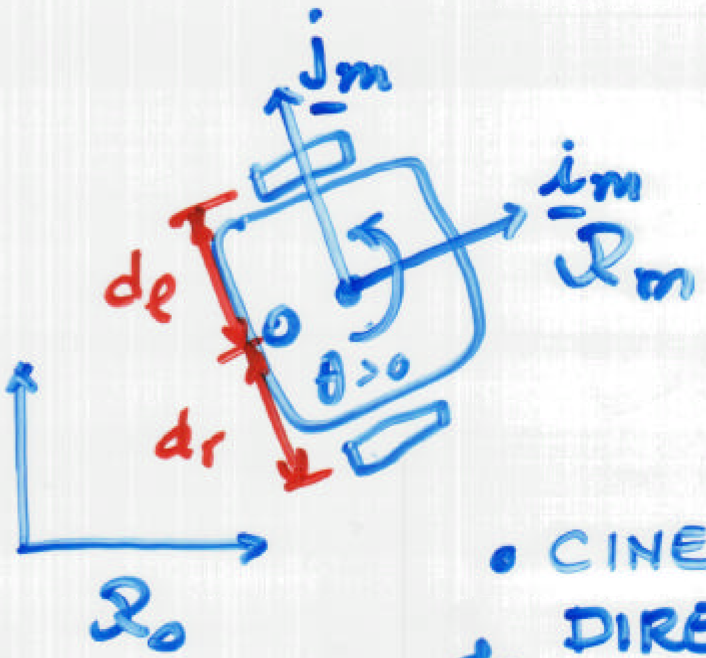


• CINEMATICA

& DIRETTA
INVERSA

r_r ; r_e raggi ruote

$r_r = r_e$ per ipotesi $= r$

$\|\omega_r\| = \dot{\varphi}_r(t)$
$\|\omega_e\| = \dot{\varphi}_e(t)$ } variabili di comando giunto

d_r ; d_e lunghezze semiasse

$d_r = d_e = d$ per ipotesi

$\mathcal{R}_m$ sta sull'asse tale che

Ruota destra è centrata in

$$\begin{bmatrix} 0 \\ -d \\ 0 \end{bmatrix}_{\mathcal{R}_m}$$

ruota sinistra

$$\begin{bmatrix} 0 \\ d \\ 0 \end{bmatrix}_{\mathcal{R}_m}$$

VARIABILI GIUNTO

$q_r(t)$ e $q_\ell(t)$

$\dot{q}_r = V_r(t) \quad V_\ell(t) = \dot{q}_\ell$

Comandi dati come incremento di conteggi ?!?

ENCODER

KEPHERA II

24 slot

motoriduttore da 25:1

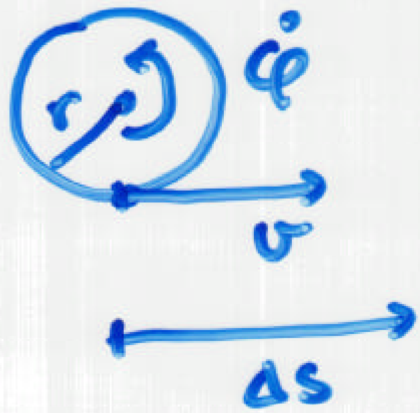
$24 \times 25 = 600$

$\frac{600}{2\pi}$ = risoluzione x radiante

$t \rightarrow t_k ; t_{k+1} ; t_{k+2}$

$T = 1$ ms
10 ms
20 ms

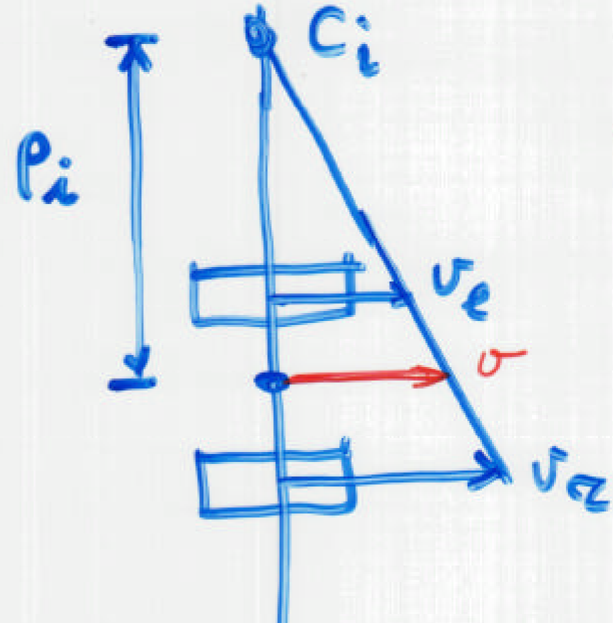
$$v_r = r\,\dot{\varphi}_r$$
$$v_\ell = r\,\dot{\varphi}_s$$



$$v_r \Delta T = \Delta s_r$$
$$v_\ell \Delta T = \Delta s_\ell$$

$$\Delta s_r = \int_{t_{k-1}}^{t_k} v_r(\tau)\, d\tau = v_r \Delta T$$

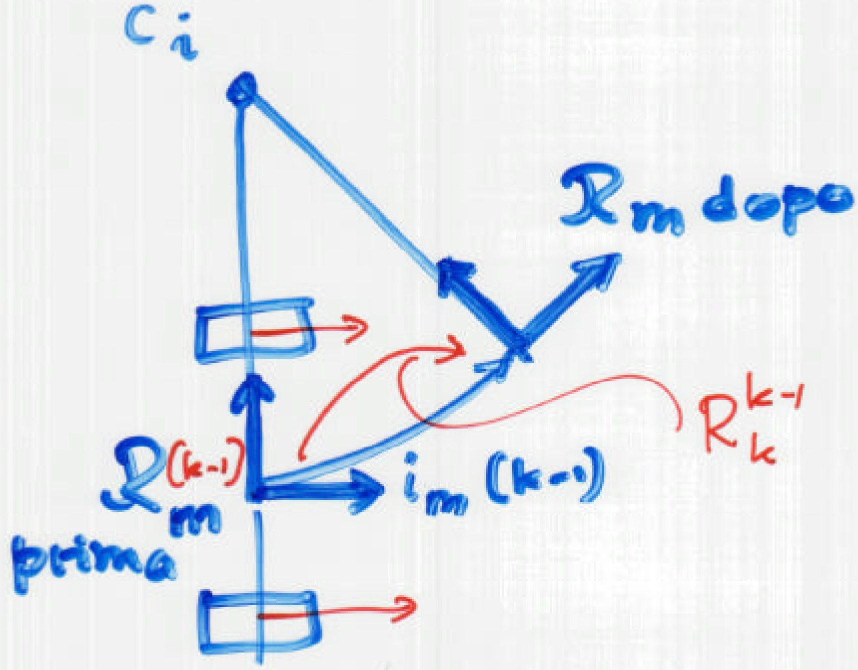
$$\Delta T \doteq t_k - t_{k-1}$$



$\rho_i \to \infty$
per
$v_r - v_\ell \to 0$

$$v = \frac{v_r + v_\ell}{2}$$

tra k-1 e k ΔT



CINEMATICA DIRETTA

AL TEMPO k-1
CONOSCIAMO

$$T_m^0(k-1) < \begin{matrix} R_m^0(k-1) \rightarrow \theta(k-1) \\ t_m^0(k-1) \end{matrix}$$

& COMANDI

$v_z(k)$

$v_e(k)$

$\mathcal{R}_m(k-1)$

$$\underline{v_z} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} v_z$$

$$\underline{v_e} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} v_e$$

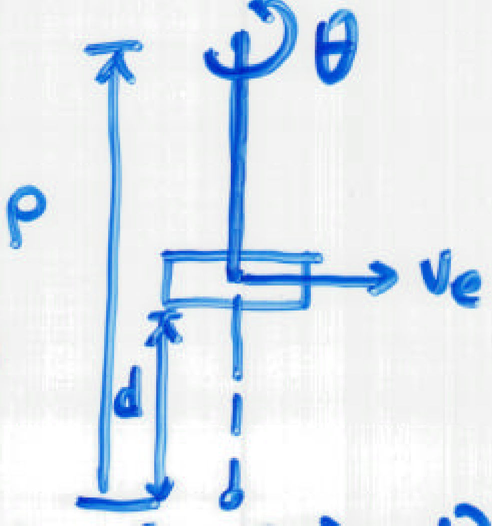
CALCOLARE

$$T_m^0(k) < \begin{matrix} R_m^0(k) \rightarrow \theta(k) \\ t_m^0(k) \end{matrix}$$

$$v_\ell(k) = r\,\dot{\varphi}_\ell(k)$$

$$= (\rho - d)\,\dot{\theta}$$

$$= (\rho_i(k) - d)\,\dot{\theta}(k)$$



$$v_r = r\,\dot{\varphi}_r(k) = (\rho_i(k) + d)\,\dot{\theta}(k)$$

$$v_r + v_\ell = 2\rho_i\,\dot{\theta} \longrightarrow \boxed{\dot{\theta} = \frac{v_r + v_\ell}{2\rho} \qquad \rho = \frac{v_r + v_\ell}{2\dot{\theta}}}$$

se $\dot{\theta} = 0$ $\rho \to \infty$

$$v_r - v_\ell = 2d\,\dot{\theta} \longrightarrow \dot{\theta} = \frac{v_r - v_\ell}{2d}$$

se $v_r = v_\ell$ $\dot{\theta} \to 0$

$$v_0 = \frac{v_r + v_\ell}{2}$$

METODO A

esatto, ma dipende da ρ

e non si può usare se $\rho \to \infty$

METODO B

approssimato, si può usare sempre

— o —

METODO A vale solo se $v_r \neq v_e$

o meglio se

$v_r - v_e \geq \varepsilon$ assegnato

passo

$k = k-1$ $R^0_m(k-1)$ e $\underline{P}(k-1)$

1. Calcolo di $\dot\theta(k) = \dfrac{v_r(k) - v_e(k)}{2d}$

2. Calcolo $\rho_i(k) = \dfrac{v_r(k) + v_e(k)}{2\dot\theta(k)}$

3. Calcolo $\Delta\theta(k) = \dot\theta(k)\Delta T$

4. Calcolo matrice

$$R^{k-1}_k = \begin{bmatrix} \cos\Delta\theta(k) & -\sin\Delta\theta(k) & 0 \\ \sin\ldots & \cos\ldots & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

5. Calcolo

$R^0_m(k)$

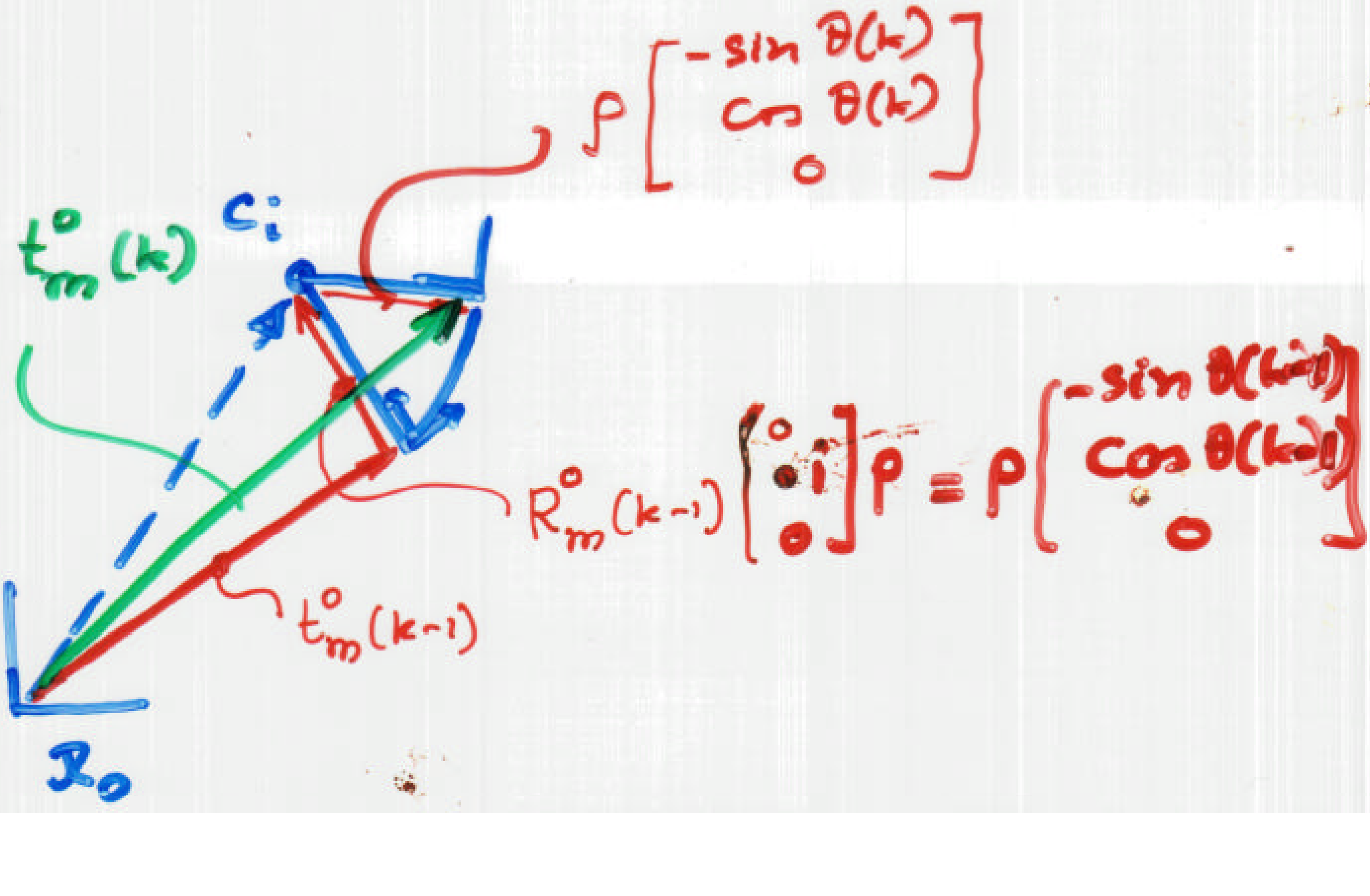
a) calcolo $\theta(k) = \theta(k-1) + \Delta\theta(k)$

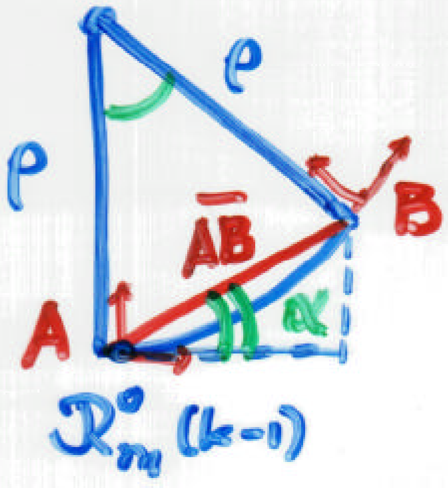
$$R^0_m(k) = \begin{bmatrix} \cos\theta(k) & -\sin\theta(k) & 0 \\ \sin\dots & \cos\dots & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

b)

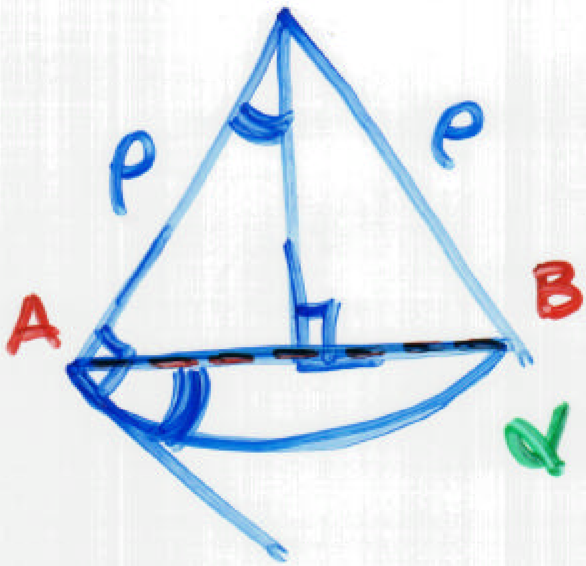
$$R^0_m(k) = R^0_m(k-1)\, R^{k-1}_k$$

c) $\underline{c}_i(k-1) = \underline{c}_i(k)$

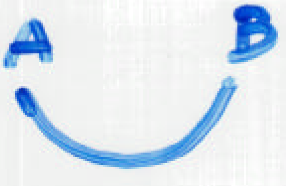




$$\overrightarrow{AB} = \begin{bmatrix}\cos\alpha \\ \sin\alpha \\ 0\end{bmatrix} AB$$



$$\alpha = \frac{\Delta\theta(k)}{2}$$

AB $\simeq$ 

Arco AB $\doteq \widehat{AB}$

$\approx v_0 \Delta T$ arco $\widehat{AB}$

APPROSSIMAZIONE È BUONA

METODO B

1) Calcolo di $\dot{\theta}(k)$ con A

2) " di $\Delta S(k) = \dfrac{v_r(k) + v_\ell(k)}{2} \Delta T$

3) $t_k^{k-1} = AB = \begin{bmatrix} \cos\frac{\Delta\theta}{2} \\ \sin\frac{\Delta\theta}{2} \\ 0 \end{bmatrix} \Delta S(k)$

4) $t^0_m(k) = t^0_m(k-1) + R^0_m(k-1)\, t^{k-1}_k$

— o —

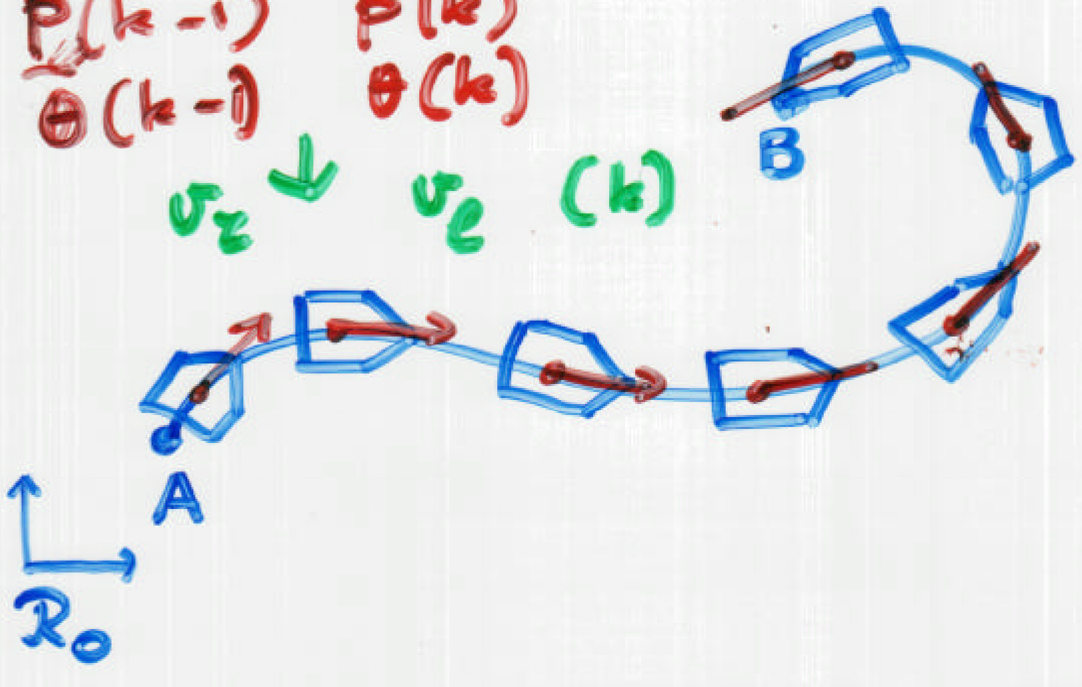
CINEMATICA INVERSA

$P(k-1)$ $\quad p(k)$

$\theta(k-1)$ $\quad \theta(k)$

$\downarrow$

$v_r \quad v_\ell \quad (k)$



$$\Delta\theta(k) = \theta(k) - \theta(k-1) \rightarrow \dot{\theta} = \frac{\Delta\theta(k)}{\Delta T}$$

$$\underline{v}(k) = \frac{\underline{p}(k) - \underline{p}(k-1)}{\Delta T}$$

$$\dot{\theta} = \frac{v_r - v_\ell}{2d} \rightarrow v_r(k) - v_\ell(k) = \dot{\theta}\, 2d$$

$$= \frac{2d}{\Delta T}\Delta\theta(k)$$

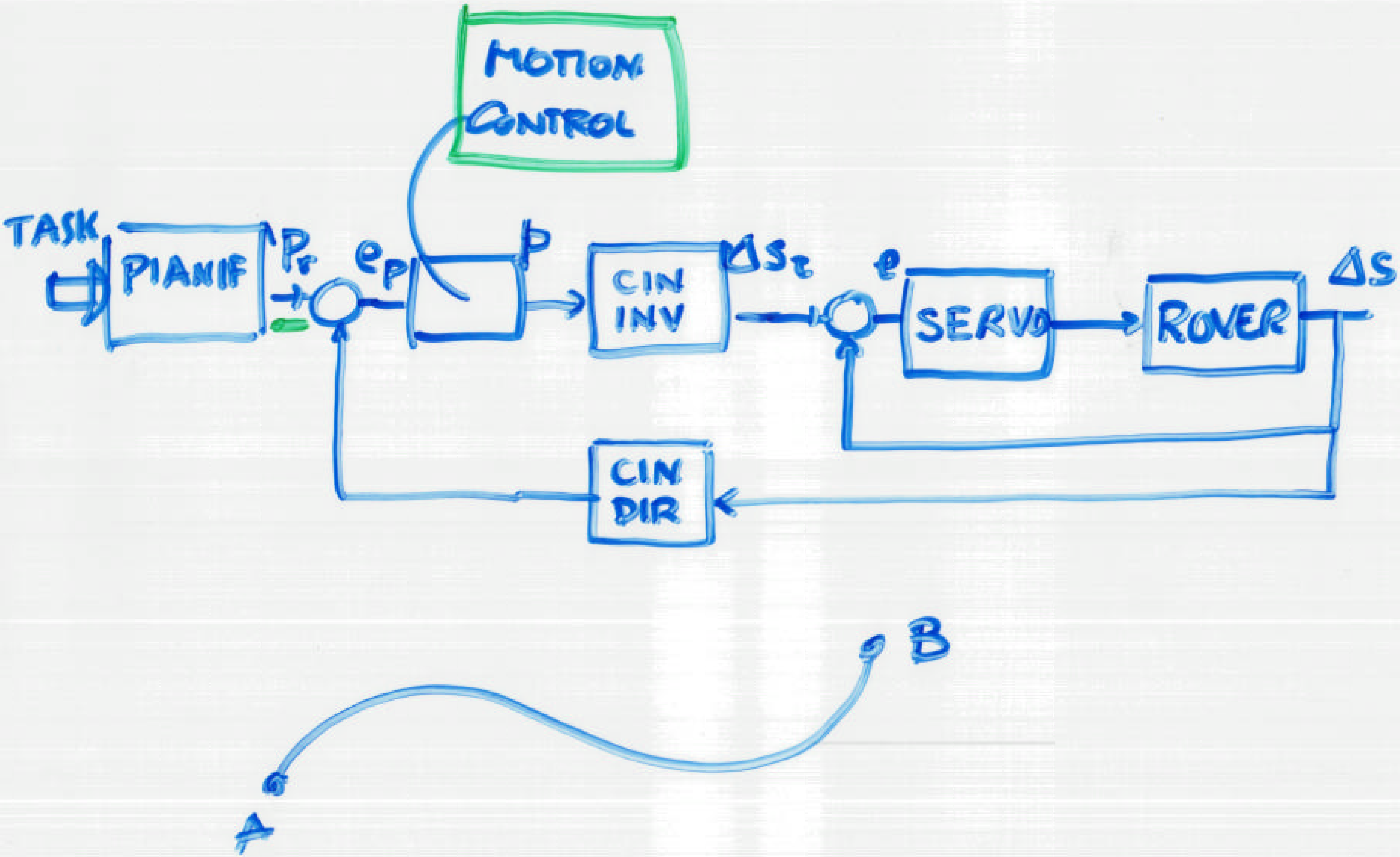
$$v_o = \frac{v_r + v_\ell}{2}$$

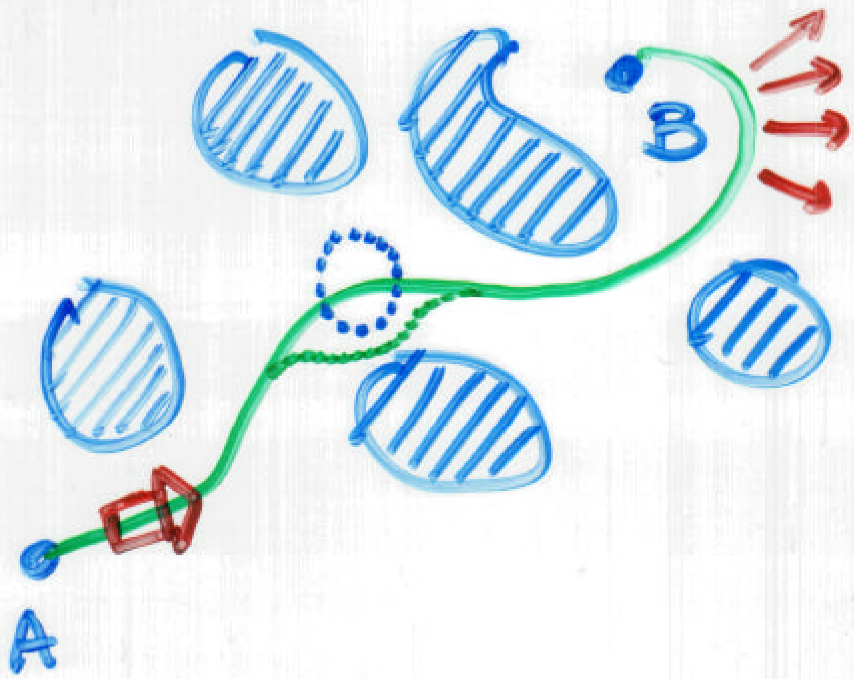
$$v_r + v_\ell = 2\|\underline{v}(k)\|$$

chiamiamo $V = \|\underline{p}(k) - \underline{p}(k-1)\|$

$$v_r + v_\ell = \frac{2}{\Delta T} V$$

$$\boxed{v_r = \frac{V + d\Delta\theta}{\Delta T} \qquad v_\ell = \frac{V - d\Delta\theta}{\Delta T}}$$


MOTION CONTROL
TASK
PIANIF
Pr
ep
P
CIN INV
ΔSr
e
SERVO
ROVER
ΔS
CIN DIR
B
A



B
A