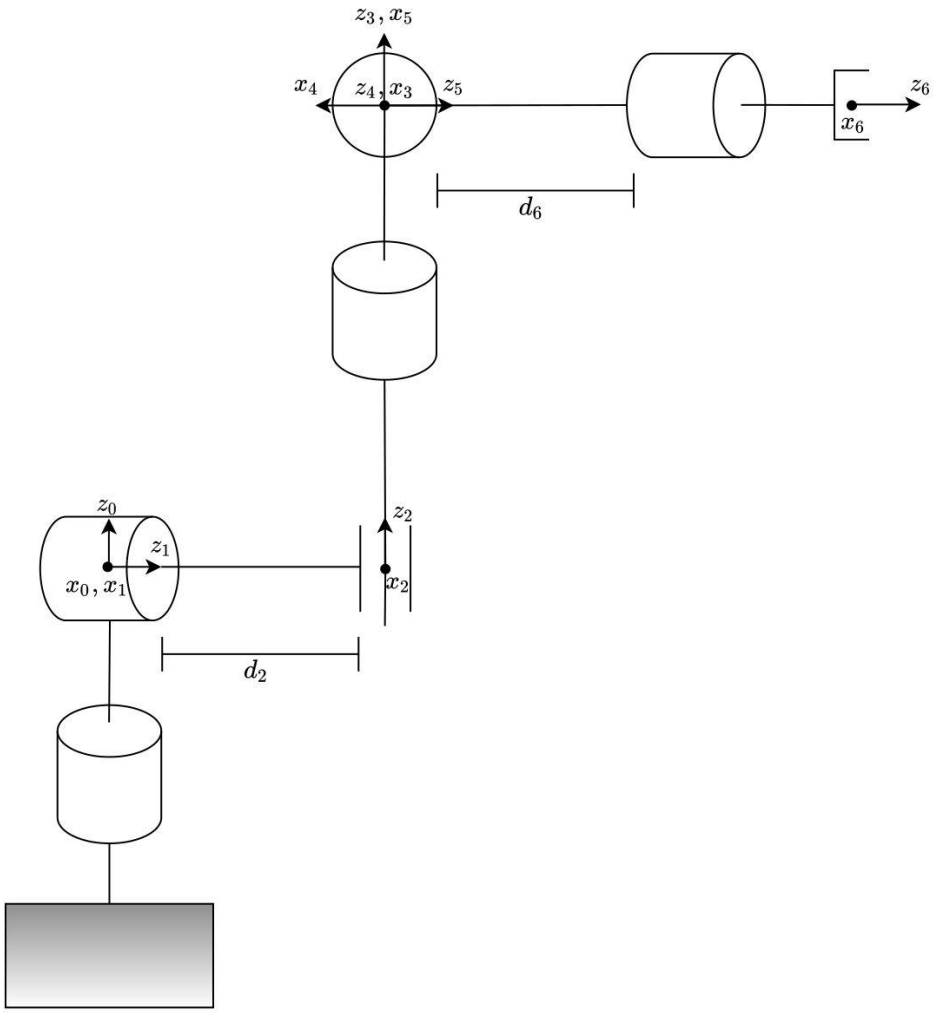
Cinematica inversa manipolatore di Stanford

Manipolatore di Stanford




```
syms q1 q2 q3 q4 q5 q6 d2 d6 real
DHstanford = [0, -pi/2, 0, q1;
              0, pi/2, d2, q2;
              0, 0, q3, 0;
              0, -pi/2, 0, q4;
              0, pi/2, 0, q5;
              0, 0, d6, q6]
```

```
DHstanford =
```

$$\begin{pmatrix} 0 & -\frac{\pi}{2} & 0 & q_1 \\ 0 & \frac{\pi}{2} & d_2 & q_2 \\ 0 & 0 & q_3 & 0 \\ 0 & -\frac{\pi}{2} & 0 & q_4 \\ 0 & \frac{\pi}{2} & 0 & q_5 \\ 0 & 0 & d_6 & q_6 \end{pmatrix}$$

```
TstanfordList = cinDirDH(DHstanford);
T01 = TstanfordList{1};
T12 = TstanfordList{2};
T23 = TstanfordList{3};
T34 = TstanfordList{4};
T45 = TstanfordList{5};
T56 = TstanfordList{6};
T03 = T01*T12*T23
```

T03 =

$$\begin{pmatrix} \cos(q_1)\cos(q_2) & -\sin(q_1) & \cos(q_1)\sin(q_2) & q_3\cos(q_1)\sin(q_2) - d_2\sin(q_1) \\ \cos(q_2)\sin(q_1) & \cos(q_1) & \sin(q_1)\sin(q_2) & d_2\cos(q_1) + q_3\sin(q_1)\sin(q_2) \\ -\sin(q_2) & 0 & \cos(q_2) & q_3\cos(q_2) \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

```
T36 = T34*T45*T56
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T36 =

$$\begin{pmatrix} \cos(q_4)\cos(q_5)\cos(q_6) - \sin(q_4)\sin(q_6) & -\cos(q_6)\sin(q_4) - \cos(q_4)\cos(q_5)\sin(q_6) & \cos(q_4)\sin(q_5) & d_6\,\mathrm{co} \\ \cos(q_4)\sin(q_6) + \cos(q_5)\cos(q_6)\sin(q_4) & \cos(q_4)\cos(q_6) - \cos(q_5)\sin(q_4)\sin(q_6) & \sin(q_4)\sin(q_5) & d_6\,\mathrm{si} \\ -\cos(q_6)\sin(q_5) & \sin(q_5)\sin(q_6) & \cos(q_5) & d \\ 0 & 0 & 0 & \end{pmatrix}$$

```
T06 = TstanfordList{7}
```

T06 =

$$\begin{pmatrix} -\cos(q_6)\,\sigma_8 - \sin(q_6)\,\sigma_4 & \sin(q_6)\,\sigma_8 - \cos(q_6)\,\sigma_4 & \sigma_5 - \sin(q_5)\,\sigma_{10} & q_3\cos(q_1)\sin(q_2) \\ \cos(q_6)\,\sigma_6 + \sin(q_6)\,\sigma_3 & \cos(q_6)\,\sigma_3 - \sin(q_6)\,\sigma_6 & \sigma_7 & d_2\cos(q_1 \\ \sin(q_2)\sin(q_4)\sin(q_6) - \cos(q_6)\,\sigma_2 & \sin(q_6)\,\sigma_2 + \cos(q_6)\sin(q_2)\sin(q_4) & \sigma_1 & \\ 0 & 0 & 0 & \end{pmatrix}$$

where

$$\sigma_1 = \cos(q_2)\cos(q_5) - \cos(q_4)\sin(q_2)\sin(q_5)$$

$$\sigma_2 = \cos(q_2)\sin(q_5) + \cos(q_4)\cos(q_5)\sin(q_2)$$

$$\sigma_3 = \cos(q_1)\cos(q_4) - \cos(q_2)\sin(q_1)\sin(q_4)$$

$$\sigma_4 = \cos(q_4)\sin(q_1) + \cos(q_1)\cos(q_2)\sin(q_4)$$

$$\sigma_5 = \cos(q_1)\cos(q_5)\sin(q_2)$$

$$\sigma_6 = \cos(q_5)\,\sigma_9 - \sin(q_1)\sin(q_2)\sin(q_5)$$

$$\sigma_7 = \sin(q_5)\,\sigma_9 + \cos(q_5)\sin(q_1)\sin(q_2)$$

$$\sigma_8 = \cos(q_5)\,\sigma_{10} + \cos(q_1)\sin(q_2)\sin(q_5)$$

$$\sigma_9 = \cos(q_1)\sin(q_4) + \cos(q_2)\cos(q_4)\sin(q_1)$$

$$\sigma_{10} = \sin(q_1)\sin(q_4) - \cos(q_1)\cos(q_2)\cos(q_4)$$

Test cinematica inversa

```
d_2 = 1;
d_6 = 1;
q_1 = 0.1;
q_2 = 0.2;
q_3 = 0.3;
q_4 = 0.4;
q_5 = 0.5;
q_6 = 0.6;
T_06 = subs(T06, [q1,q2,q3,q4,q5,q6,d2,d6], [q_1,q_2,q_3,q_4,q_5,q_6,d_2,d_6]);
round(cinInvStanford(T_06, d_2, d_6), 2)
```

```
ans = (0.1   0.2   0.3   0.4   0.5   0.6)
```