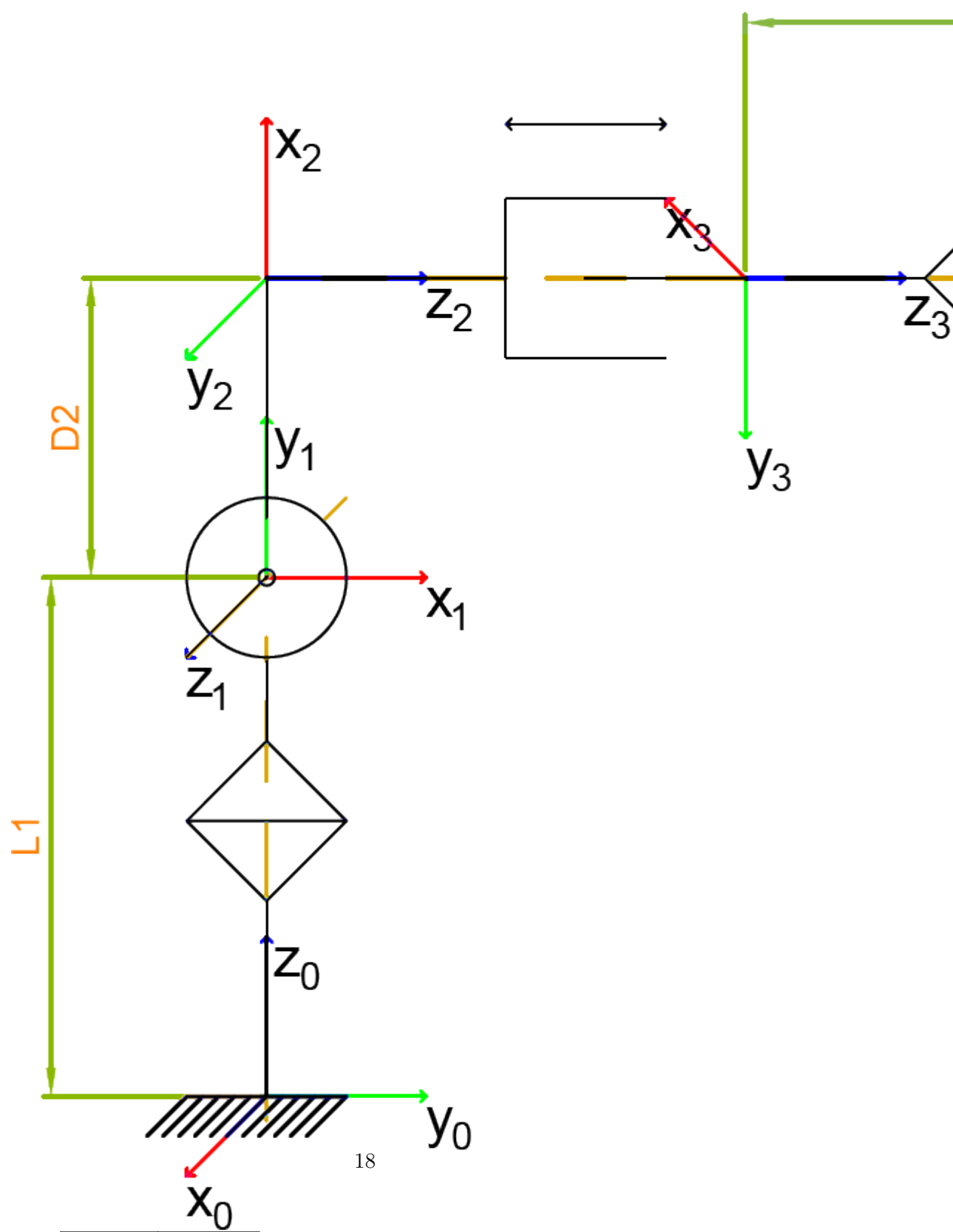
RRR Planare con Polso



		$A_z(\theta, d)$		$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1	
R_2	q_2	0	0	D_2	
R_3	q_3	0	0	D_3	

$$\begin{pmatrix} \cos q_1 \sin q_2 \sin q_3 \sin q_4 \sin q_6 + \sin q_1 \cos q_2 \sin q_3 \sin q_4 \sin q_6 + \sin q_1 \sin q_2 \cos q_3 \sin q_4 \sin q_6 - \cos q_1 \sin q_2 \sin q_3 \sin q_4 \sin q_6 - \cos q_1 \cos q_2 \sin q_3 \sin q_4 \sin q_6 - \cos q_1 \sin q_2 \cos q_3 \sin q_4 \sin q_6 - \sin q_1 \sin q_2 \sin q_3 \sin q_4 \sin q_6 \\ \sin q_1 \sin q_2 \sin q_3 \sin q_4 \sin q_6 - \cos q_1 \cos q_2 \sin q_3 \sin q_4 \sin q_6 - \cos q_1 \sin q_2 \cos q_3 \sin q_4 \sin q_6 - \sin q_1 \sin q_2 \sin q_3 \sin q_4 \sin q_6 - \cos q_1 \cos q_2 \sin q_3 \sin q_4 \sin q_6 - \cos q_1 \sin q_2 \cos q_3 \sin q_4 \sin q_6 - \sin q_1 \sin q_2 \sin q_3 \sin q_4 \sin q_6 \end{pmatrix}$$

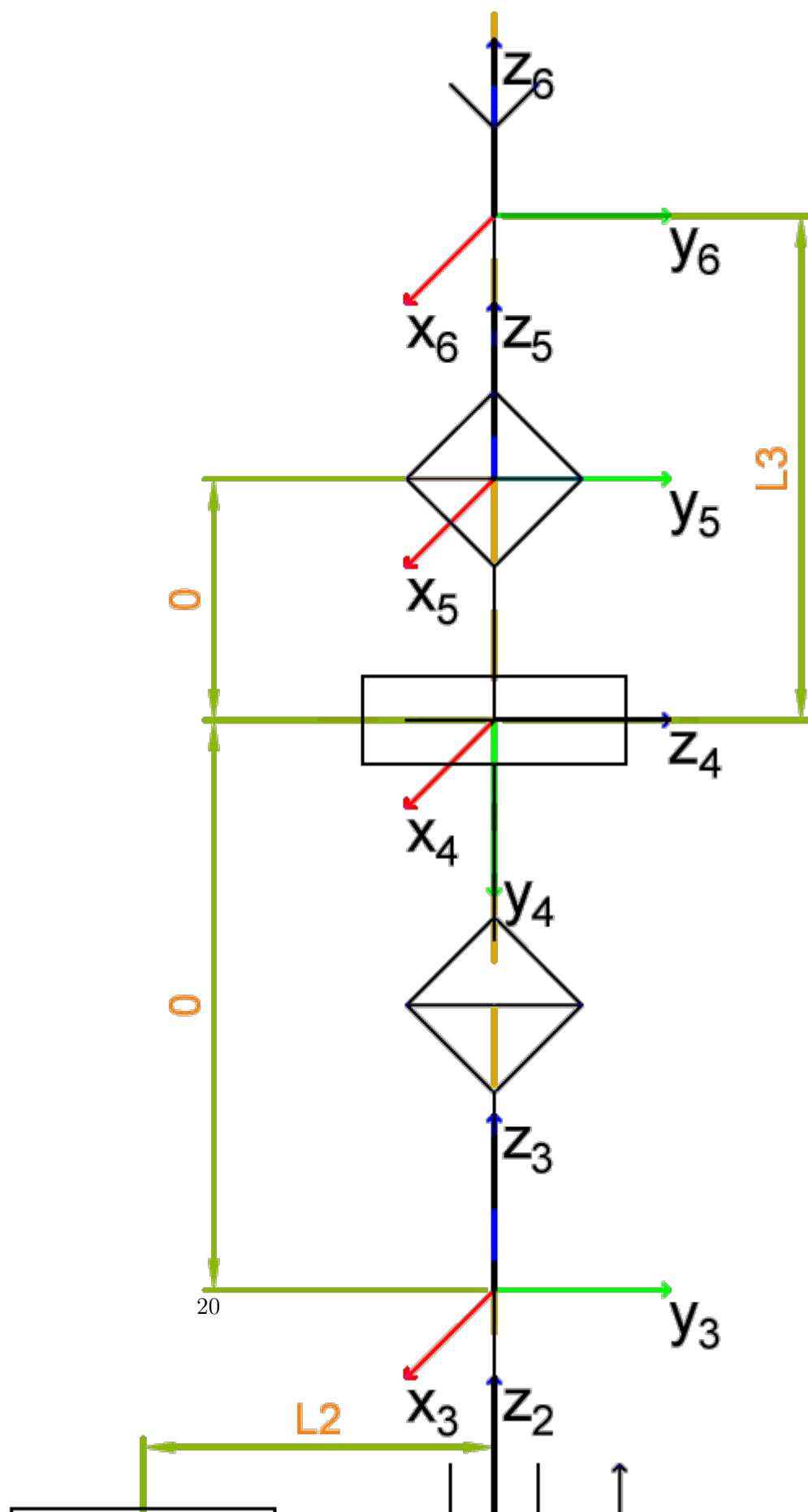
Sferico 1 con Polso



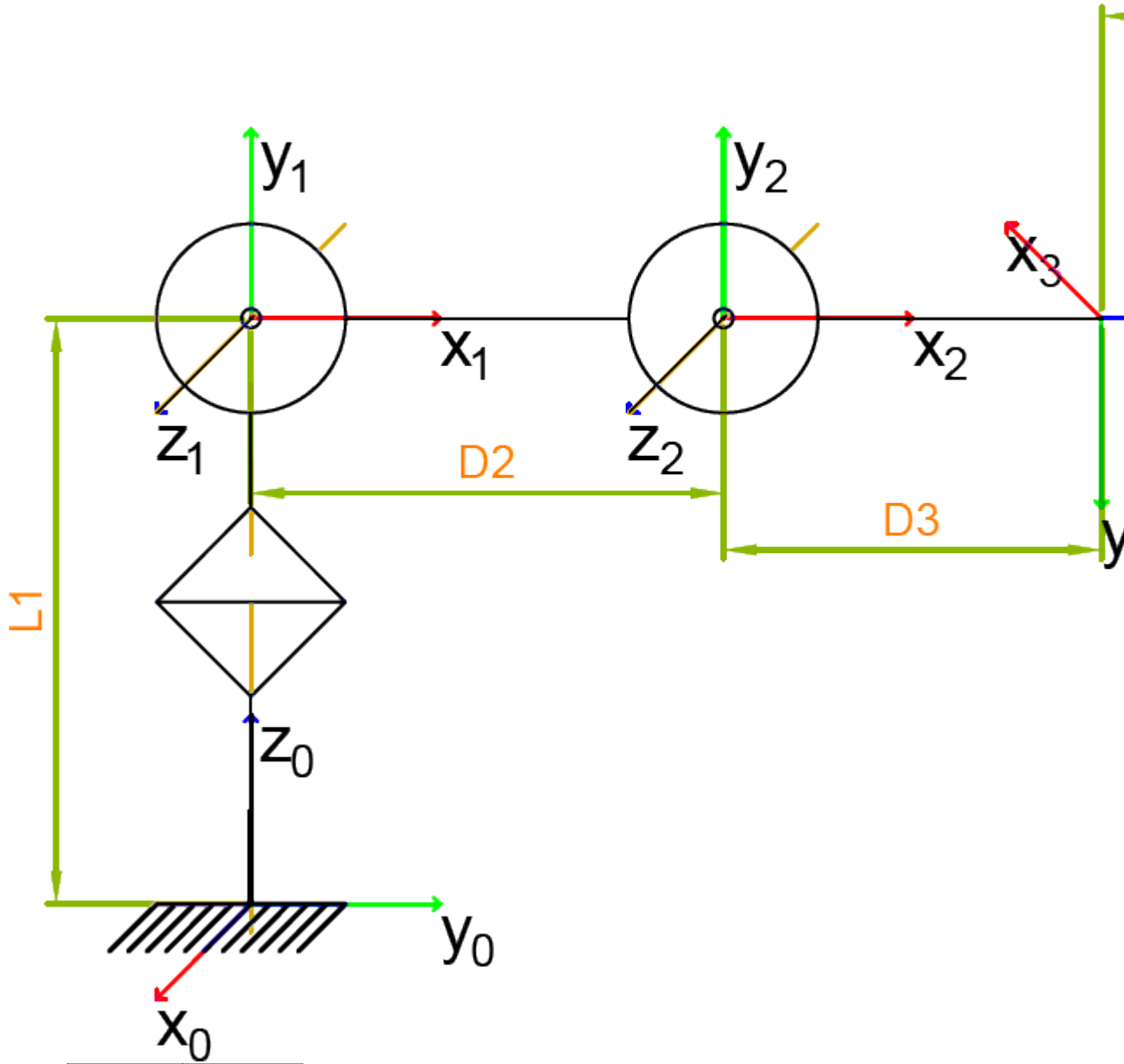
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		$A_z(\theta, d)$	$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1
R_2	q_2	0	0	D_2
R_3	q_3	0	0	D_3

Sferico di Stanford con Polso



Antropomorfo con Polso



	$A_z(\theta, d)$		$A_x(\alpha, a)$	
R_1	q_1	0	0	D_1
R_2	q_2	0	0	D_2
R_3	q_3	0	0	D_3

$$\begin{pmatrix} \cos q_1 \sin q_2 \sin q_3 \sin q_4 \sin q_6 - \cos q_1 \cos q_2 \cos q_3 \sin q_4 \sin q_6 - \cos q_1 \cos q_2 \sin q_3 \cos q_4 \sin q_6 - \cos q_1 \sin q_2 \sin q_3 \sin q_4 \sin q_6 - \sin q_1 \cos q_2 \cos q_3 \sin q_4 \sin q_6 - \sin q_1 \cos q_2 \sin q_3 \cos q_4 \sin q_6 - \sin q_1 \sin q_2 \sin q_3 \sin q_4 \sin q_6 \\ - (\cos q_2 \sin q_3 \sin q_4 \sin q_6 + \sin q_2 \cos q_3 \sin q_4 \sin q_6 + \sin q_2 \sin q_3 \cos q_4 \sin q_6 + \sin q_2 \sin q_3 \sin q_4 \sin q_6) \end{pmatrix}$$

