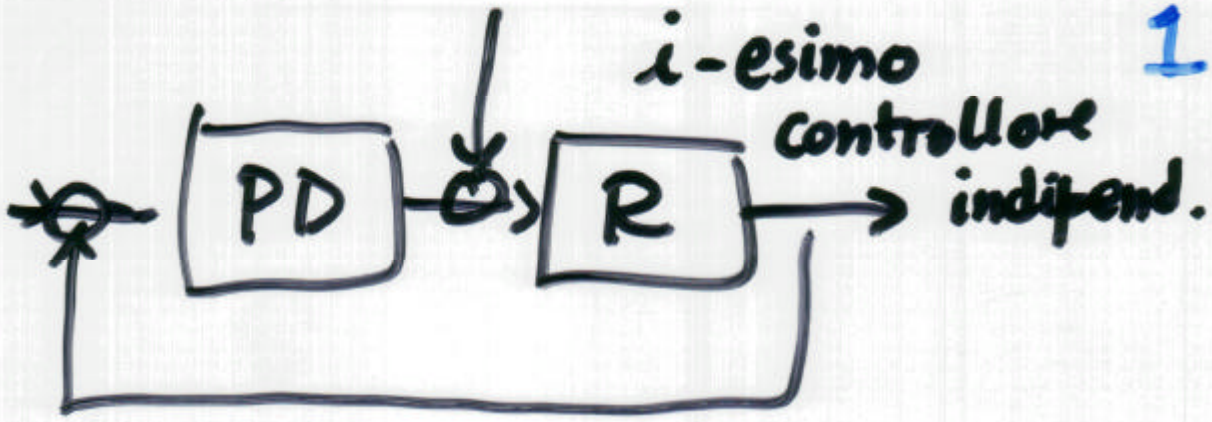


$$\xi \sim \frac{1}{\sqrt{J_t}} \qquad \omega_n \approx \frac{1}{\sqrt{J_t}}$$

$$J_t = \underbrace{\frac{1}{r_m^2} J_b}_{A} + \underbrace{J_m}_{B}$$

$$\frac{A}{A+B} = 10 \div 15\,\%$$

$$J_b = H_{ii}(q)$$

$$H = \begin{bmatrix} \cdots & \vdots & \cdots \\ \cdots & H_{ii} & \cdots \\ \cdots & \vdots & \cdots \end{bmatrix}$$

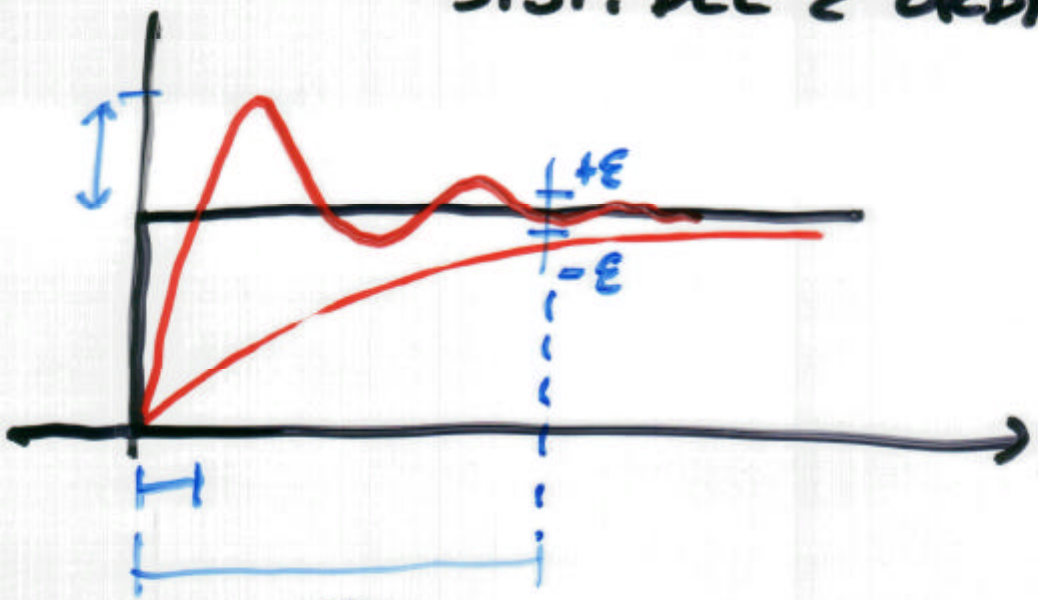
CONTROLLORE HA GUADAGNI

K_P & K_D COSTANTI

COME LI CALCOLO? DIVERSE STRATEGIE

A) STRATEGIA PRUDENTE "WORST-CASE"

SIST. DEL 2° ORDINE



$$T_{a\varepsilon} \simeq -\frac{1}{\zeta\omega_n} \ln 0.01\varepsilon \sim T_t$$

$$T_{a\varepsilon} < 1\,s$$

STIMO $T_{t\,MAX}$

USO $T_{t\,MAX}$ NELLE FORMULE

STABILISCO LE SPECIFICHE

RICAVO K_P e K_D

PARAMETRI IN FREQUENZA

PICCO DI RISONANZA

$$M_r = |G_{eq}(j\omega_r)| = \frac{1}{2\zeta\sqrt{1-\zeta^2}}$$

$$\omega_r = \omega_n\sqrt{1-2\zeta^2}$$

$$\omega_B \cong (-1.196\zeta + 1.85)\omega_n$$

però solo tra

$$0.3 \leq \zeta \leq 0.8$$

CASO PESSIMO → TROPPO CONSERVATIVO

CASO % PESSIMO : DIPENDE DAI MOVIMENTI "ATTESI"

CONSIDERAZIONI PRATICHE

• PRESTAZIONI A REGIME

$$e(t) = q_r(t) - q(t) = \frac{1}{r}\left(\theta_r(t) - \theta_m(t)\right) =$$

ANGOLI

ANTITRASFORMATE

$$= \frac{1}{r}\left(\theta_r(t) - G_1\theta_r - G_2\tau_d\right)$$

$$r\,e(s) = \left[1 - G_1(s)\right]\theta_r - G_2(s)\,\tau_d$$

ingresso a gradino $\theta_r = \frac{1}{s}$

disturbo " " $\tau_d = \frac{\tau_d}{s}$

per $t \to \infty$

$$e(s) = \frac{1}{r J_t k}\,\tau_d(s)$$

disturbo strutturato

eventuale disturbo additivo

$$= \frac{R_a}{r^2 K_D K_p K_\tau}\left(\tau_d' + \tau_e'\right)$$

τ_d' = effetti inerziali mutui +

+ effetti centrifughi & coriolis

+ effetti attrito

+ effetti gravitazionali

+ effetti environment

ATTIVI ANCHE PER $\dot{q}$ e $\ddot{q} \neq 0$

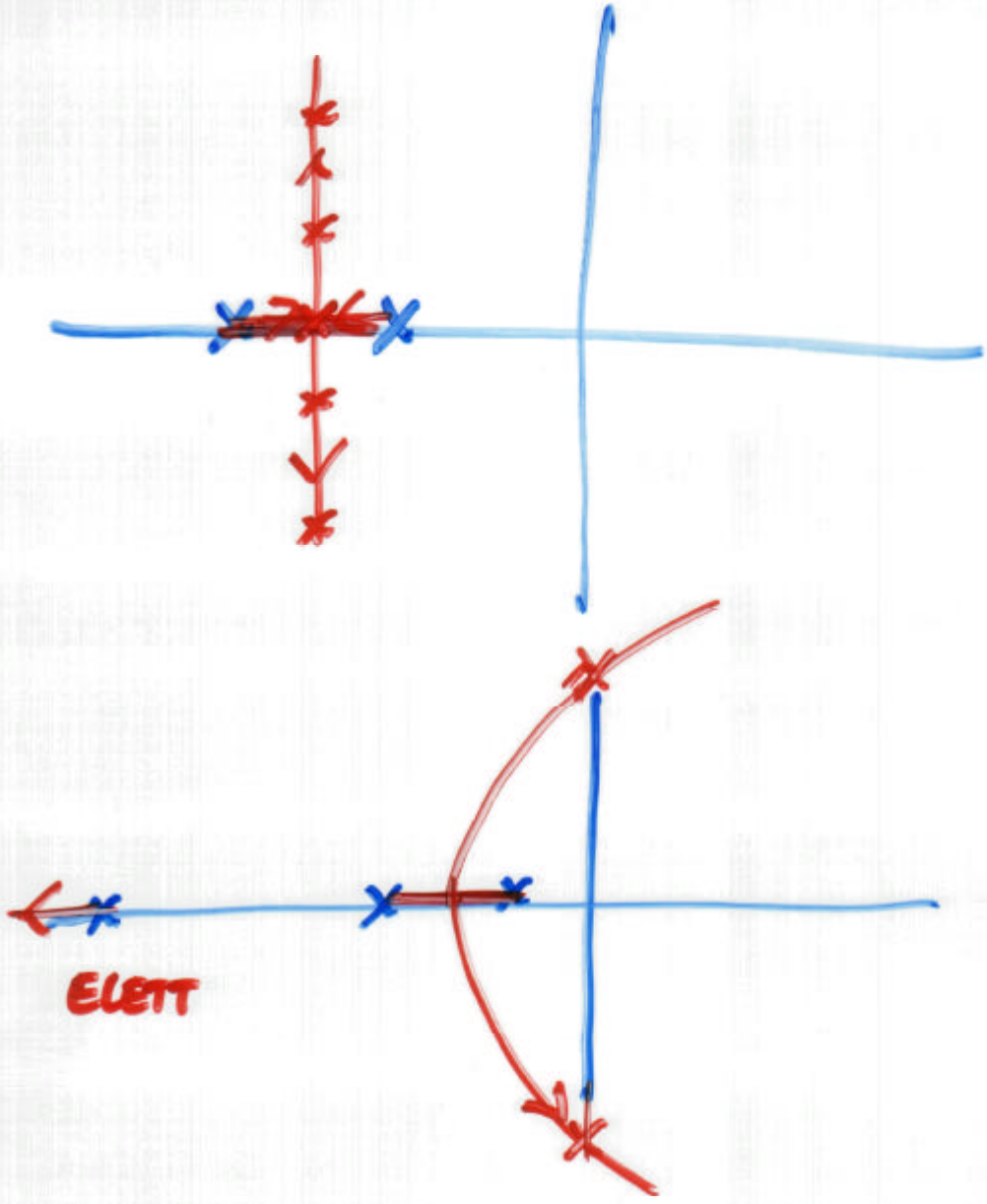
PER TOGLIERE L'ERRORE A REGIME SI AGGIUNGE AL CONTROLLORE UN TERMINE INTEGRATIVO

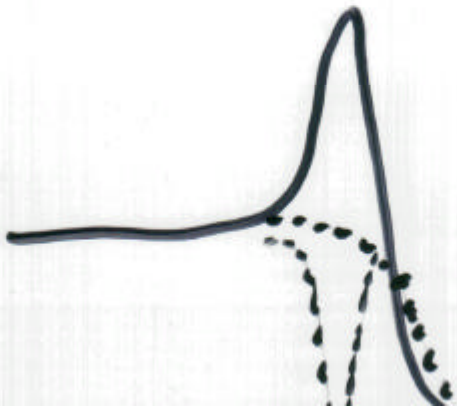
$$C(s) = K_p + sK_D + \frac{1}{s}K_I$$

- RICORDARE LE DINAMICHE "PARASSITE" TRASCURATE

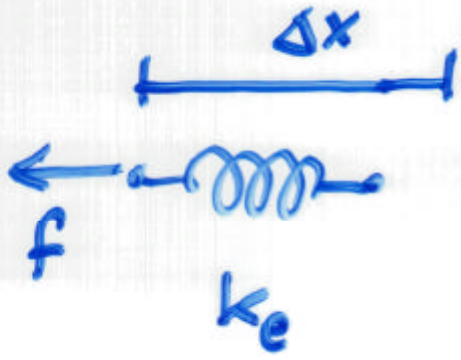
  a) DIN. ELETTRICA

  b) DIN. ELASTICA


ELETT



ELASTICITA'



$$f = k_e \Delta x$$

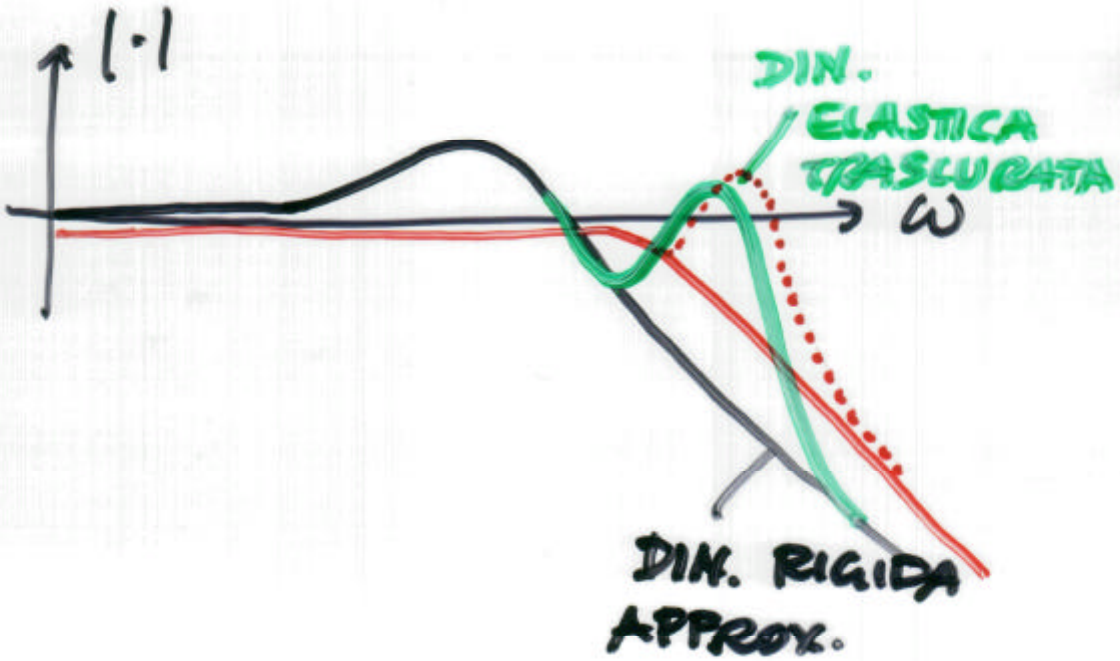
k_e grande = sistema + rigido

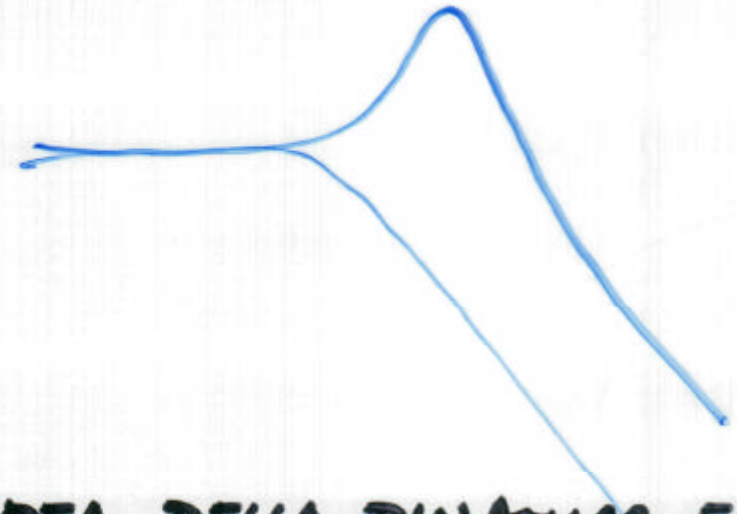
$$k_e > 10^5 \div 10^6$$

$k_e = \infty$ ALLORA SI' CHE E' RIGIDO

DOVE NASCE L'ELASTICITA'

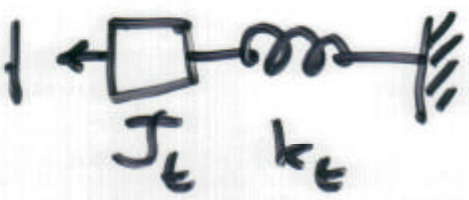
- ELASTICITA' "CONCENTRATA".
- " "DISTRIBUITA".
- " DOVUTA AL CONTROLLO.





UN' IDEA DELLA DINAMICA ELASTICA*

$$J_t \ddot{\theta}_m(t) + k_t \theta_m(t) = 0$$



$$\omega_{re} = \sqrt{\frac{k_t}{J_t}}$$

CON J_0 NOTO RICAVO ω_0

A J_t ?

$$\omega_{re} = \omega_0 \sqrt{\frac{J_0}{J_t}}$$

$$\frac{\omega_{re}}{\omega_{ro}} = \sqrt{\frac{J_0}{J_t}}$$

$$J\ddot{\theta} + k\theta = 0$$

MISURA DOVE? A o B ?

DI SOLITO MISURO IN A PER MUOVERE BRACCIO