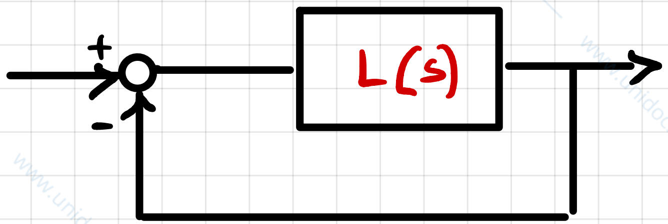
ESERCITAZIONE SUL LUOGO DELLE RADICI

\- Es. 1



* - TRACCIARE L.D.R.

* - STABILITÀ AL VARIARE DI ρ ?

$$L(s) = \frac{\rho}{s(s+3)(s+5)}$$

$n=3$ RAMI

$m=0$

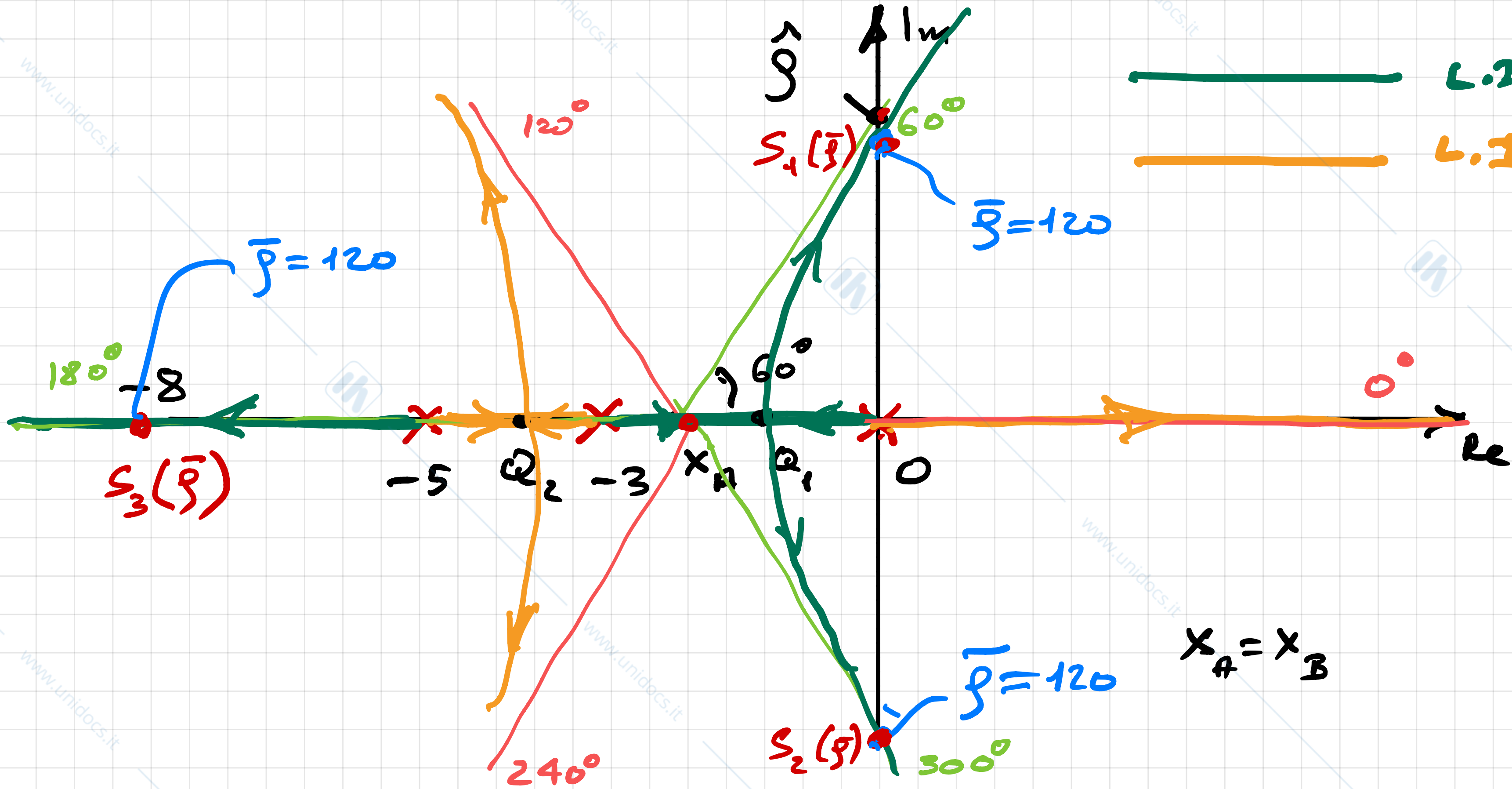
$\nu = 3$ ASINTOTI

$\nu \geq 2 \longrightarrow$ IL BARICENTRO SI CONSERVA

$$x_A = \frac{1}{\nu}\left(\Sigma_i z_i - \Sigma_i p_i\right) = \frac{1}{3}(-8) = -\frac{8}{3}$$

$$x_B = \frac{1}{n}\left(-\Sigma_i p_i\right) = -\frac{8}{3}$$

$$\psi_{ak} = \begin{cases} 60^\circ, 180^\circ, 300^\circ & \text{L.D.} \\ 0^\circ, 120^\circ, 240^\circ & \text{L.I.} \end{cases}$$



Im
$\hat{\rho}$
$s_1(\bar{\rho})$
$60°$
$\bar{\rho}=120$
L.D. $\rho>0$
L.I. $\rho<0$
$120°$
$\bar{\rho}=120$
$180°$
-8
$60°$
$0°$
$s_3(\bar{\rho})$
-5
Q_2
-3
x_A
Q_1
0
Re
$\bar{\rho}=120$
$x_A = x_B$
$s_2(\bar{\rho})$
$240°$
$300°$

- PER DETERMINARE Q_1 E Q_2 '

$$\gamma(x) = -\frac{D(x)}{N^*(x)} = -x(x+3)(x+5) = -x^3 - 8x^2 - 15x$$

$$\gamma'(x) = -3x^2 - 16x - 15 = 0 \Longrightarrow x = \frac{-8 \pm \sqrt{19}}{3} \simeq \begin{cases} -4.12 & Q_2 \\ -1.21 & Q_1 \end{cases}$$

- STABILITÀ

$$\text{AS. STAB.} \Longleftrightarrow 0 < \rho < \bar{\rho} = 120$$

- CALCOLO DI $\bar{\rho}$

REGOLA BARICENTRO

$$x_B(\bar{\rho}) = \frac{1}{3}\Big(\underbrace{\cancel{s_1(\bar{\rho}) + s_2(\bar{\rho})}}_{j\omega - j\omega = 0} + s_3(\bar{\rho})\Big) = x_B = -\frac{8}{3} \Longrightarrow \boxed{s_3(\bar{\rho}) = -8}$$

REGOLA PUNTEGGIATURA

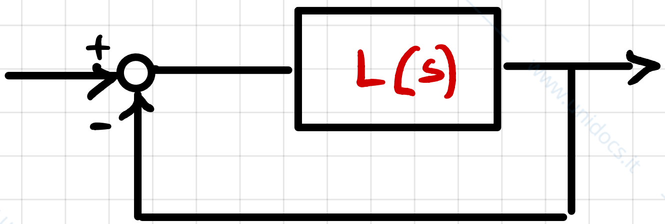
$$\bar{\rho} = \frac{\text{PROD. DIST. DAI POLI}}{\text{PROD. DIST. DA ZERI}} = \frac{3 \cdot 5 \cdot 8}{1} = 120$$

- COMPITO A CASA

ROUTH SU $\varphi_{AC}(s)$

VERIFICA CON BODE

_ Es. 2



* - TRACCIARE L.D.R.
* - STABILITÀ AL VARIARE DI ρ ?

$$L(s) = \rho \frac{s-5}{s^2(s+10)}$$

$n = 3$ RAMI

$\nu = 2$ ASINTOTI

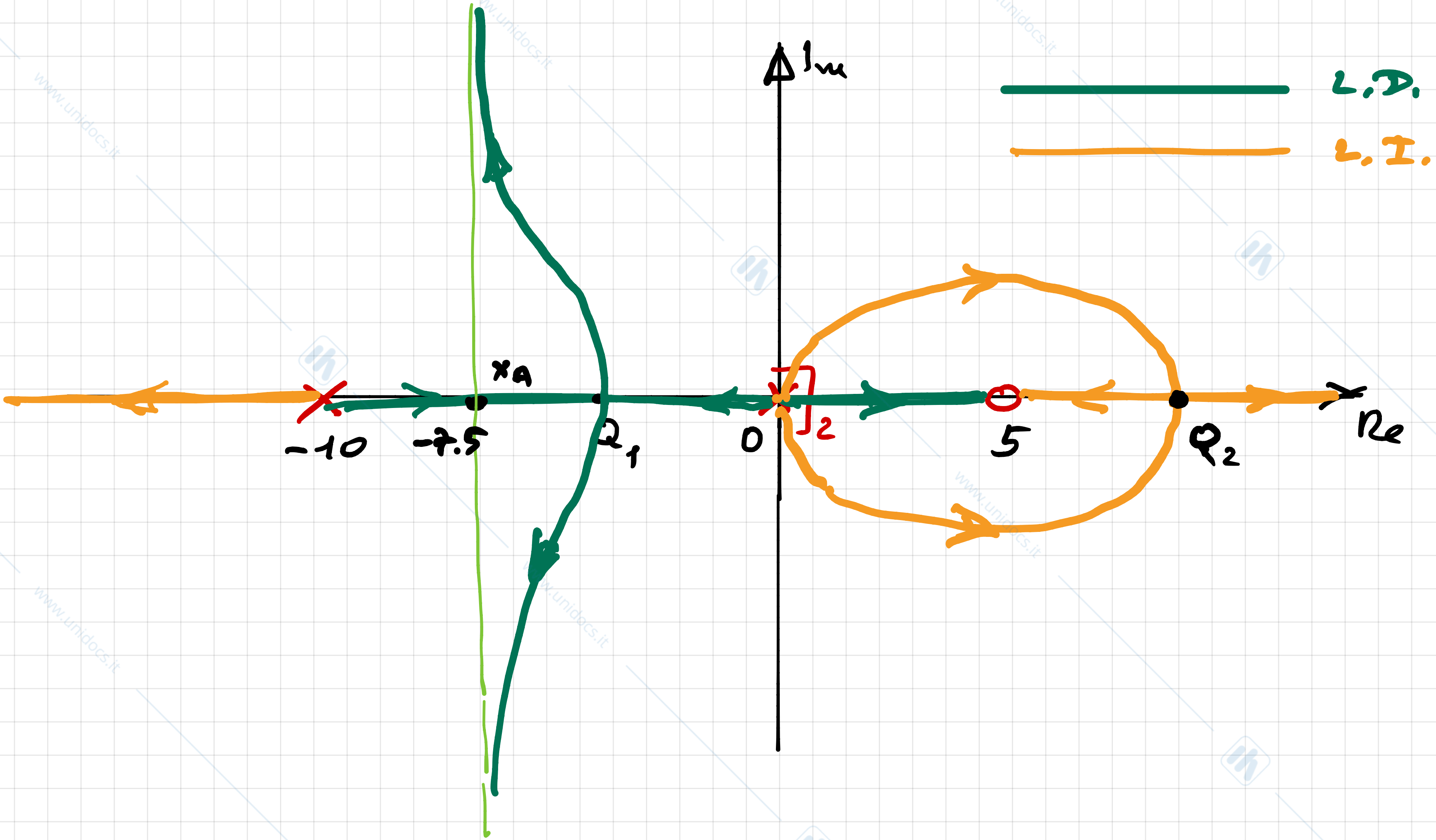
↓

IL BARICENTRO SI CONSERVA

$$x_A = \frac{1}{2}(-5-10) = -7.5$$

$$x_B = \frac{1}{3}(-10) = -\frac{10}{3} \simeq -3.33$$

$$\varphi_{2k} = \begin{cases} 90^\circ, 270^\circ & \text{L.D.} \\ 0^\circ, 180^\circ & \text{L.I.} \end{cases}$$


Im
L.D.
L.I.
x_A
-10
-7.5
Q_1
0
2
5
Q_2
Re

- PER DETERMINARE Q_1 E Q_2:

$$\gamma(x) = -\frac{D(x)}{N^*(x)} = -\frac{x^2(x+10)}{x-5}$$

$$\gamma'(x) = \ldots\ldots = 0 \Longrightarrow x \cong \begin{cases} -5.93 & Q_1 \\ 8.43 & Q_2 \end{cases}$$

- STABILITÀ

NON C'È AS. STABILITÀ $\forall \rho$

$$s^3 + 10s^2 + \underbrace{\rho s - 5\rho}_{\text{DISCORDI}}$$

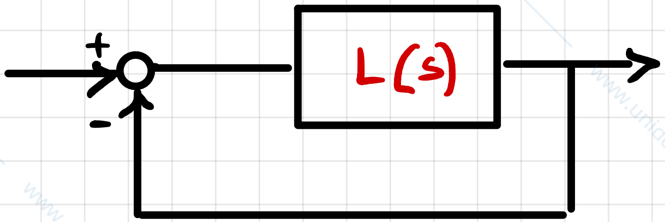
NON AS. STAB.

$$\varphi_{AC}(s) = s^2(s+10) + \rho(s-5)$$

- COMPITO A CASA:

VERIFICA CON BODE ......

_ Es. 3



* _ DETERMINARE ρ IN MODO CHE, IN A.C., RISULTI $t_a \simeq 2.5$

* _ VALUTARE POI LO SMORZAMENTO IN A.C.

$$L(s) = \rho \, \frac{s+3}{s(s+1)(s+10)}$$

$$t_a \simeq \frac{5}{|\sigma|} = 2.5 \implies |\sigma| = 2 \implies \mathrm{Re} = -2$$

Re POLI DOMINANTI

$\implies$ TUTTI I POLI IN A.C. DEVONO AVERE $\mathrm{Re} \leq -2$

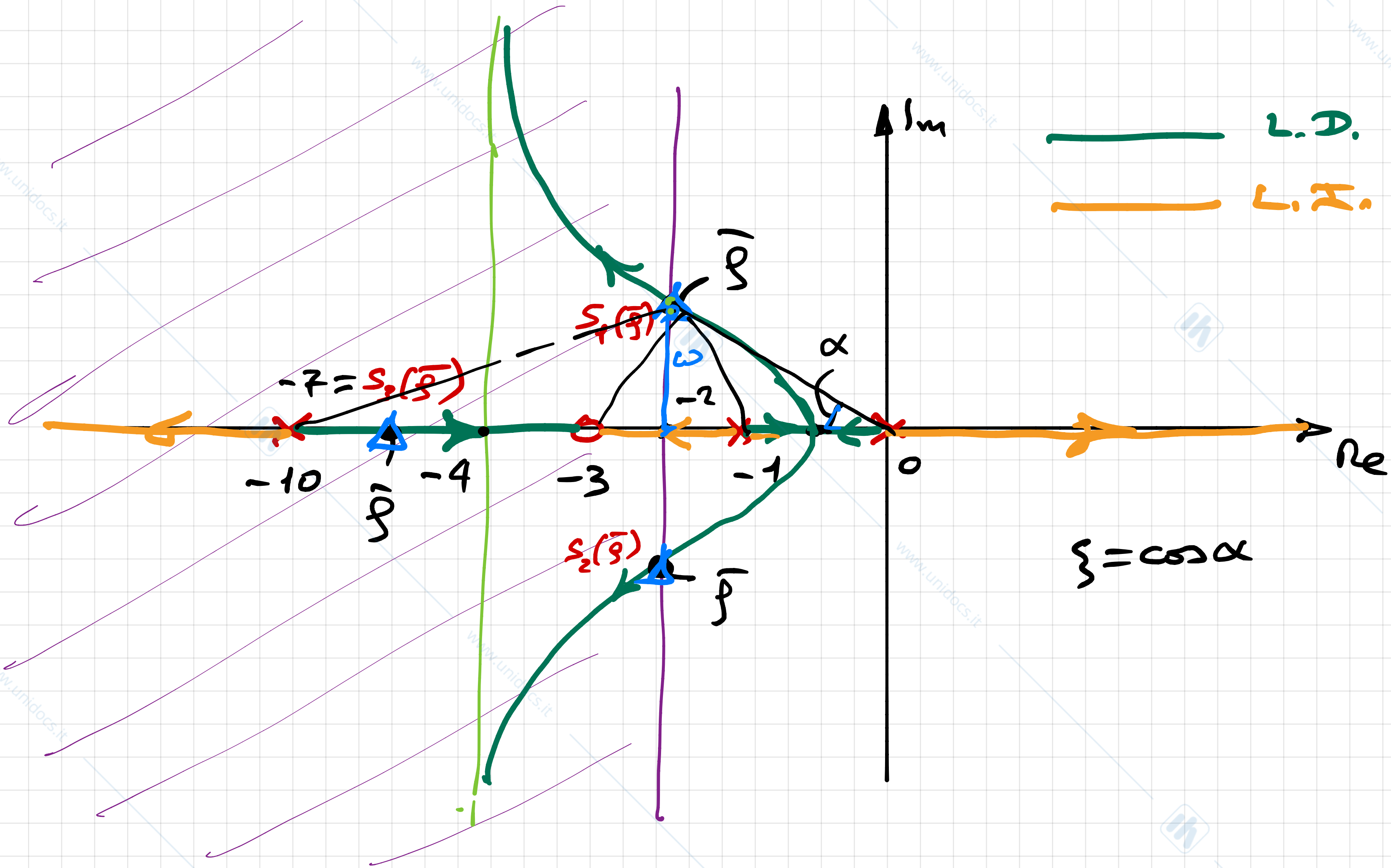
3 RAMI

2 ASINTOTI

$x_A = -4$

$x_B = -\frac{11}{3}$

$$\psi_{ak} = \begin{cases} 90°, 270° & \text{L.D.} \\ 0°, 180° & \text{L.I.} \end{cases}$$


Im
Re
L.D.
L.I.
$\bar{\rho}$
$s_1(\bar{\rho})$
ω
α
$-7 = s_3(\bar{\rho})$
-2
-10
-4
-3
-1
0
$\bar{\rho}$
$s_2(\bar{\rho})$
$\bar{\rho}$
$\xi = \cos\alpha$

- CALCOLO DI $\bar{\rho}$

REGOLA BARICENTRO

$$\frac{1}{3}\Big(\underbrace{s_1(\bar{\rho})+s_2(\bar{\rho})}_{2\,Re\,=\,-4}+s_3(\bar{\rho})\Big)=-\frac{11}{3} \Longrightarrow s_3(\bar{\rho})=-7$$

REGOLA PUNTEGGIATURA IN $s_3(\bar{\rho})$

$$\boxed{\bar{\rho}=\frac{3\cdot 6\cdot 7}{4}=\frac{63}{2}=31.5}$$

- VALUTAZIONE SMORZAMENTO IN A.C.

$$s_{1,2}(\bar{\rho})=-2\pm j\omega \qquad \xi=\cos\Big(\underbrace{\operatorname{arctg}\frac{\omega}{2}}_{\alpha}\Big)$$

REGOLA PUNTEGGIATURA IN $s_1(\bar{\rho})$:

DIST. DAI POLI

$$31.5=\bar{\rho}=\frac{\sqrt{4+\omega^2}\,\cancel{\sqrt{1+\omega^2}}\,\sqrt{64+\omega^2}}{\cancel{\sqrt{1+\omega^2}}} \Longrightarrow 31.5=\sqrt{4+\omega^2}\sqrt{64+\omega^2}$$

DIST. DALLO ZERO

$\Downarrow$ EQ. BIQUADRATICA

$$\omega^2 = \begin{cases} 9.5 \\ <0 \quad \text{NON INTERESSANTE} \end{cases}$$

$\Downarrow$

$$\boxed{\xi=\cos\left(\operatorname{arctg}\frac{3.02}{2}\right)\simeq 0.54} \Longleftarrow \omega=\sqrt{9.5}\simeq 3.08$$