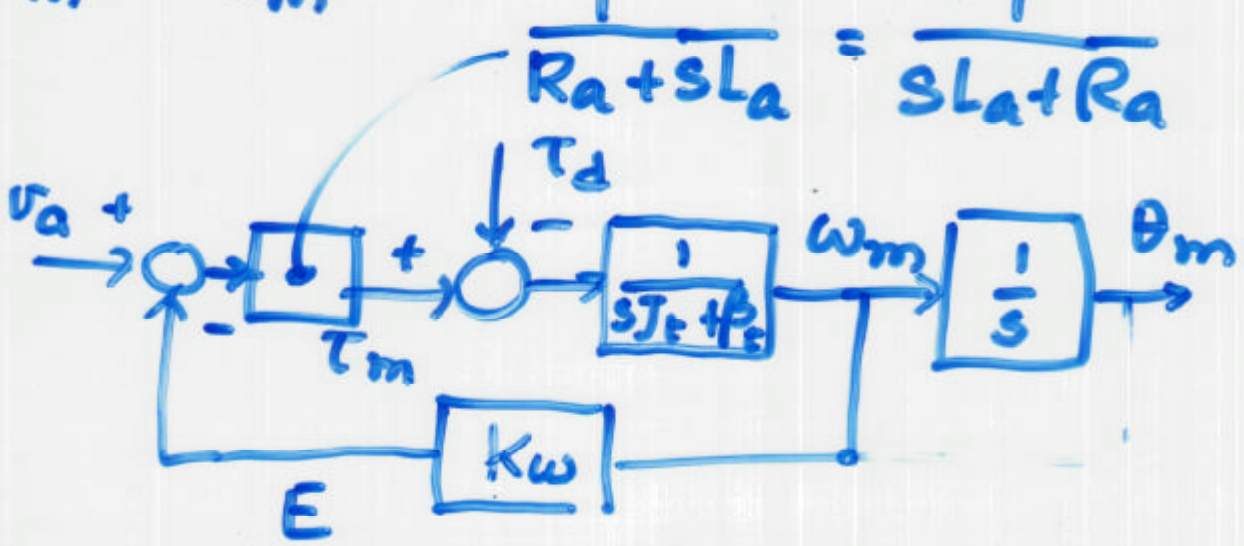
$$\tau_m(t) - \tau_d(t) = \tau_p(t) = J_t \ddot{\theta}_m(t) + \beta_t \dot{\theta}_m(t)$$

$$\downarrow$$

(disturbo)

$$\begin{cases} (sJ_t + \beta_t)\,\omega_m(s) = \tau_m(s) - \tau_d(s) \\ \omega_m = s\,\theta_m \end{cases}$$



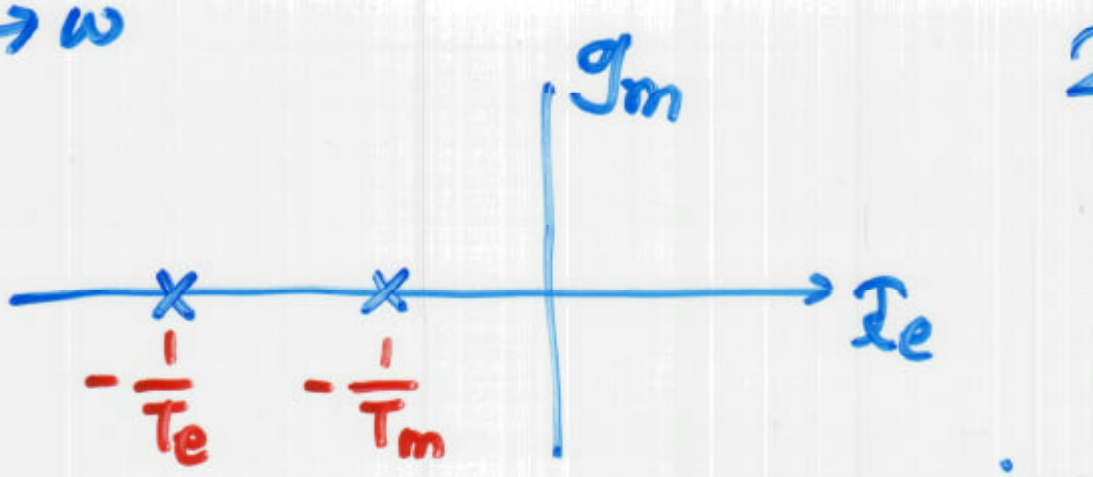
DINAMICA ELETTRICA

$$\frac{1}{sL_a + R_a} = \frac{\frac{1}{L_a}}{\left(s + \frac{R_a}{L_a}\right)} \qquad \frac{1}{T_e}$$ polo elettrico

DINAMICA MECCANICA

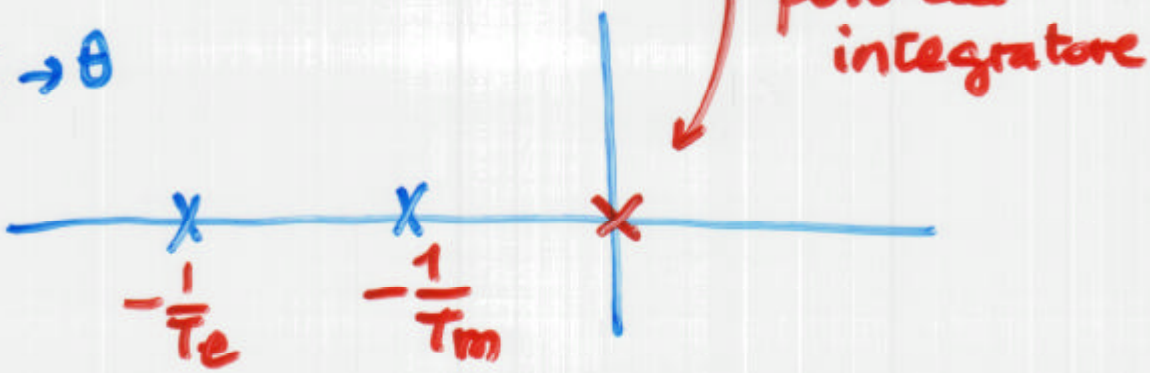
$$\frac{1}{sJ_t + \beta_t} = \frac{\frac{1}{J_t}}{s + (\beta_t / J_t)} \rightarrow \frac{1}{T_m}$$ polo meccanico

$\tau \to \omega$



$s = \sigma + j\omega$

$\tau \to \theta$



APPROSSIMAZIONE → DINAMICA ELETTRICA TRASCURABILE

$L_a \simeq 0 \qquad -\frac{1}{\tau_e} \to -\infty$

$$v_a - R_a i_a = K_\omega \omega_m$$

$$i_a = \frac{\tau_m}{K_\tau} \longrightarrow v_a - R_a \frac{\tau_m}{K_\tau} = K_\omega \omega_m$$

$$\tau_m = \tau_d + J_t \dot{\omega}_m + \beta_t \omega_m$$

$$v_a - \frac{R_a}{K_\tau} \tau_d = \left[\frac{R_a}{K_\tau} J_t s + \left(K_\omega + \frac{R_a}{K_\tau}\beta_t\right)\right] \omega_m$$

COSTANTE TECNOLOGICA

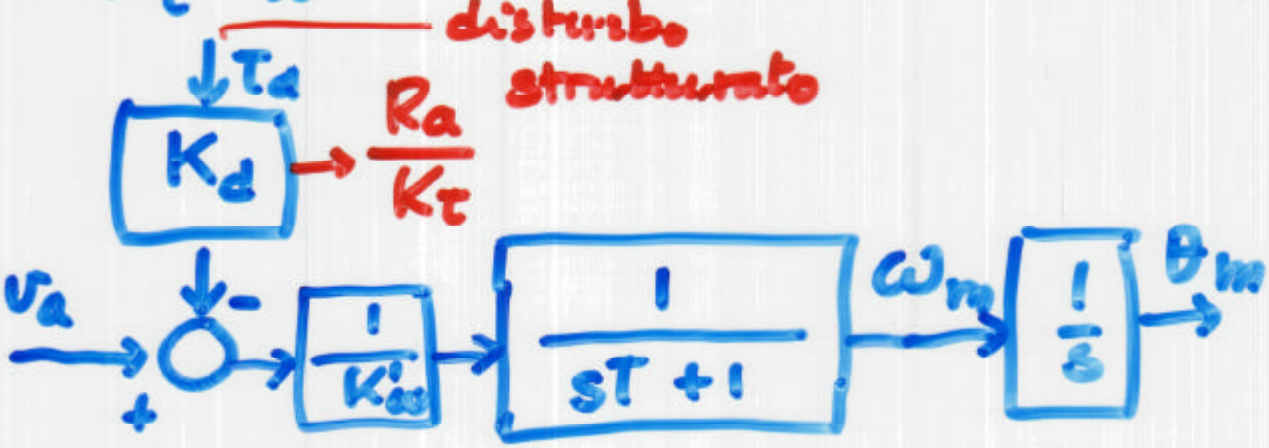
K'_ω

$$K'_\omega \simeq K_\omega$$

$$\left[\frac{R_a J_t}{K_\tau K'_\omega} s + 1\right] \omega_m = \frac{1}{K'_\omega} v_a - \frac{R_a}{K'_\omega K_\tau} \tau_d$$

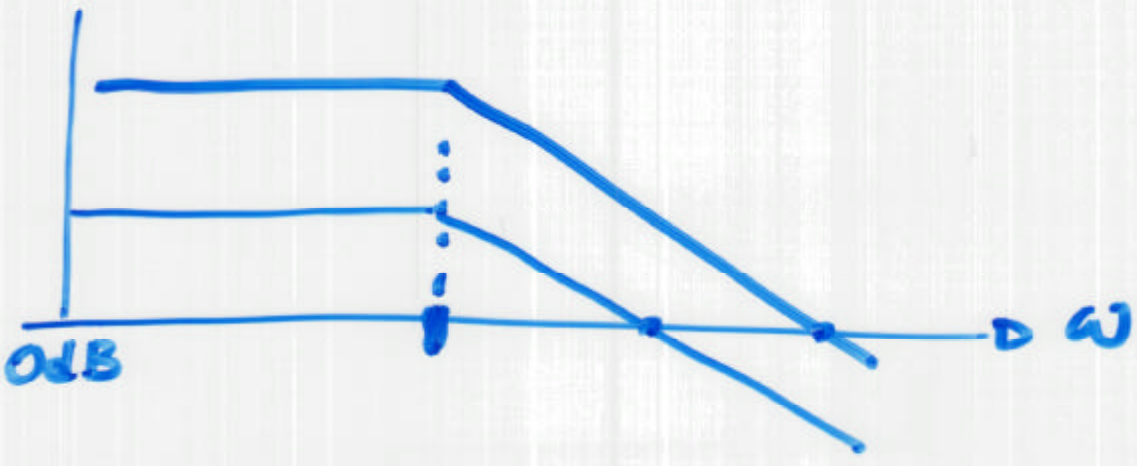
$= \tau$

$$T := \frac{R_a J_t}{K_t K'_\omega} \qquad J_t = J_m + \frac{1}{r^2} J_b(q)$$

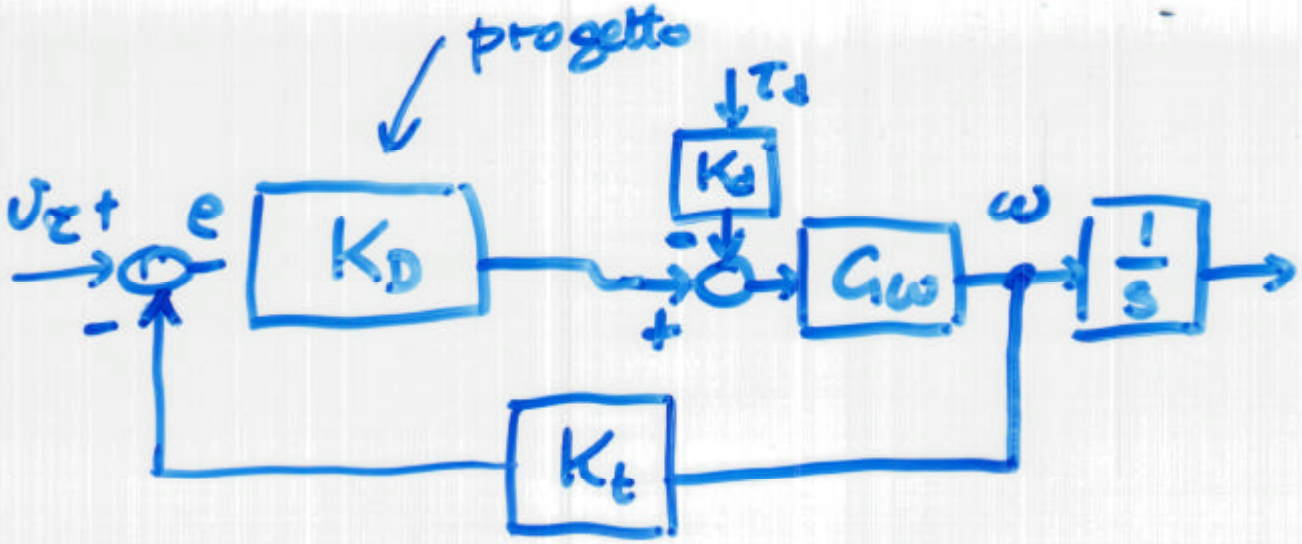


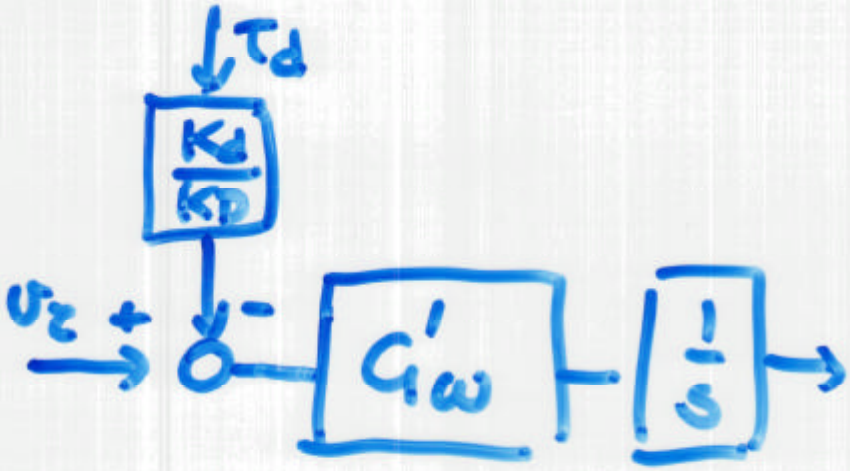
$$\frac{\omega_m}{v_a} = G_\omega(s) = \frac{1}{K'_\omega (sT+1)}$$

$$\frac{\omega_m}{\tau_d} = G_d(s) = -K_d G_\omega(s)$$



COMPENSATORE DI VELOCITA'

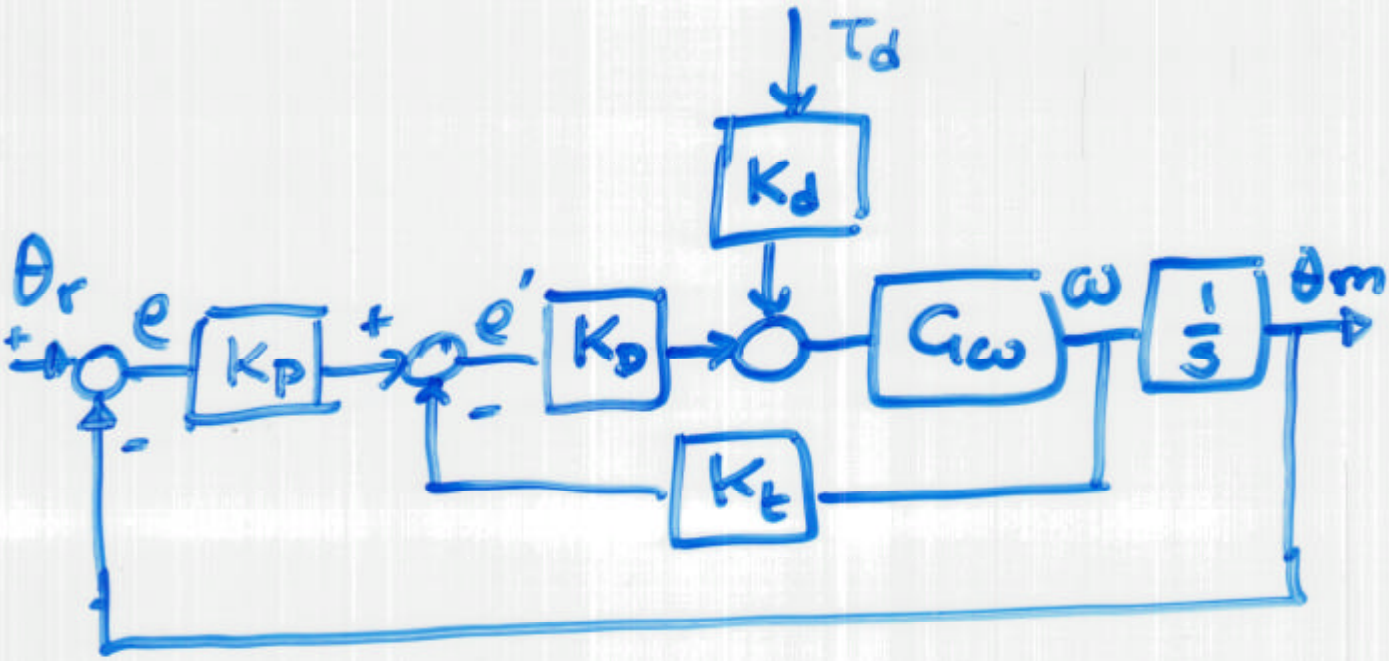




$$G_\omega \rightarrow G'_\omega = \frac{\alpha K_D}{K'_\omega (1 + s\alpha T)}$$

$$G_d \rightarrow G'_d = -\frac{K_d}{K_D} G'_\omega = -\frac{\alpha T}{J_t (1 + s\alpha T)}$$

$$\alpha = \frac{K'_\omega}{K'_\omega + K_D K_t} < 1$$



$$\frac{\theta_m}{\theta_r} = G_1(s) = \frac{K}{s^2 + s\frac{1}{\alpha T} + K}$$

$$\frac{\theta_m}{\tau_d} = G_2(s) = -\frac{1}{J_t\left(s^2 + s\frac{1}{\alpha T} + K\right)}$$

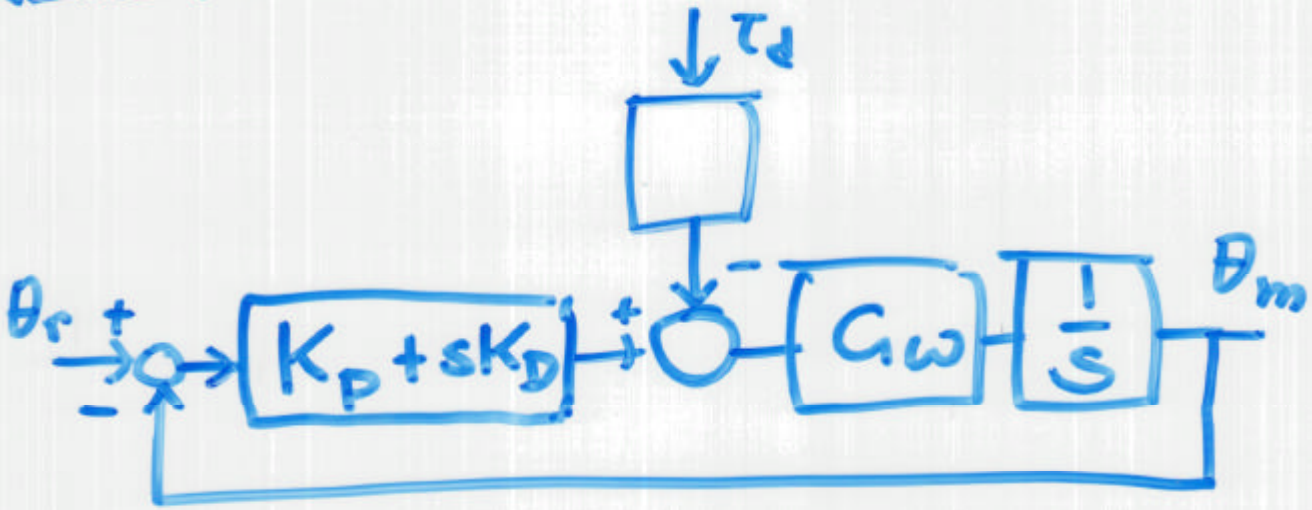
$$K = \frac{K_D K_p}{T K'_\omega} = \frac{K_D K_p K_\tau}{R_a J_t}$$

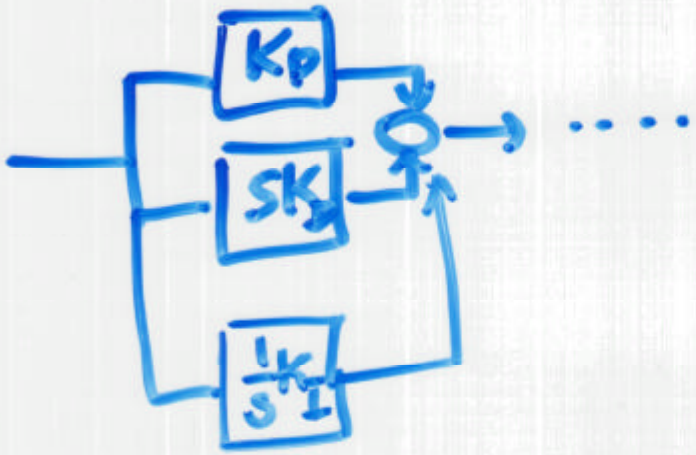
$$\xi = \frac{1}{2\alpha T\sqrt{K}} = \frac{1}{\sqrt{J_t}} \cdot \frac{K_\tau K'_\omega}{2\alpha\sqrt{R_a K_D K_p K_\tau}}$$

$$\omega_n = \sqrt{K} = \frac{1}{\sqrt{J_t}} \cdot \sqrt{\frac{K_D K_p K_T}{R_a}}$$

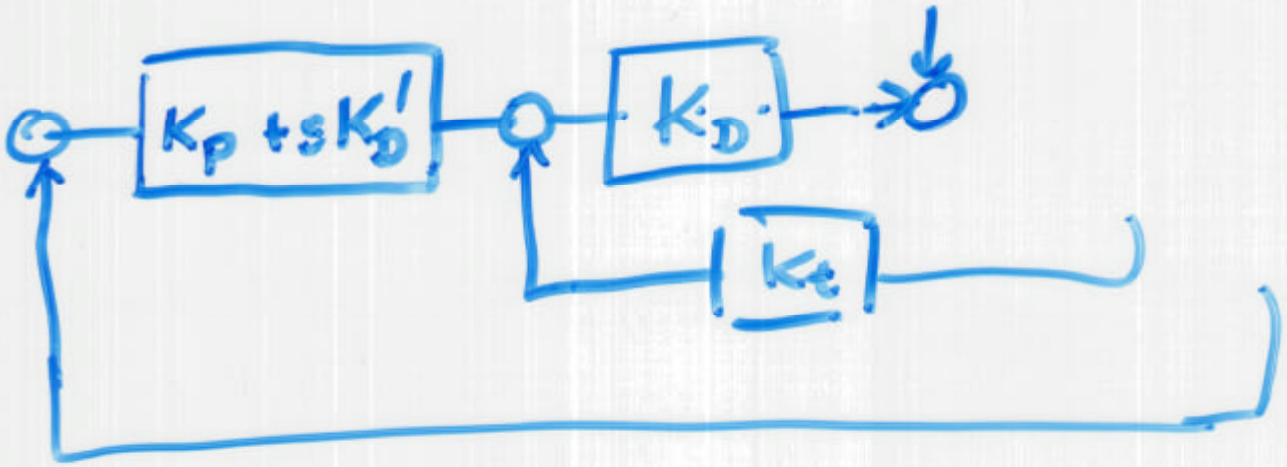
— o —

RETE PD





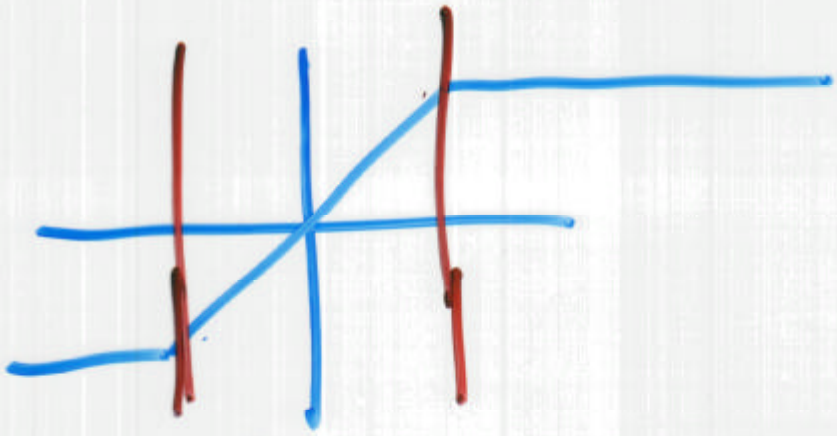
$$\zeta = \dots \frac{1}{\sqrt{J_t}} \qquad \omega_n = \dots \frac{1}{\sqrt{J_t}}$$



CONSIDERAZIONI PRATICHE

- DINAMICA "PARASSITA"
  ↓
  DINAMICA ELETTRICA

- ATTUATORI SONO SATURANTI



- ELASTICITA' NON CONSIDERATA
- ATTRITI NON LINEARI & BANDE MORTE