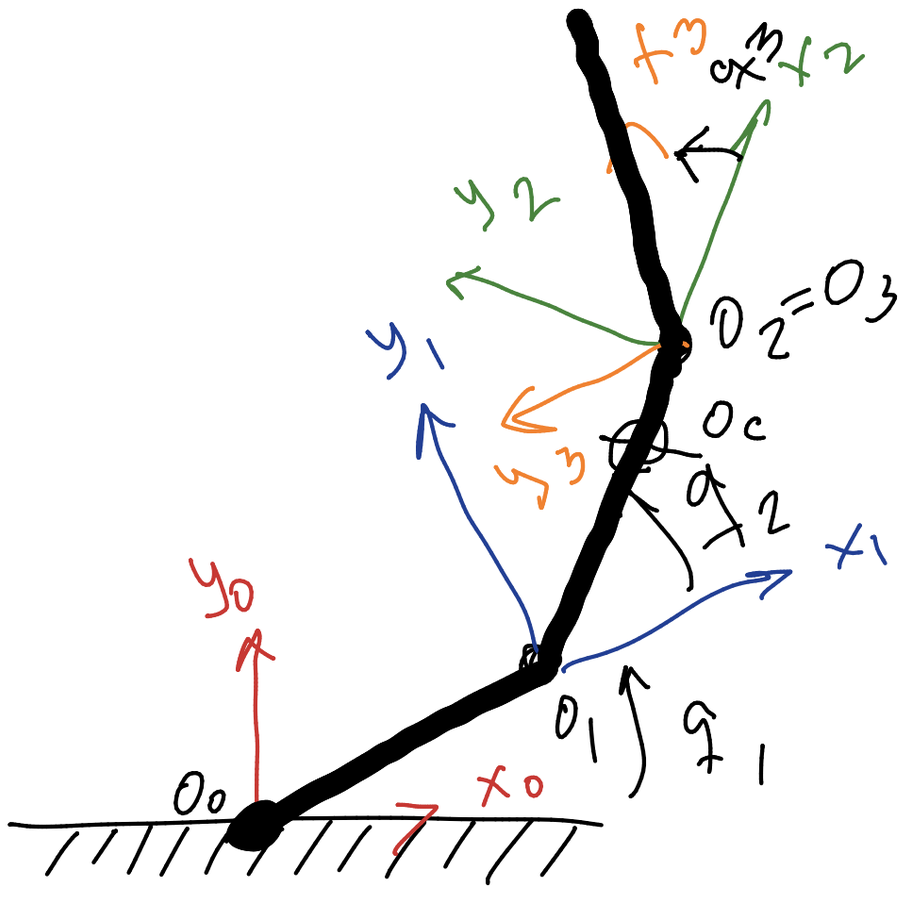


0-1: $Rot_{z,q_1} Trans_{x,l_1}$

1-2 $Rot_{z,q_2} Trans_{x,l_2}$

2-3 $Rot_{z,q_3}$

## Velocity Jacobian:

- 1st column: 1st joint revolute: $Z_0^0 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

$$\boxed{Z_0^0 \times (O_c^0 - O_0)}$$

$$O_c^0 = H_2^0 O_c^2 = H_2^0 \begin{bmatrix} -(l_2 - l_c) \\ 0 \\ 0 \\ 1 \end{bmatrix} \qquad O_0^0 = 0$$

- 2nd column: $Z_1^0 \times (O_c^0 - O_1^0)$ $\qquad Z_1^0 = Z_0^0$

$$O_1^0 = H_1^0 [1{:}3, 4]$$

- 3rd column: Zero: motion of 3rd link doesn't affect $O_c$

## Angular velocity Jacobian

1st col: $Z_0^0$, 2nd col: $Z_1^0$; 3rd col: $\emptyset$