

%% Sistema non compensato (=> comp. con rete ritardatrice)

```
s=zpk('s');
```

```
G=10/(1+s)/(1+0.5*s)/(1+0.1*s)
```

```
[z,p,k] = zpkdata(G,'v')
```

```
G = zpk(z,p,k,'d','f')
```

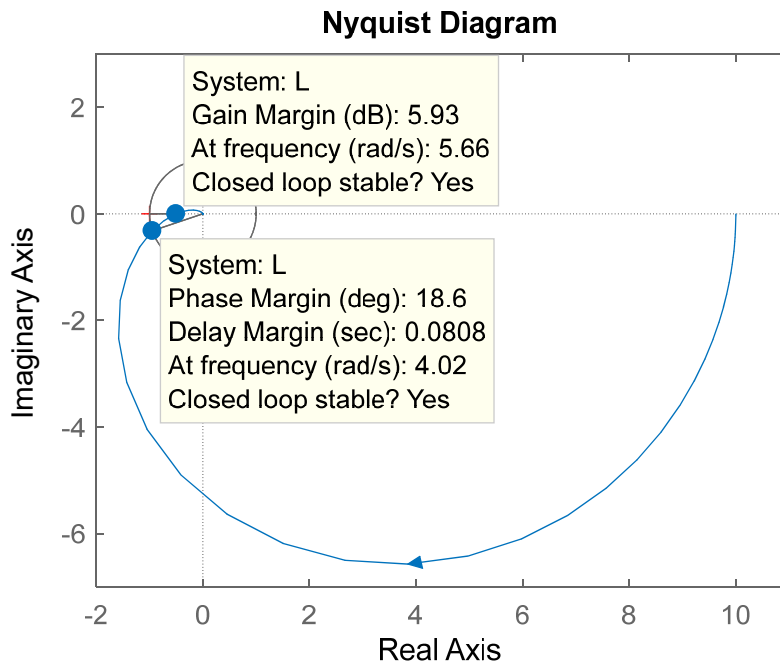
```
H=1
```

```
L=G*H
```

```
nyquist(L)
```

```
daspect([1 1 1])
```

$$L = \frac{10}{(1+s)(1+s/2)(1+s/10)}$$



```
[mag,phase,w]=bode(L);
```

```
[Gm,Pm,Wcg,Wcp]=margin(L)
```

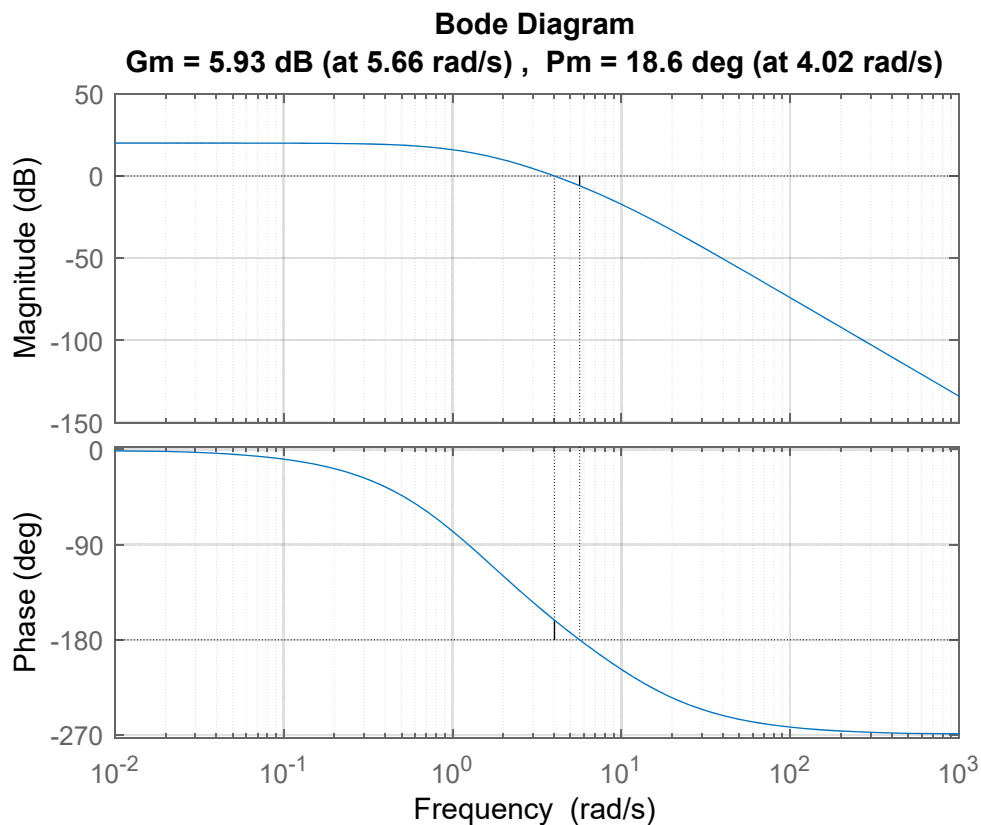
```
Gm = 1.9801
```

```
Pm = 18.5895
```

```
Wcg = 5.6570
```

```
Wcp = 4.0150
```

```
margin(L)
```



SISTEMA COMPENSATO con RETE RITARDATRICE

$G_c = (1+s)/(1+s/0.1)$

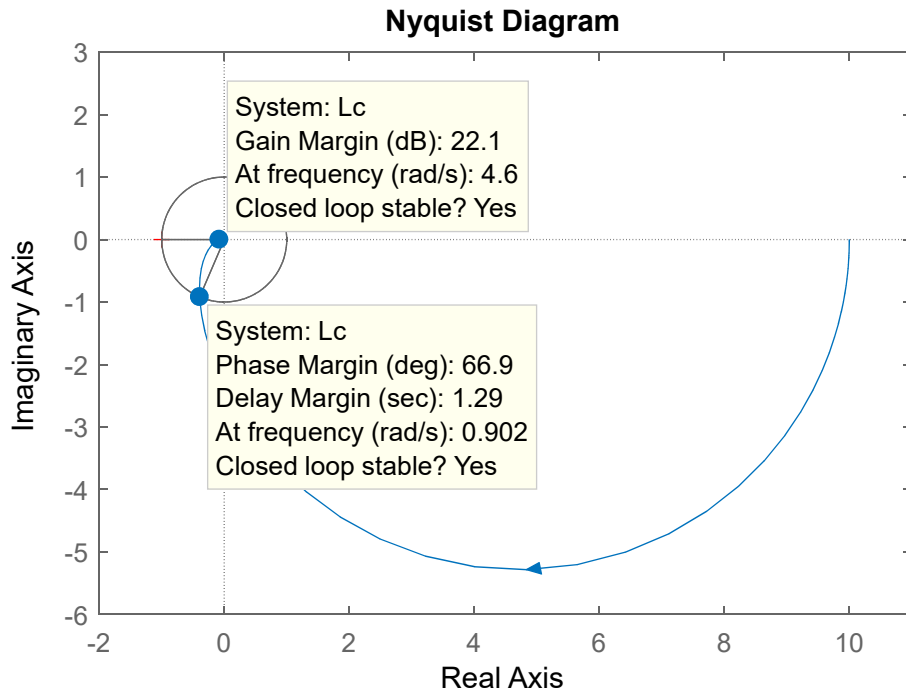
$L_c = G_c * L$

$L_c = \min_{\text{real}}(G_c * L)$

`nyquist(Lc)`

`daspect([1 1 1])`

$$L_c = \frac{(1+s)}{(1+s/0.1)} \cdot \frac{10}{(1+s)(1+s/2)(1+s/10)}$$



`[mag,phase,w]=bode(Lc);`

`[Gm,Pm,Wcg,Wcp]=margin(Lc)`

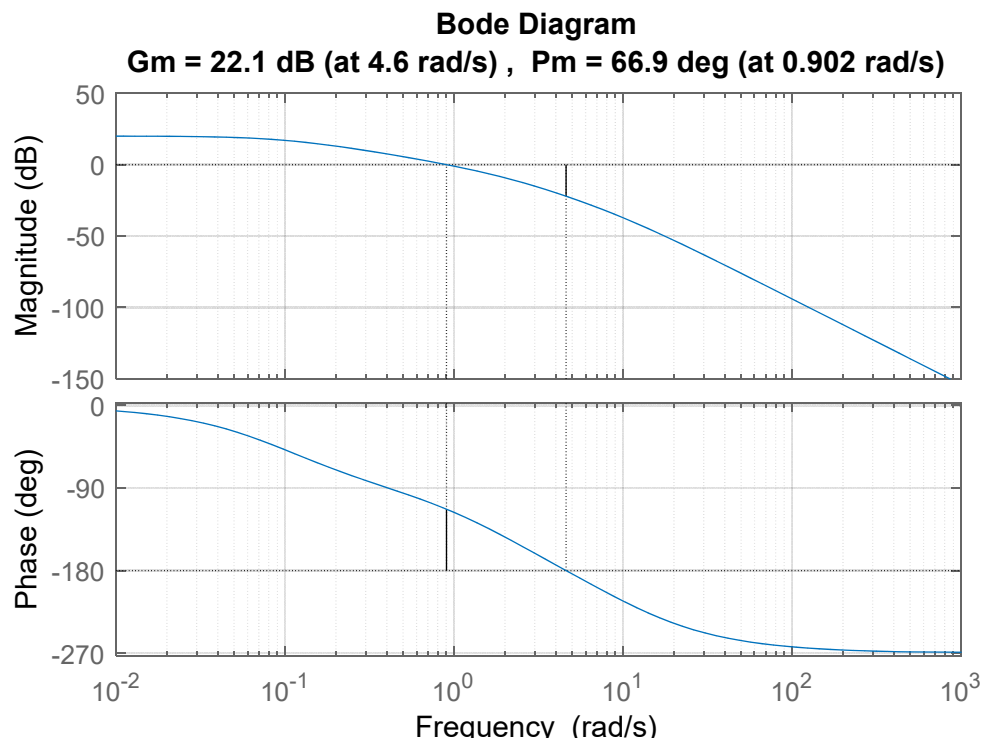
Gm = 12.7261

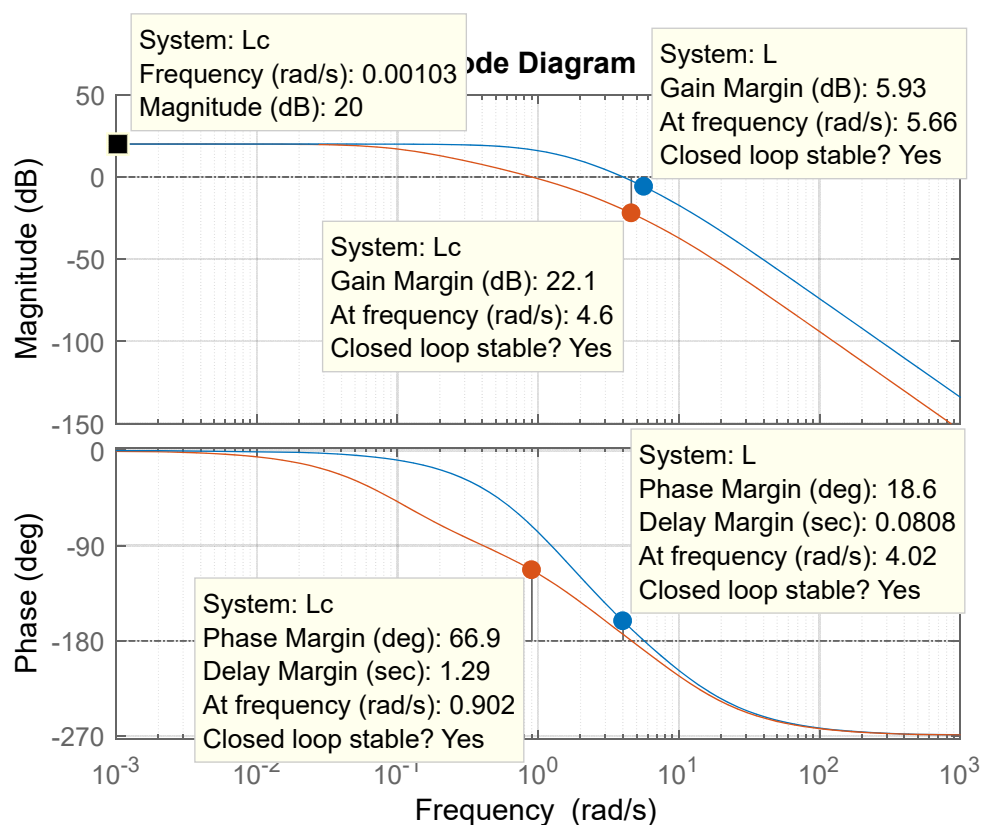
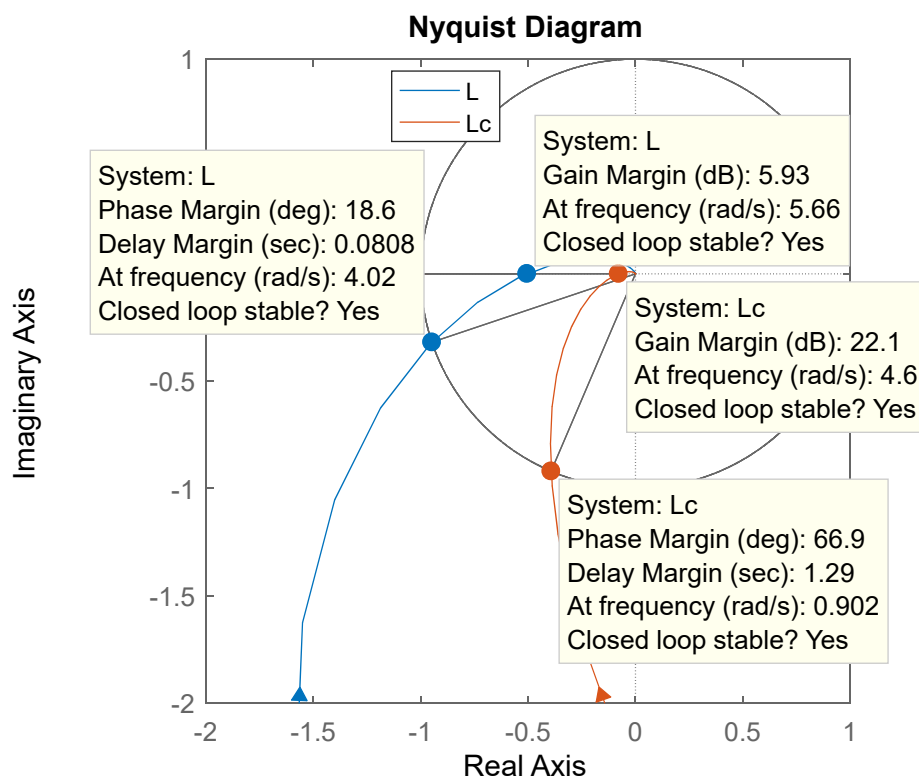
Pm = 66.8859

Wcg = 4.6044

Wcp = 0.9023

`margin(Lc)`

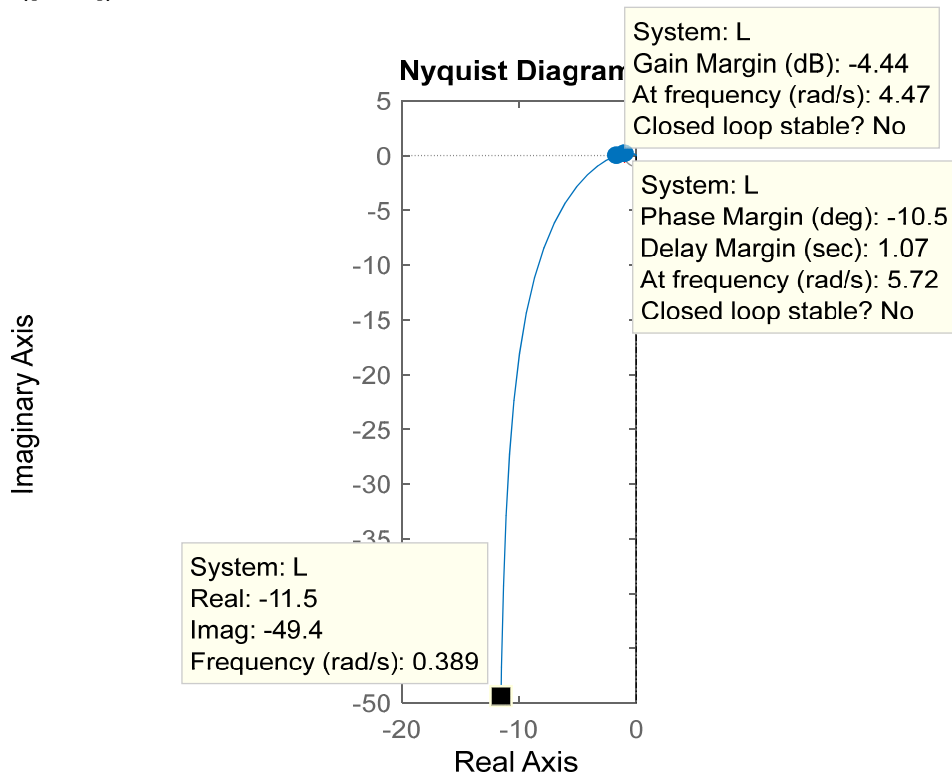




%%Sistema non compensato (=> comp. con rete anticipatrice)

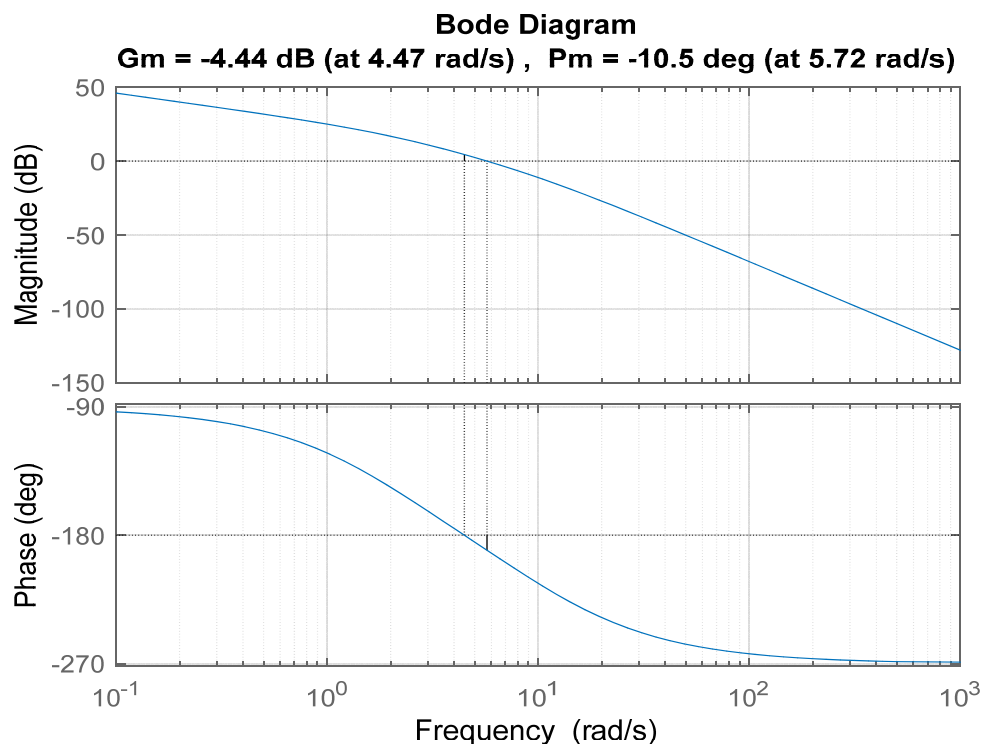
```
s=zpk('s');
G=20/s/(1+0.5*s)/(1+0.1*s);
[z,p,k] = zpkdata(G,'v');
G = zpk(z,p,k,'d','f');
H=1
L=G*H
nyquist(L)
daspect([1 1 1])
```

$$L = \frac{20}{s(1+s/2)(1+s/10)}$$



```
[mag,phase,w]=bode(L);
[Gm,Pm,Wcg,Wcp]=margin(L)
Gm = 0.6000
Pm = -10.5320
Wcg = 4.4721
Wcp = 5.7247
margin(L)
```

Warning: The closed-loop system is unstable.



# SISTEMA COMPENSATO con RETE ANTICIPATRICE

$$G_c = (1+s/2)/(1+s/20)$$

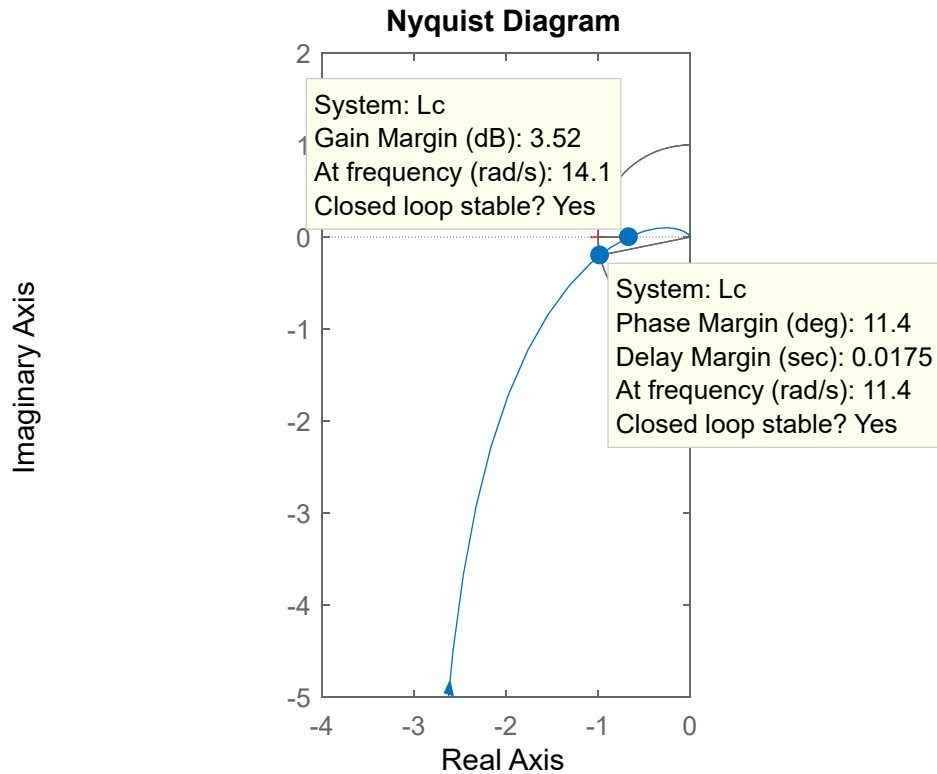
$$L_c = G_c * L$$

$$L_c = \min_{\text{real}}(G_c * L)$$

$$\text{nyquist}(L_c)$$

$$\text{daspect}([1 \ 1 \ 1])$$

$$L_c = \frac{(1+s/2)}{(1+s/20)} \cdot \frac{20}{s(1+s/2)(1+s/10)}$$



$$[\text{mag}, \text{phase}, \text{w}] = \text{bode}(L);$$

$$[\text{Gm}, \text{Pm}, \text{Wcg}, \text{Wcp}] = \text{margin}(L)$$

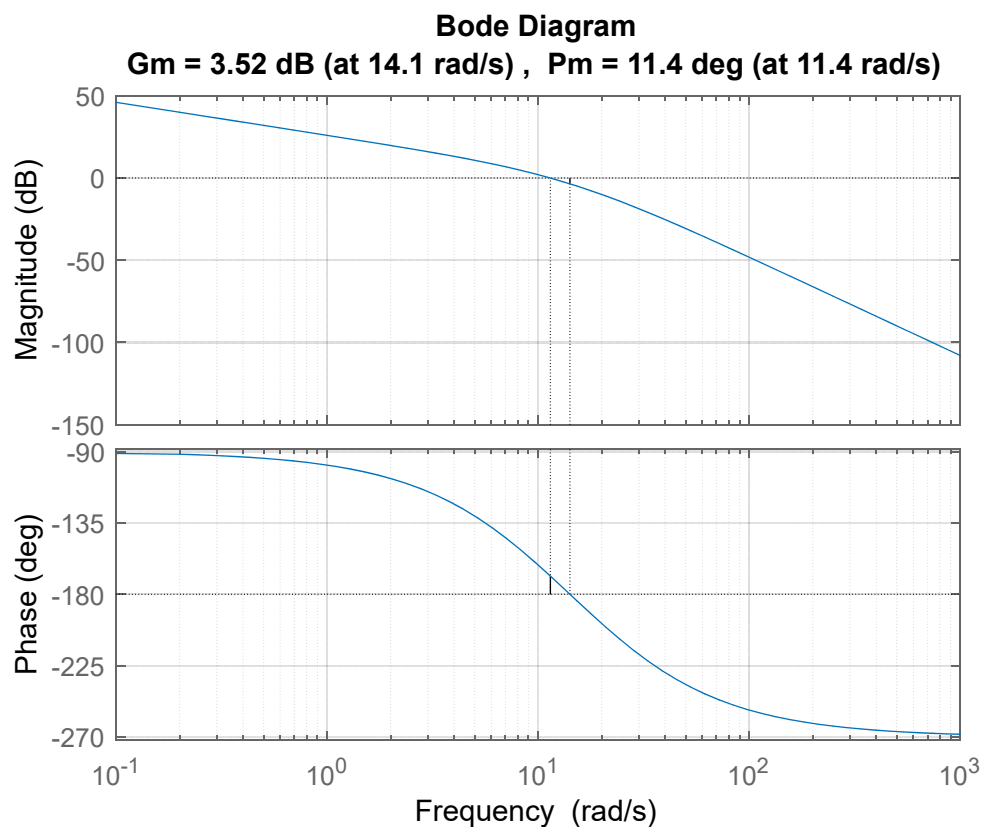
$$\text{Gm} = 1.5000$$

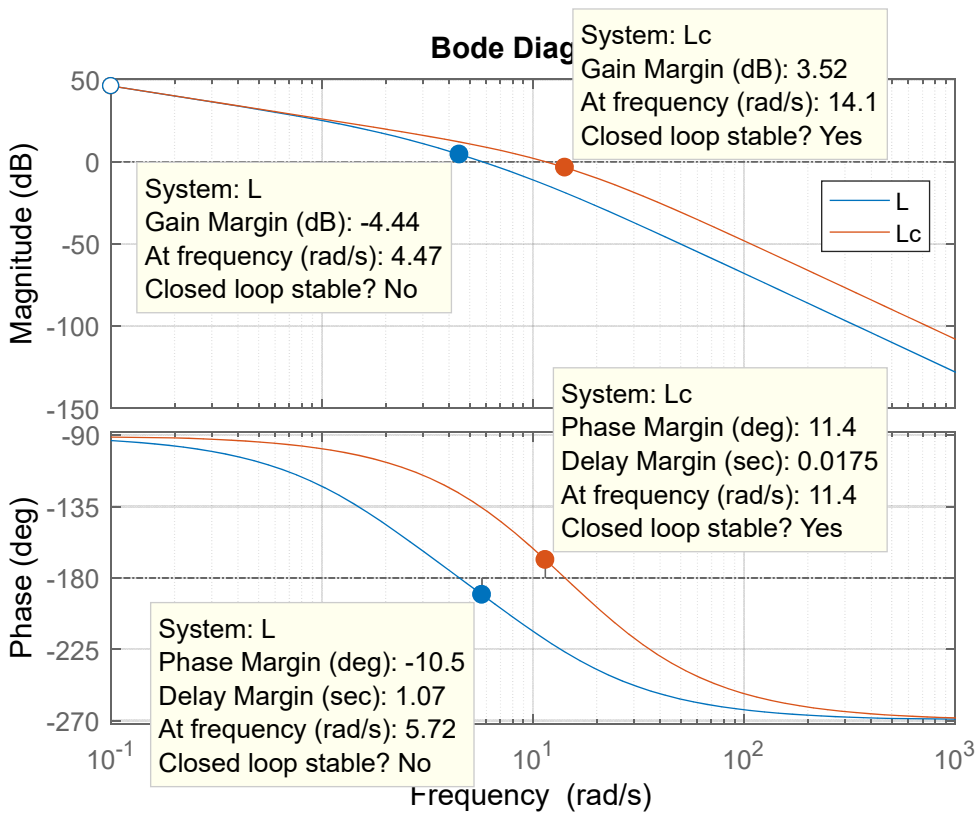
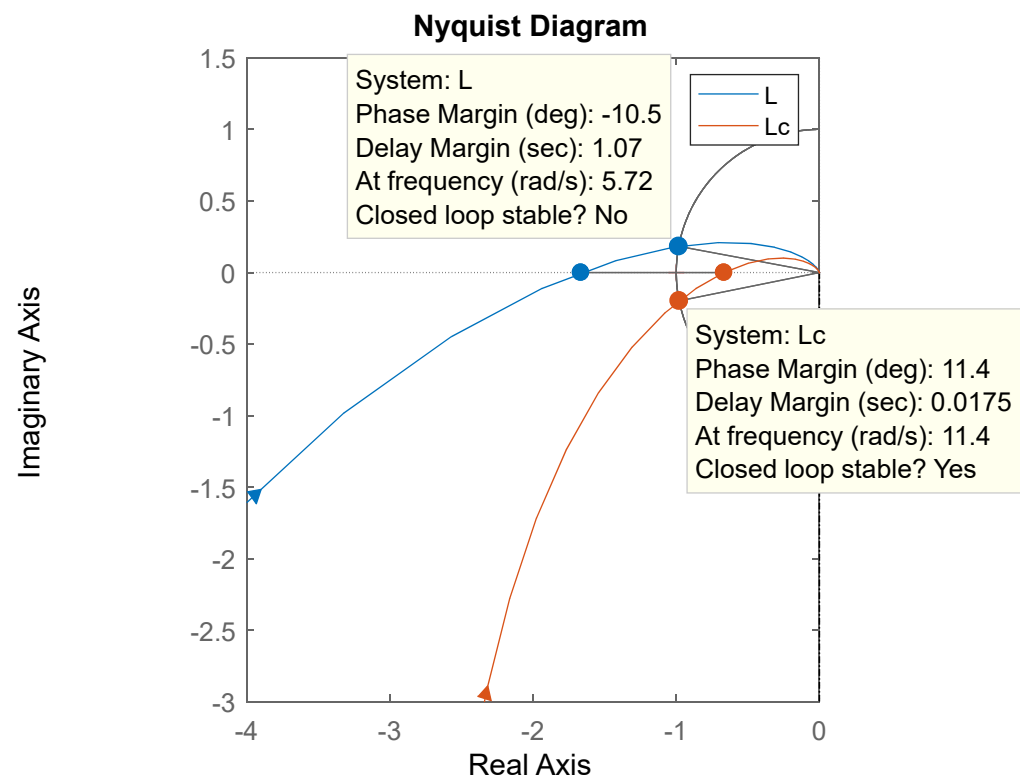
$$\text{Pm} = 11.4304$$

$$\text{Wcg} = 14.1421$$

$$\text{Wcp} = 11.4309$$

$$\text{margin}(L)$$





%%Sistema non compensato (=> comp. con rete a sella)

```
s=zpk('s');
```

```
G=20/(1+s)/(1+0.25*s)/(1+0.1*s);
```

```
[z,p,k] = zpkdata(G,'v');
```

```
G = zpk(z,p,k,'d','f');
```

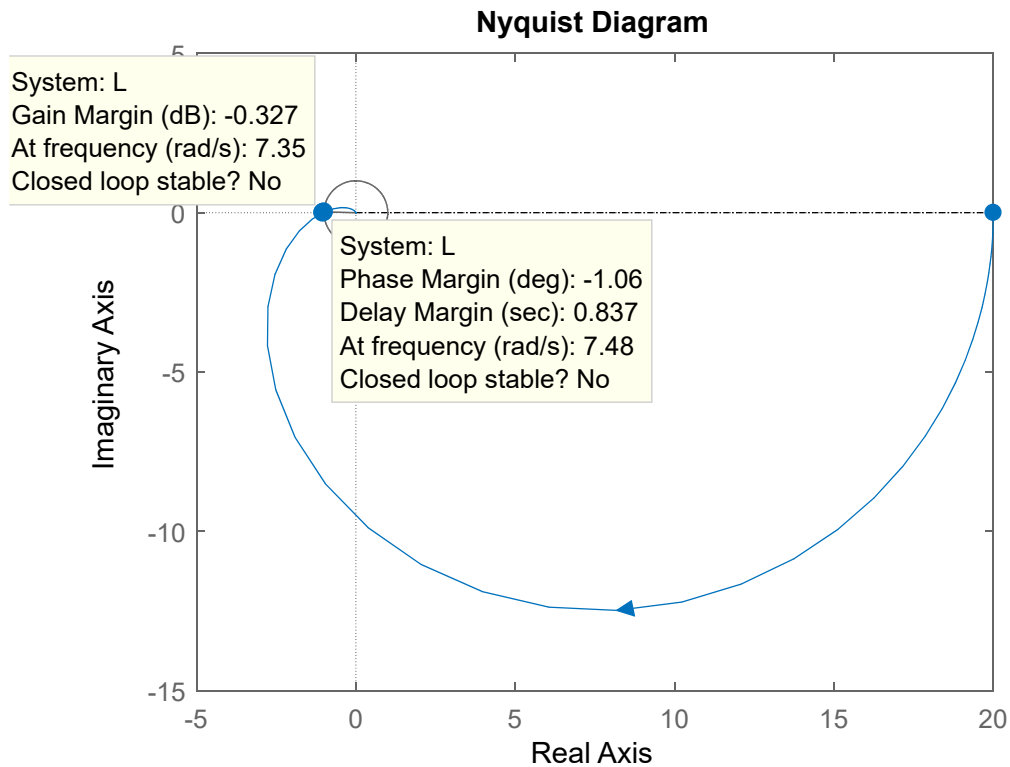
```
H=1
```

```
L=G*H
```

```
nyquist(L)
```

```
daspect([1 1 1])
```

$$L = \frac{20}{(1+s)(1+s/4)(1+s/10)}$$



```
[mag,phase,w]=bode(L);
```

```
[Gm,Pm,Wcg,Wcp]=margin(L)
```

Warning: The closed-loop system is unstable.

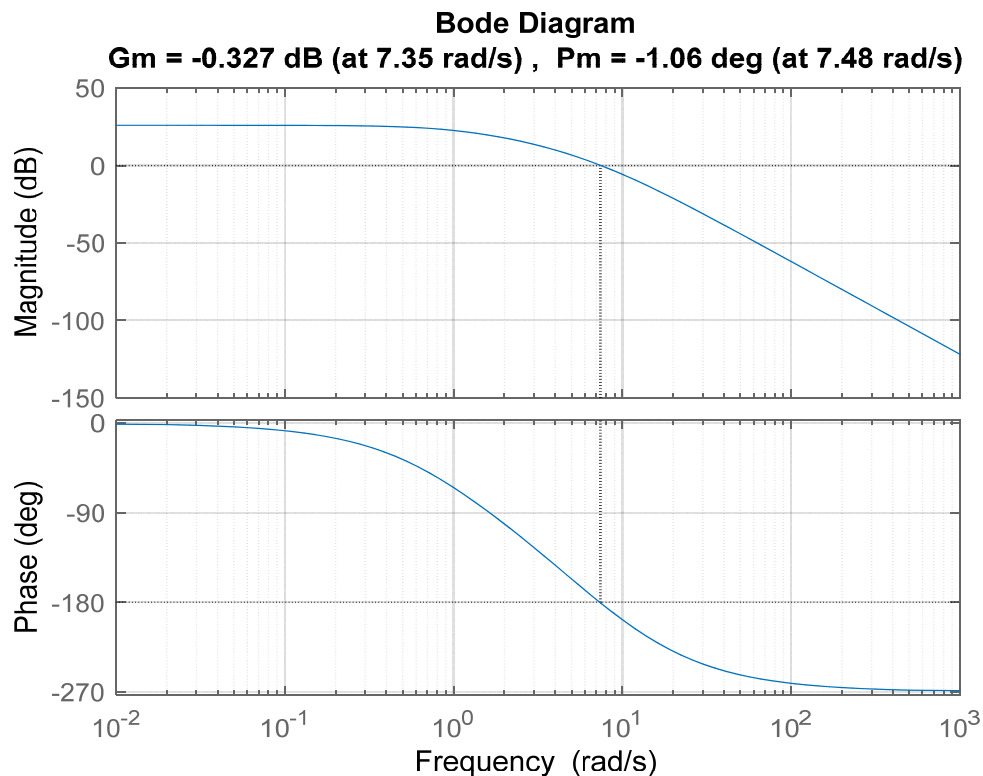
```
Gm = 0.9630
```

```
Pm = -1.0602
```

```
Wcg = 7.3504
```

```
Wcp = 7.4818
```

```
margin(L)
```



# SISTEMA COMPENSATO con RETE A SELLA

$$G_c = (1+s/2)/(1+s/20)$$

$$L_c = G_c * L$$

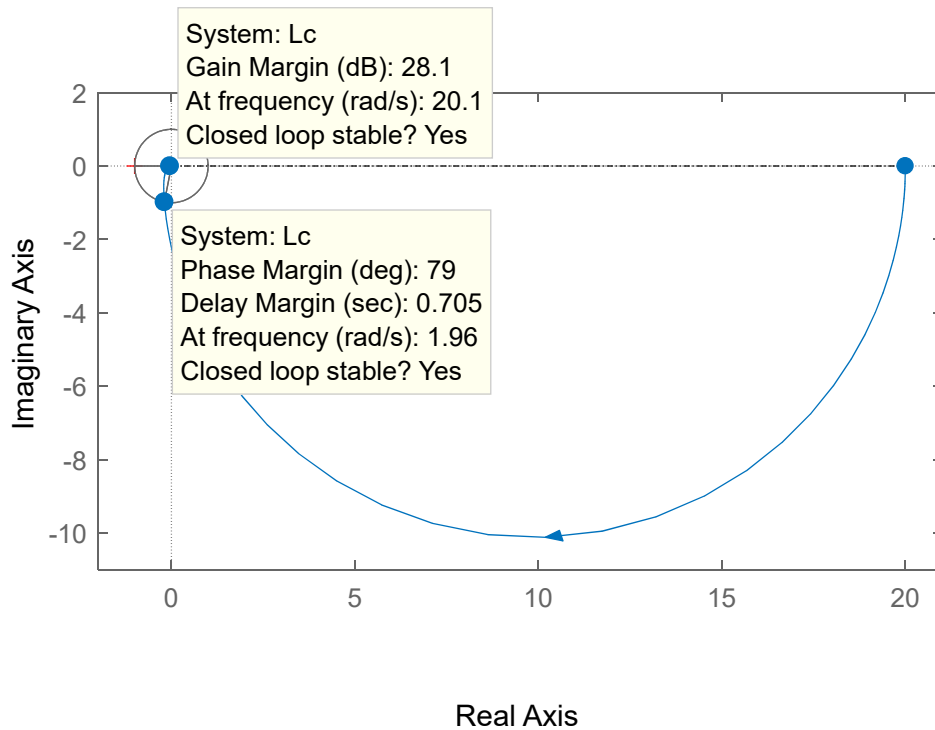
$$L_c = \minreal(G_c * L)$$

$$\text{nyquist}(L_c)$$

$$\text{daspect}([1 \ 1 \ 1])$$

$$L_c = \frac{(1+s) (1+s/4)}{(1+s/0.1) (1+s/40) (1+s) (1+s/4) (1+s/10)} \cdot 20$$

## Nyquist Diagram



$$[\text{mag}, \text{phase}, \text{w}] = \text{bode}(L);$$

$$[\text{Gm}, \text{Pm}, \text{Wcg}, \text{Wcp}] = \text{margin}(L)$$

$$\text{Gm} = 25.3131$$

$$\text{Pm} = 79.0443$$

$$\text{Wcg} = 20.1246$$

$$\text{Wcp} = 1.9578$$

$$\text{margin}(L)$$

## Bode Diagram

**Gm = 28.1 dB (at 20.1 rad/s) , Pm = 79 deg (at 1.96 rad/s)**

