**Lezione 04/03/2004**
**Testo pagg. 81-88**

a) Convenzioni di Denavith - Hartenberg
b) Esempi

# denavith - hartenberg

| ① | ② | ③ | ④ |
|---|---|---|---|
| $d_i$ j | $\theta_i$ j | $a_i$ j | $\alpha_i$ |
| trasl | rot | tras | rot |

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① $T_d = \begin{bmatrix} I & \underline{d}_i \\ \underline{0}^T & 1 \end{bmatrix}$ $\qquad \underline{d}_i = \begin{bmatrix} 0 \\ 0 \\ d_i \end{bmatrix}$

② $T_\theta = \begin{bmatrix} R_\theta & \underline{0} \\ \underline{0}^T & 1 \end{bmatrix}$ $\qquad \underline{R}_\theta = Rot(\underline{k}_{i-1}, \theta_i)$

$\downarrow$

$\begin{bmatrix} C_{\theta_i} & \cdots & 0 \\ \vdots & \cdots & 0 \\ 0 & 0 & 1 \end{bmatrix}$

③ $T_a = \begin{bmatrix} I & \underline{a}_i \\ 0^T & 1 \end{bmatrix}$ $\qquad \underline{a}_i = \begin{bmatrix} a_i \\ 0 \\ 0 \end{bmatrix}$

5/4/04 (2)

(4)

$$T_\alpha = \begin{bmatrix} R_\alpha & \underline{0} \\ \underline{0}^T & 1 \end{bmatrix} \qquad R_\alpha = Rot(i_{i-1}, \alpha)$$

$$R_\alpha = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cdot & \cdot \\ 0 & \cdot & \cdot \end{bmatrix}$$

$$T_i^{i-1} = T_{d_i} T_{\theta_i} T_{a_i} T_{\alpha_i}$$

PARAMETRI DH

| i | d | θ | a | α |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| ⋮ | | | | |

$d_i(t)$ se giunto i-1 prismatico

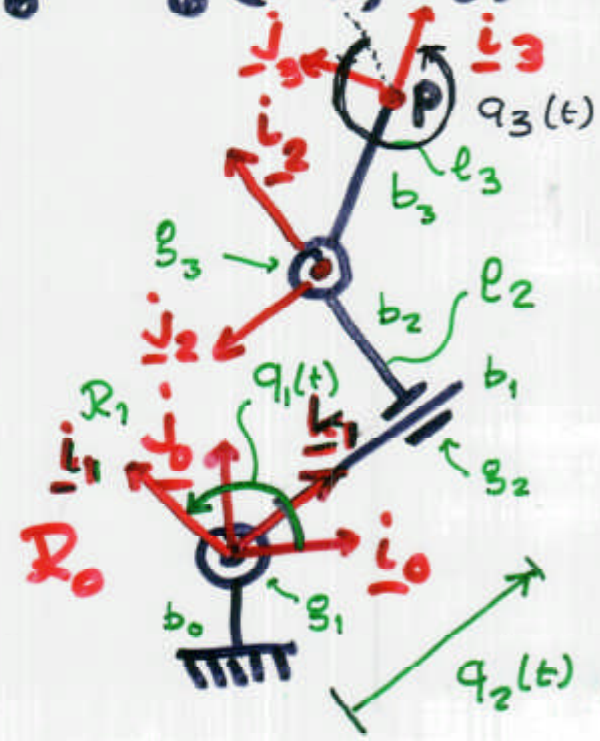
$\theta_i(t)$ se giunto i-1 rotoidale

$$T_6^0 = T_1^0 T_2^1 T_3^2 \cdots T_6^5$$

$$T_i^{i-1} = T_i^{i-1}(q_i(t))$$

$q_i$ < $\theta_i$ se Rot
$d_i$ se Pri

$$T_6^0 = T_6^0(q_1, q_2, \cdots, q_6) = T_6^0(\underline{q}(t))$$




**PLANARE !** R-P-R

$d_1 = 0$
$\theta_1 = q_1(t)$
$a_1 = 0$
$\alpha_1 = 90°$

$d_2 = q_2(t)$
$\theta_2 = 0$
$a_2 = \ell_2 = \text{cost}$
$\alpha_2 = 90°$ ?

$d_3 = \ell_3 = \text{cost}$
$\theta_3 = q_3(t)$
$a_3 = 0$
$\alpha_3 = 0$

# CINEMATICA DELLA PUNTA P

5/4/04

$$T_3^0 = \begin{bmatrix} \boxed{R_3^0} & \underline{t}_3^0 \\ \underline{0}^T & 1 \end{bmatrix}$$

$R_3^0$ ? lo devo calcolare ?

NO

$$R_3^0 = \begin{bmatrix} \cos(q_1+q_3) & 0 & -\sin(q_1+q_3) \\ \sin(q_1+q_3) & 0 & \cos(q_1+q_3) \\ 0 & 1 & 0 \end{bmatrix}$$

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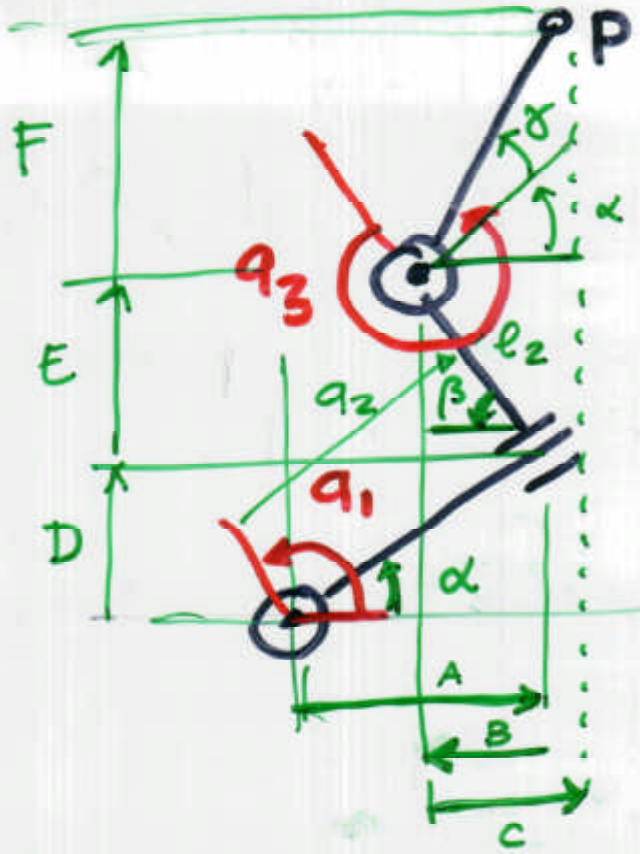


$$x_P = A + B + C$$

$$y_P = D + E + F$$

$$q_1 = \alpha + 90°$$

$$\alpha = q_1 - 90°$$

$$\beta = 90° - \alpha$$

$$q_3 = 270° + \gamma$$

$$A = q_2(t)\cos\alpha(t)$$

$$B = -\ell_2 \cos\beta$$

$$C = \ell_3 \cos(\alpha + \gamma)$$

$$\underline{t}_3^0 = \begin{bmatrix} x_P \\ y_P \\ 0 \end{bmatrix}$$

$$T_3^0 = \begin{bmatrix} R_3^0 & \underline{t}_3^0 \\ \underline{0}^T & 1 \end{bmatrix}$$