RETI CORRETTRICI

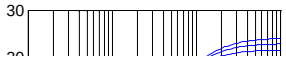
(VEDI VITELLI, VOL.2, PAR. 2.1, 2.1.1,2.2, 2.2.1, 2.2.2,2.2.3)

Dopo aver soddisfatto le specifiche a regime, si passa al transitorio:

1. Tracciare il diagramma di Bode di $(K_c/s^h)\,F(s)$
2. Osservare ω_T e m_φ
3. Confrontarli con quelli desiderati
4. Aggiungere in cascata una o più reti di correzione

- **Modificano selettivamente (a certe frequenze) modulo e/o fase di F(s)**
- **Sono semplici FILTRI**
- **Se ne possono usare più d'una in cascata**
- **Due tipi elementari:**

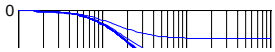
ANTICIPATRICE



$$\frac{1+\tau s}{1+\frac{\tau}{m}s}$$

$m = 2,4,\cdots,16$

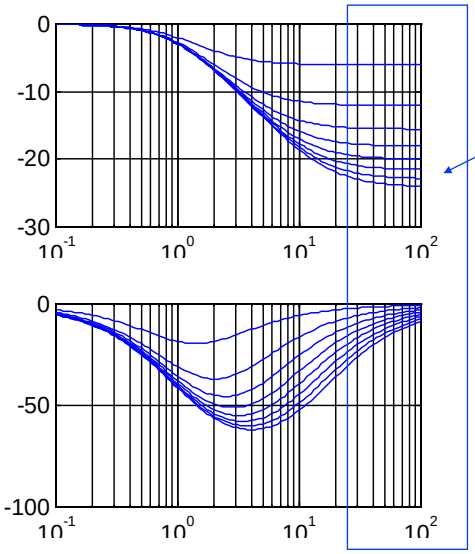
ATTENUATRICE



$$\frac{1+\frac{\tau}{m}s}{1+\tau s}$$

$m = 2,4,\cdots,16$

ATTENUATRICE



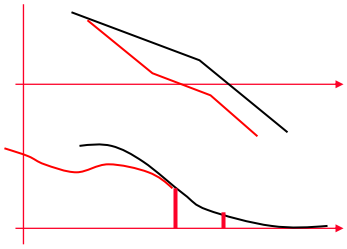
prima il polo poi lo zero

Zona utile

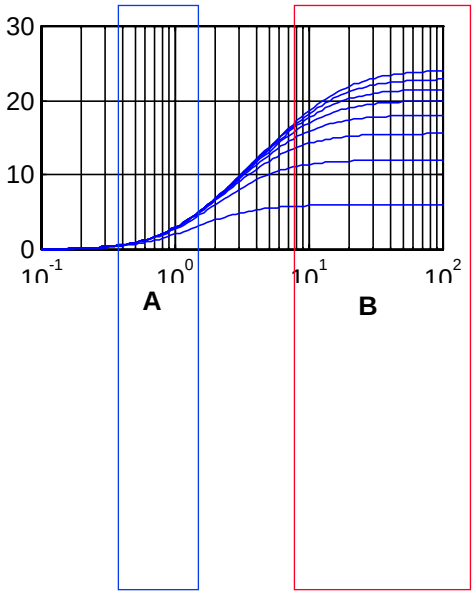
Riduce il modulo selettivamente

ma

aumenta lo sfasamento



ANTICIPATRICE



prima lo zero poi il polo

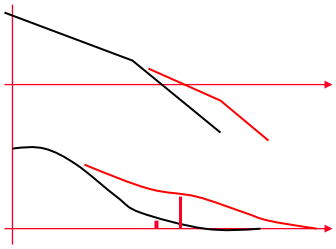
A:

aumenta le fasi e

poco il modulo

B:

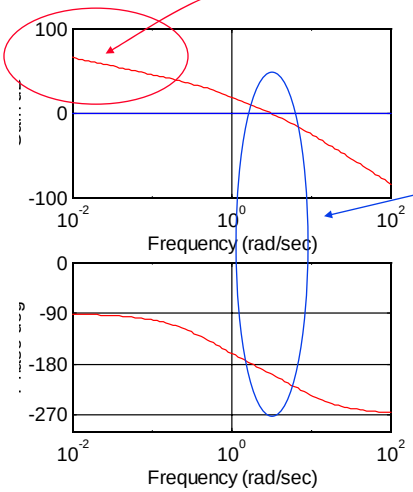
aumenta modulo e fasi



INIZIALMENTE..

Diagrammi di Bode dopo aver imposto il comportamento a regime

$$\frac{K_c}{s^h} P(s)H(s)$$



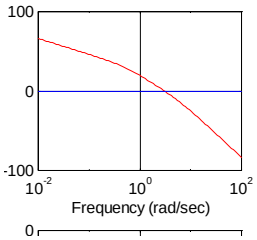
Bloccato perché imposto dalle specs a regime (si può aumentare K_F)

Da modificare per imporre

ω_T e m_ϕ

i.e. il transitorio

SITUAZIONI SEMPLICI E PROVVEDIMENTI



Aumentare m_ϕ : diversi casi

1) $m_\phi = m_\phi^*$ per $\omega = \omega_T^*$

2) $m_\phi < m_\phi^*$ per $\omega = \omega_T^*$

Aumentare ω_T: facile aumento di K_F anticipatrice (B)

*** = desiderato**

1) $\omega_T < \omega_T^*$ **aumentare** ω_T

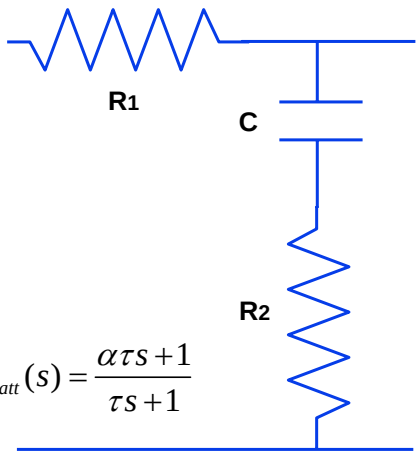
$\omega_T \geq \omega_T^*$ **attenuatrice**

2) $\omega_T << \omega_T^*$ **anticipatrice (B)**

$\omega_T \geq \omega_T^*$ **anticipatrice (A)**

ATTENUATRICE ED ANTICIPATRICE

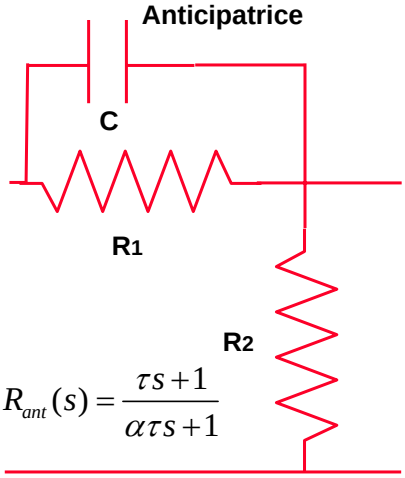
Attenuatrice



$$R_{att}(s) = \frac{\alpha\tau s + 1}{\tau s + 1}$$

$$\tau = (R_1 + R_2)C; \quad \alpha = \frac{R_2}{R_1 + R_2}$$

Anticipatrice

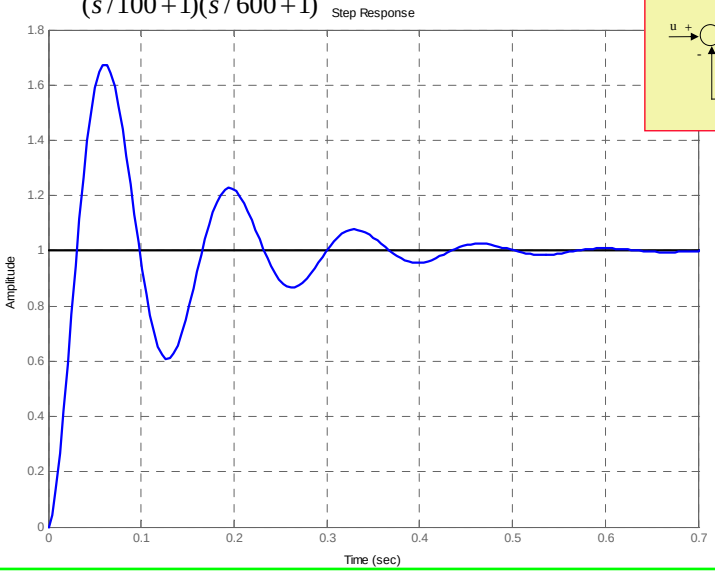


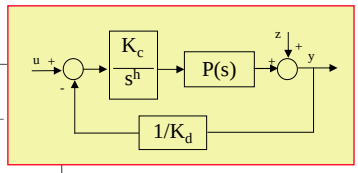
$$R_{ant}(s) = \frac{\tau s + 1}{\alpha\tau s + 1}$$

$$\tau = R_1 C; \quad \alpha = \frac{R_2}{R_1 + R_2}$$

ESEMPIO SINTESI ANTICIPATRICE

$$P(S) = \frac{500(s/60+1)(s/300+1)}{(s/100+1)(s/600+1)}; \; K_c = 4; \; h = 2; \; K_d = 1$$



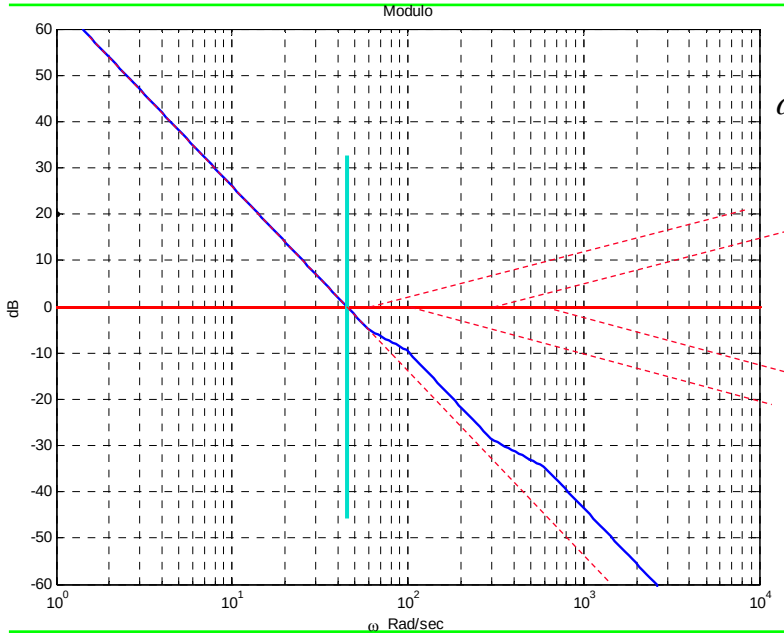


Risposta indiciale della $W(s)$

$t_r = 0.0214$ sec

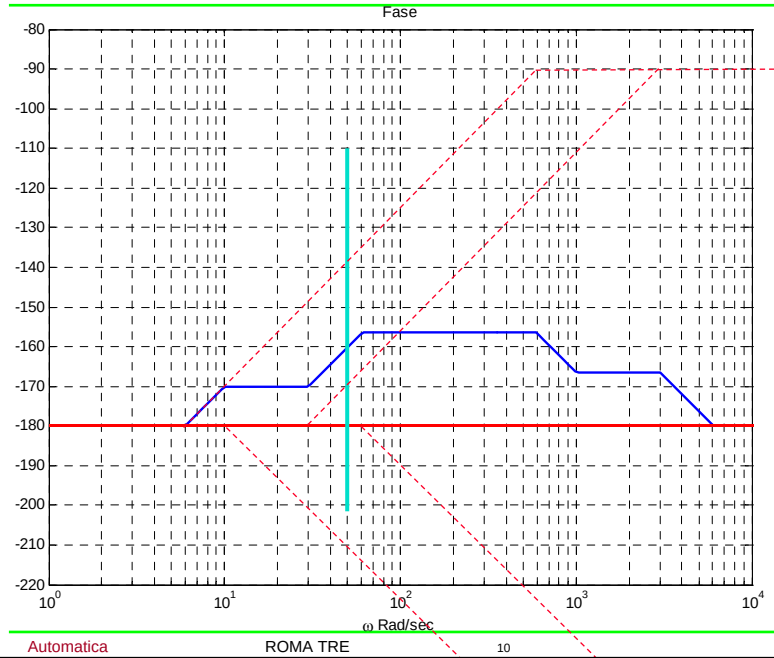
$s = 0.7$

MODULO



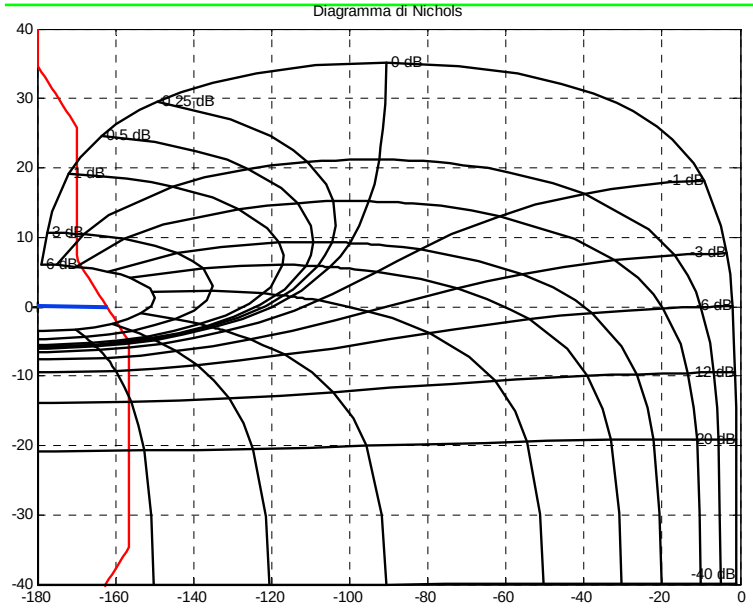
$\omega_t = 43$ rad/sec

FASE



$m_\varphi = 20^\circ$

NICHOLS PRIMA DELLA CORREZIONE



$\omega_{-3} = 77$ rad/sec

$M_r = 10.6$dB

SPECIFICHE SUL TRANSITORIO

Tempo di salita dimezzato

$\rightarrow$ Banda passante doppia ($\omega_{-3} t_r = 0.00698$)

$\rightarrow$ ω_t di taglio doppia (maggiore di 100 rad/sec)

Sovraelongazione massima del 10%

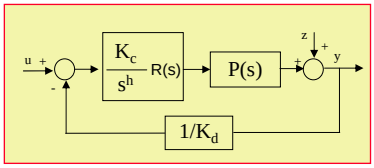
$\rightarrow$ $M_r = 1.29$ $\quad (1 + s \simeq 0.85 M_r)$

$\rightarrow$ $m_\varphi > 52.2$ $\quad (m_\varphi > 60° \times (1 - M_r \,|\, \text{dB} * 0.1)$

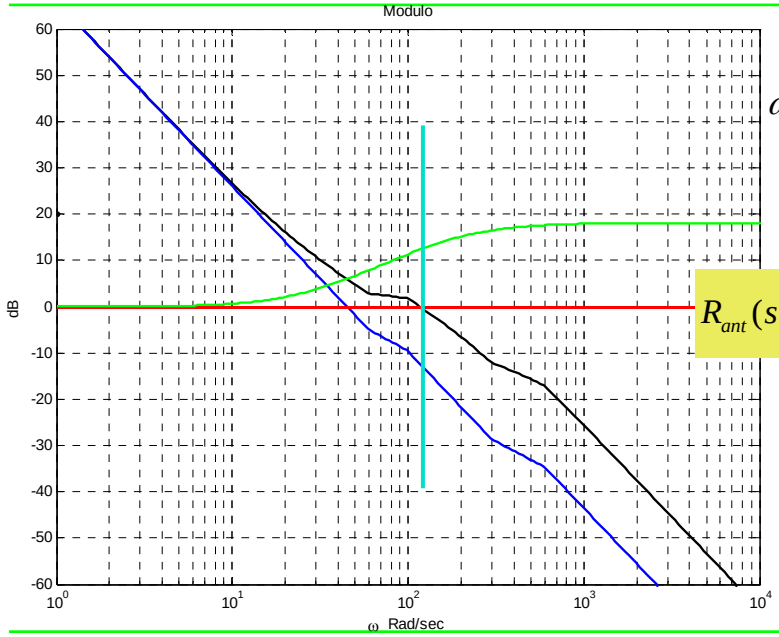
Scegliamo:

$\omega_t = 110$ rad/sec

$m_\varphi = 70°$



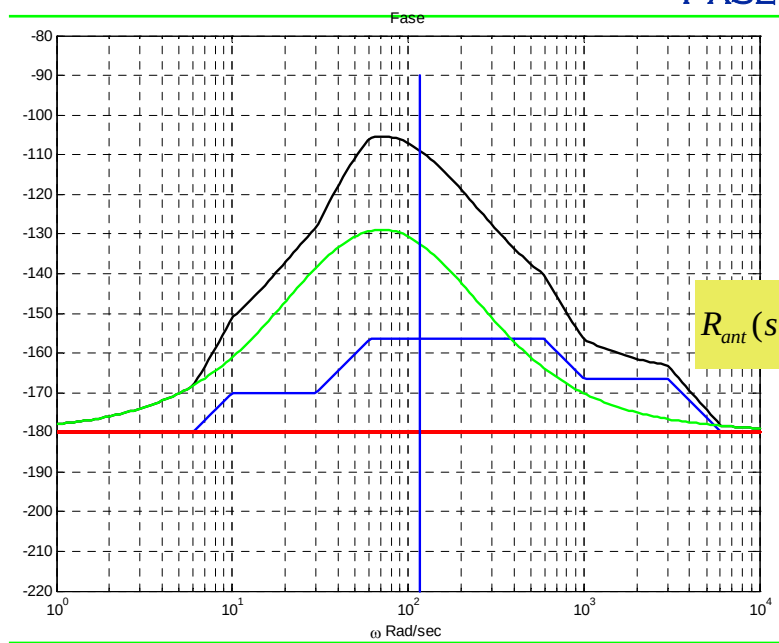
MODULO CORRETTO



$\omega_t = 110$ rad/sec

$$R_{ant}(s) = \frac{0.04s+1}{0.04/8s+1}$$

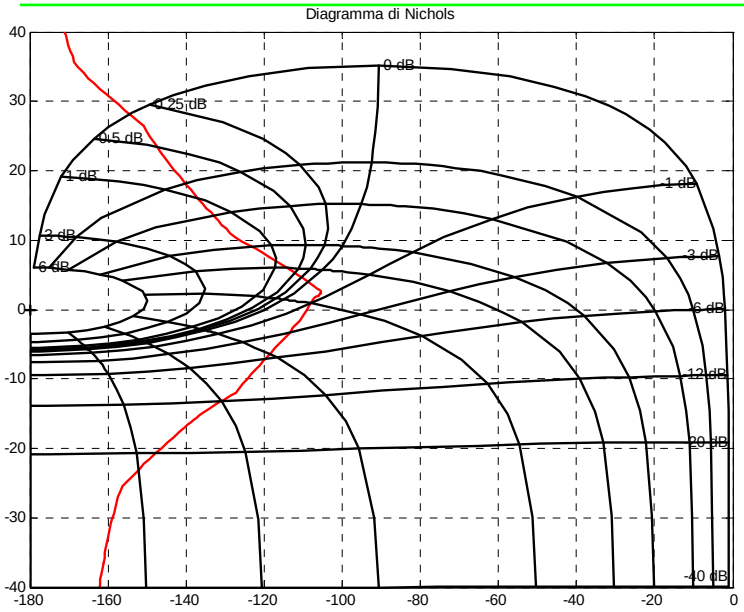
FASE CORRETTA



$m_\varphi = 70^\circ$

$$R_{ant}(s) = \frac{0.04s+1}{0.04/8s+1}$$

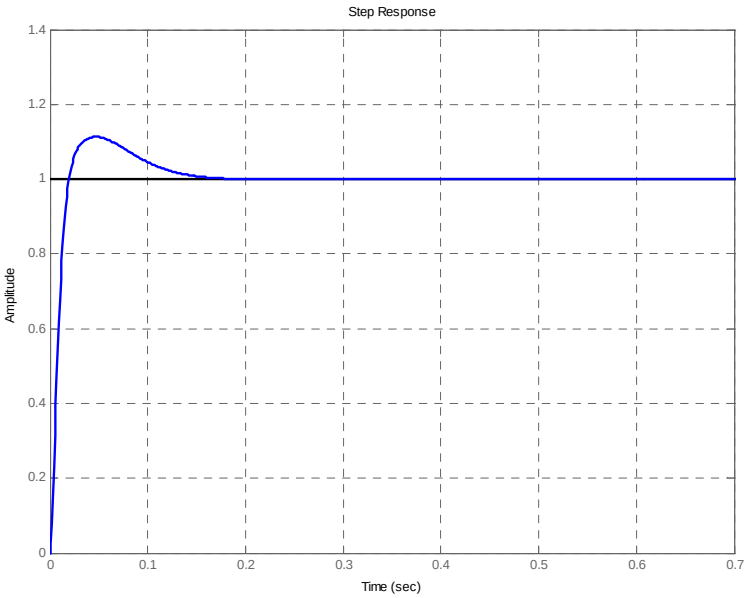
NICHOLS DOPO LA CORREZIONE



$\omega_{-3} = 162$ rad/sec

$M_r = 1.4$dB

RISPOSTA INDICIALE DOPO LA CORREZIONE

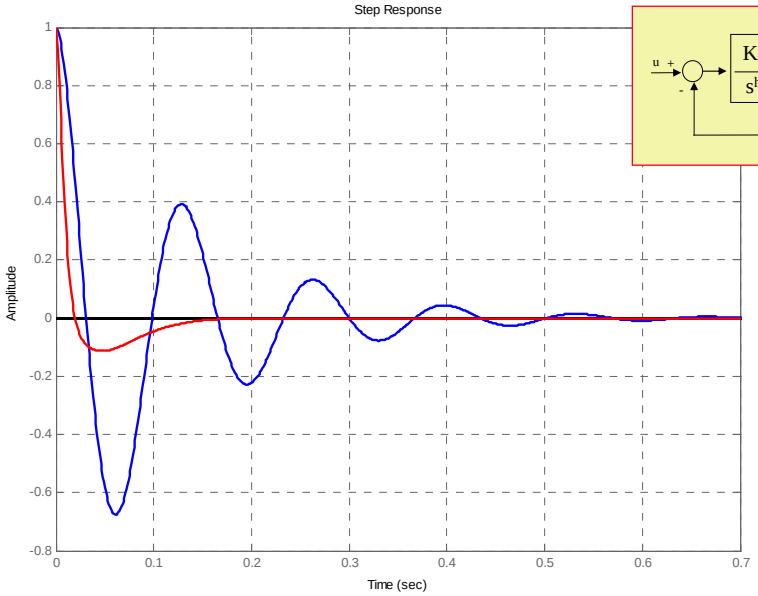


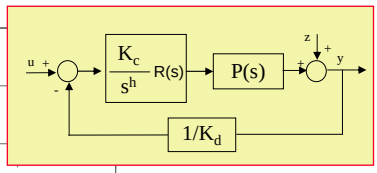
Nuova Risposta indiciale della $W(s)$

$t_r = 0.0127$ sec

$s = 0.11$

RISPOSTA AL DISTURBO A GRADINO





Senza rete

Con la rete