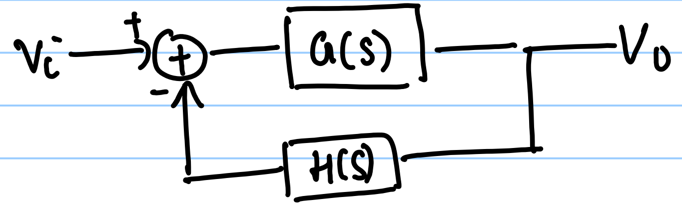
Note Title

Lecture # 48

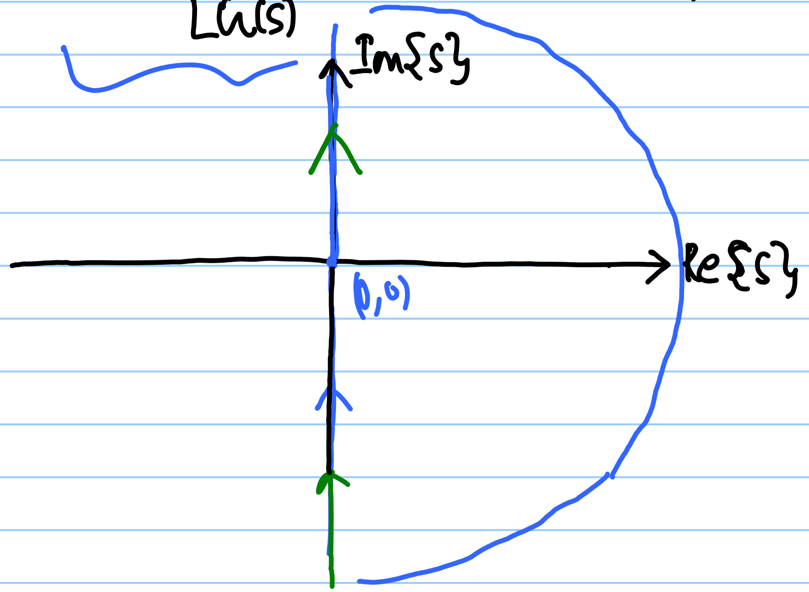
Nyquist Stability Criterion

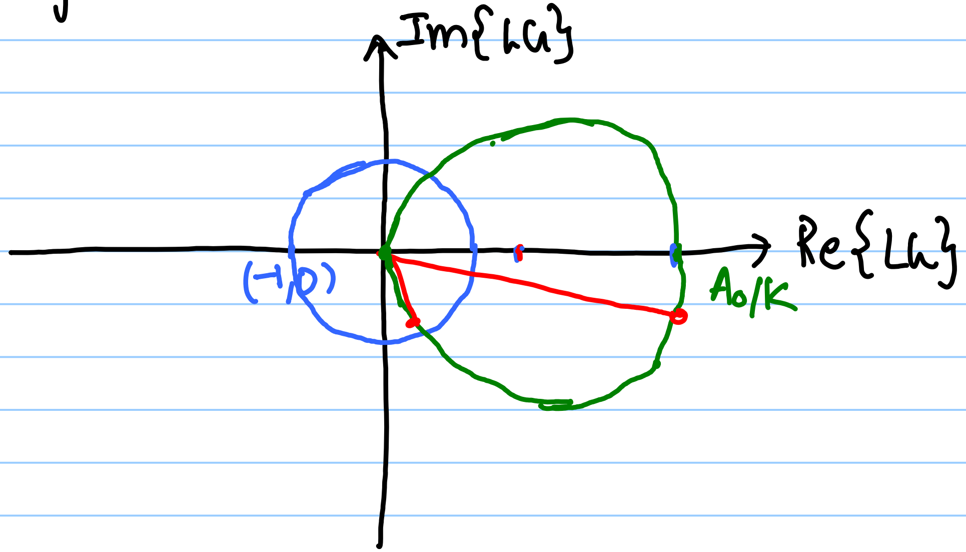


$$\frac{V_o}{V_i} = \frac{1}{H(s)} \frac{G(s)H(s)}{1+G(s)H(s)}$$

$$= \frac{1}{H(s)} \frac{1}{\frac{1}{LG} + 1}$$

$1 + \frac{1}{LG(s)} = 0$ shouldn't have any R.H.P zeros.

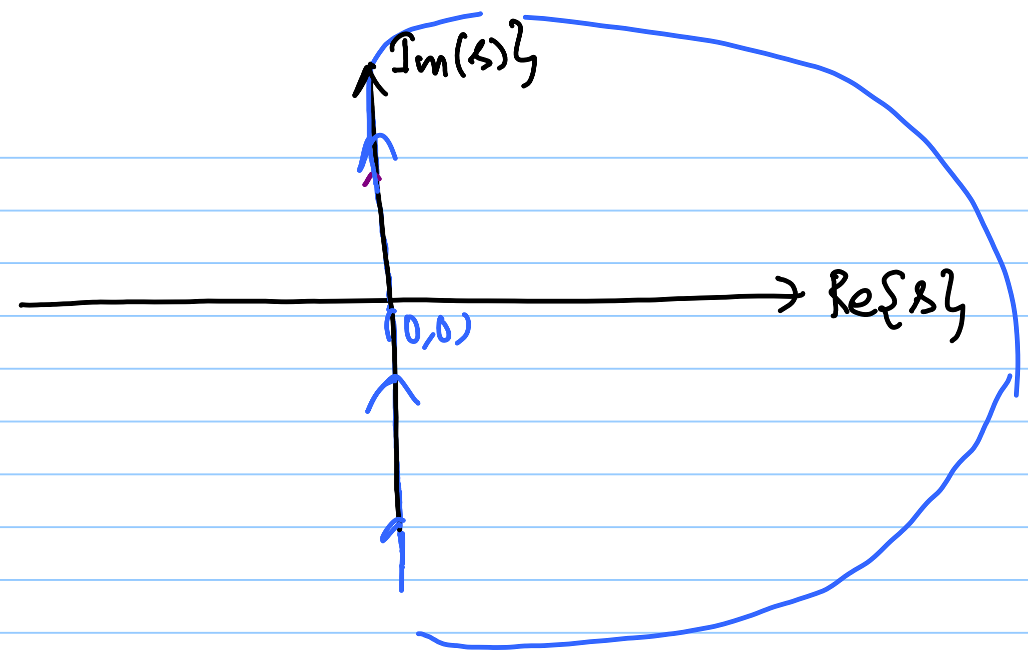




$$LG(s) = \frac{A_0}{1+s/p_1} \times \frac{1}{K}$$

$s = j\omega$

$$LG(s) = \underbrace{\frac{A_0/K}{\sqrt{1+\frac{\omega^2}{p_1^2}}}} \quad \underbrace{e^{-j\omega/p_1}}$$

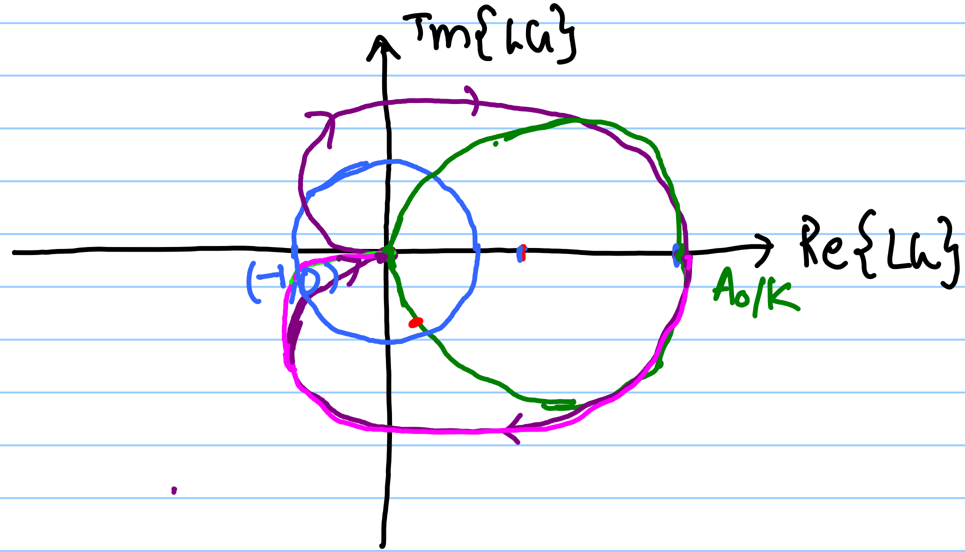


Second Order System

$$LG(s) = \frac{A_0}{(1+s/p_1)(1+s/p_2)} \frac{1}{K}$$

$$= \frac{A_0/K}{\sqrt{\left(1+\frac{\omega^2}{p_1^2}\right)\left(1+\frac{\omega^2}{p_2^2}\right)}} \quad \underbrace{\underbrace{e^{-j\omega/p_1}}_{0 \to -\pi/2} \cdot \underbrace{e^{-j\omega/p_2}}_{0 \to -\pi/2}}$$

$-180^\circ \leq \measuredangle LG$



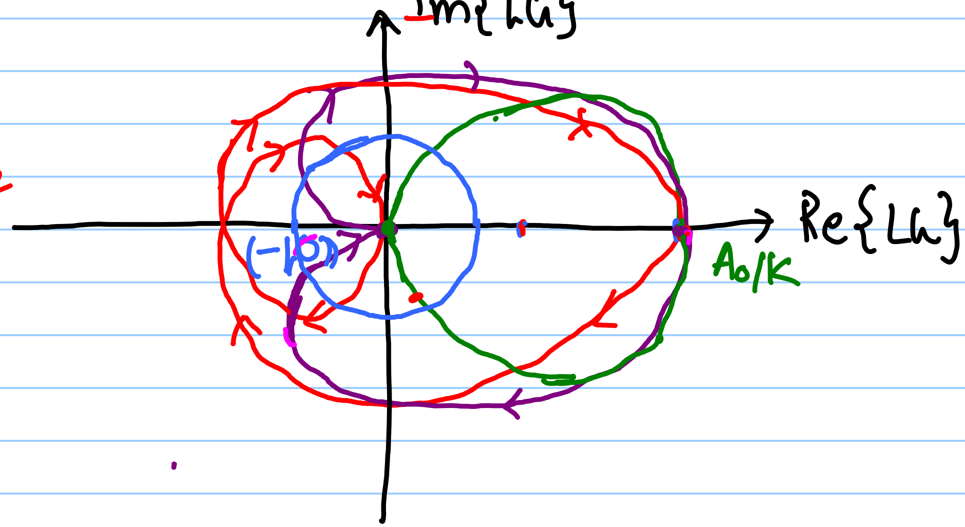
$$LG(s) = \frac{A_0/K}{(1+s/p_1)(1+s/p_2)(1+s/p_3)}$$

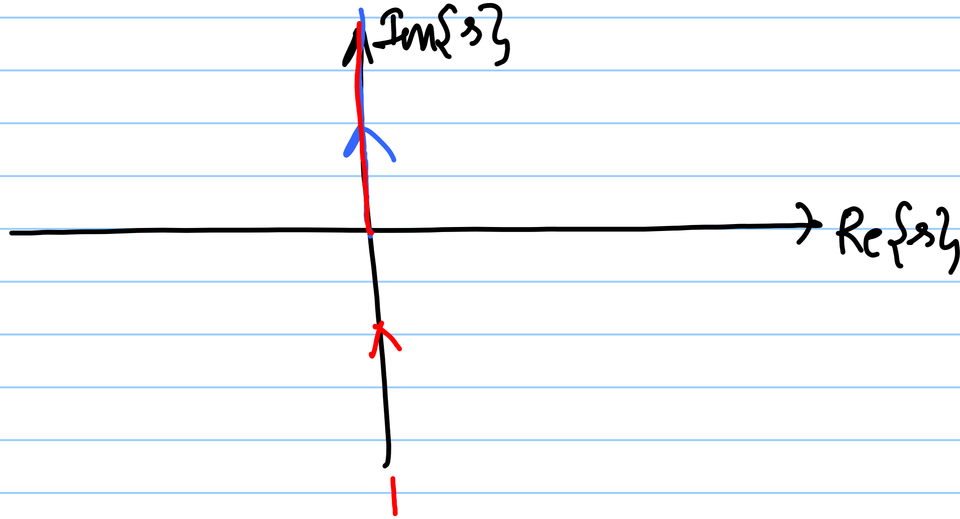
$$= \frac{A_0/K}{\sqrt{\left(1+\frac{\omega^2}{p_1^2}\right)\left(1+\frac{\omega^2}{p_2}\right)\left(1+\frac{\omega^2}{p_3^2}\right)}} \quad \underbrace{e^{-j\omega/p_1}}_{0 \to -\frac{\pi}{2}} \cdot \underbrace{e^{-j\omega/p_2}}_{0 \to -\frac{\pi}{2}} \cdot \underbrace{e^{-j\omega/p_3}}_{0 \to -\pi/2}$$

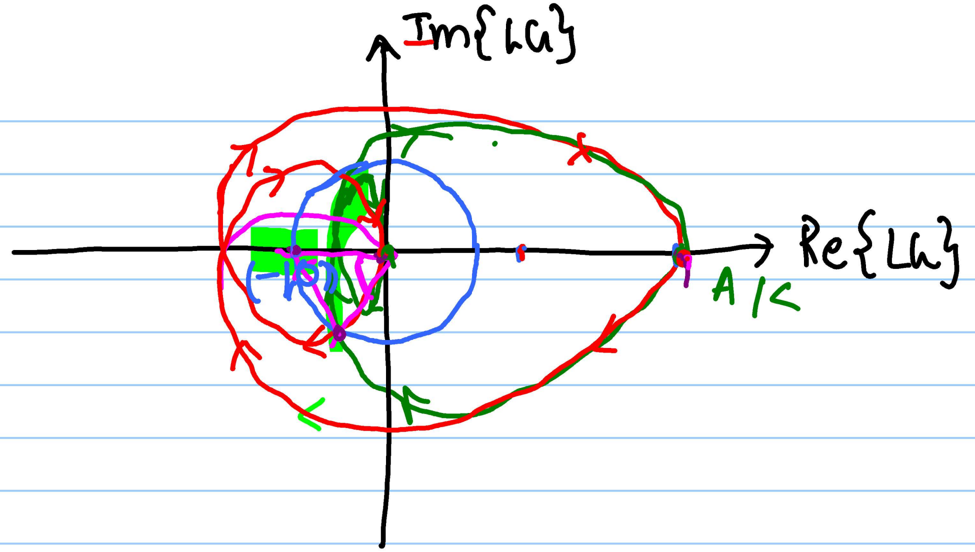
✓

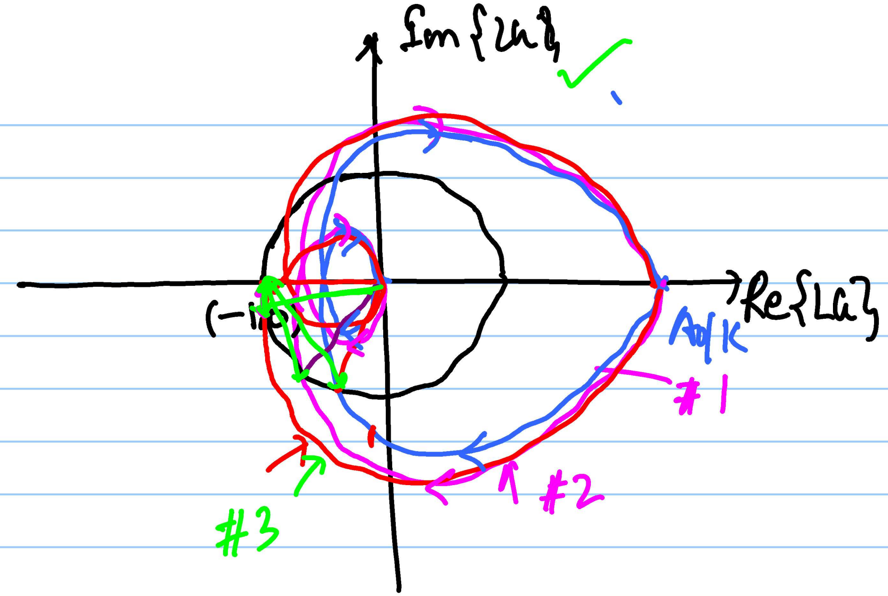
$\omega \geq \omega_u$

$|LG(\omega_u)| = 1$



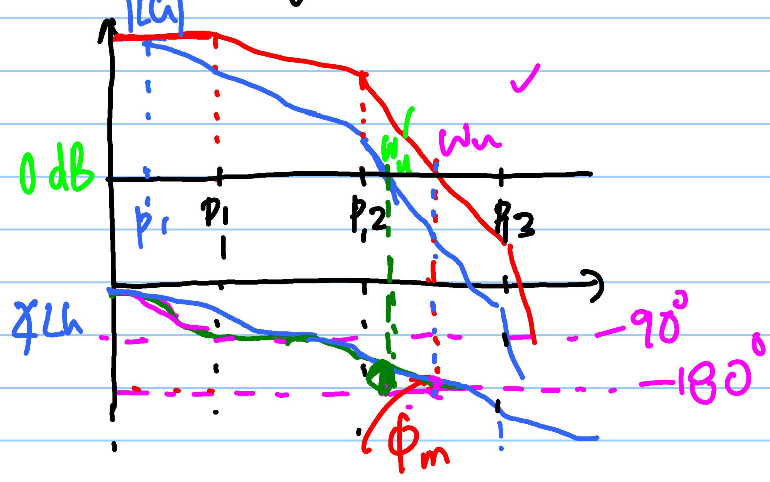


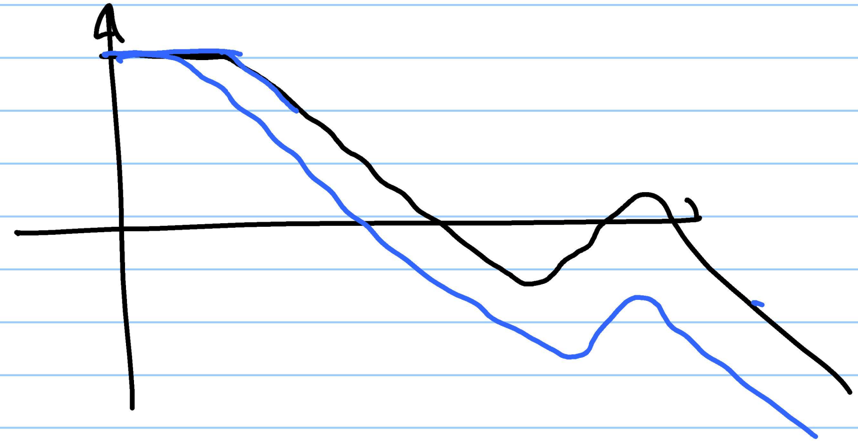


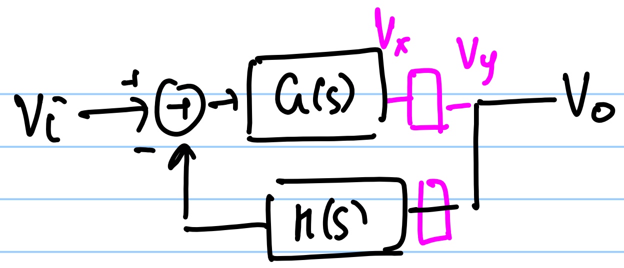


For an all pole system

- Bode plot gives same conclusions about stability of system as Nyqusit Cri.







$$X_y = V_x(t - t_d)$$

$$V_y(s) = V_x(s)\, e^{-st_d}$$

$$GG = G(s) \cdot \underline{e^{-st_d}} \cdot H(s).$$