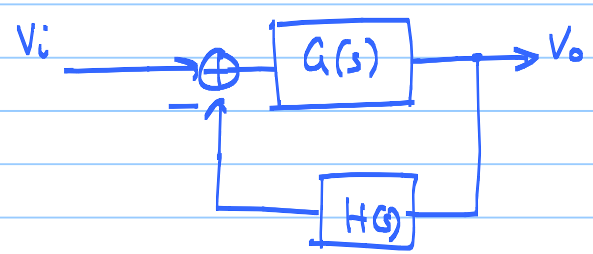
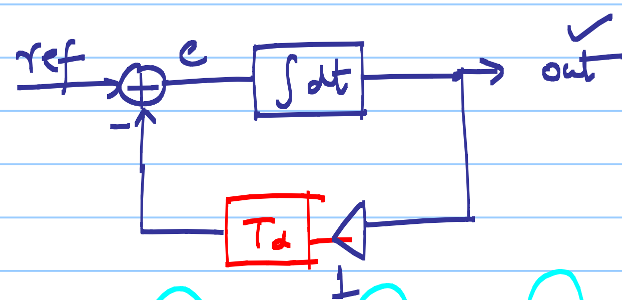
ECE 518 – Lecture 13

Note Title 3/5/2013

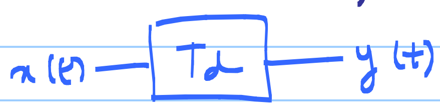


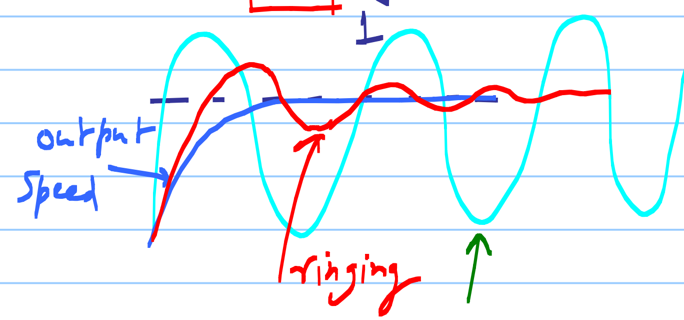


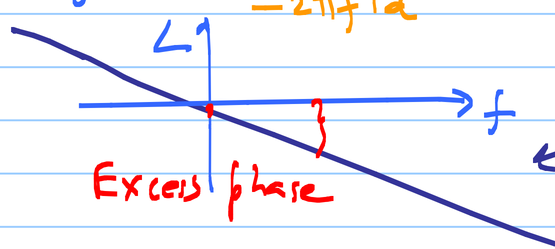
$h(t) = \delta(t - T_d) \xrightarrow{\mathcal{F}} e^{-j2\pi f T_d}$

phase

$-2\pi f T_d$





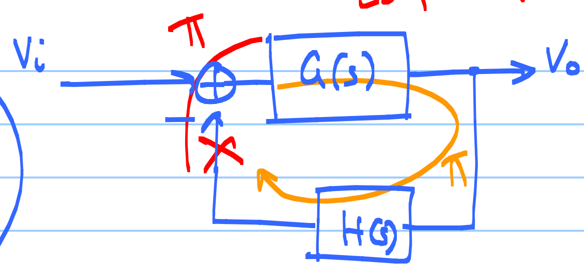


Linear phase

↳ more excess phase at high frequencies

$L(s) = G(s)\,H(s)$

Loop response



$-1 \Rightarrow e^{-j\pi}$

closed-loop TF

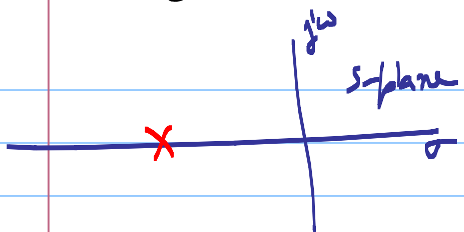
$$\frac{V_o}{V_i}(s) = \frac{G(s)}{1+G(s)H(s)} = \frac{1}{H(s)} \cdot \frac{1}{1+\frac{1}{G(s)H(s)}}$$

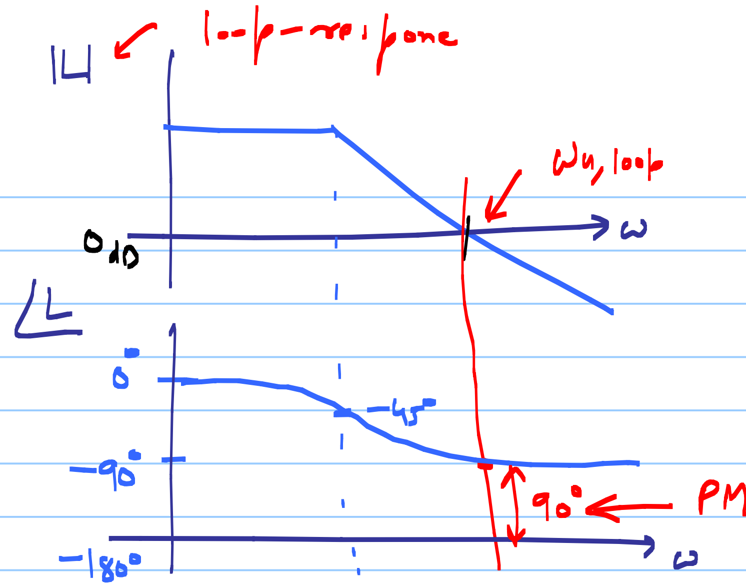
$GH(s) = -1$ ← Barkhausen's Criterim

$$\boxed{GH(s) = -1 \Rightarrow |GH(j\omega)| = 1 \;\&\; \angle GH(j\omega) = -\pi}$$

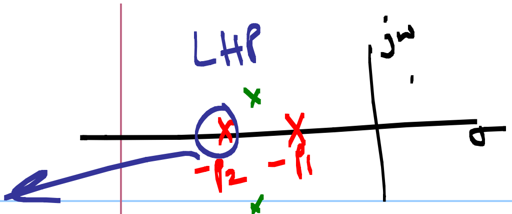
for any ω

Single-pole system





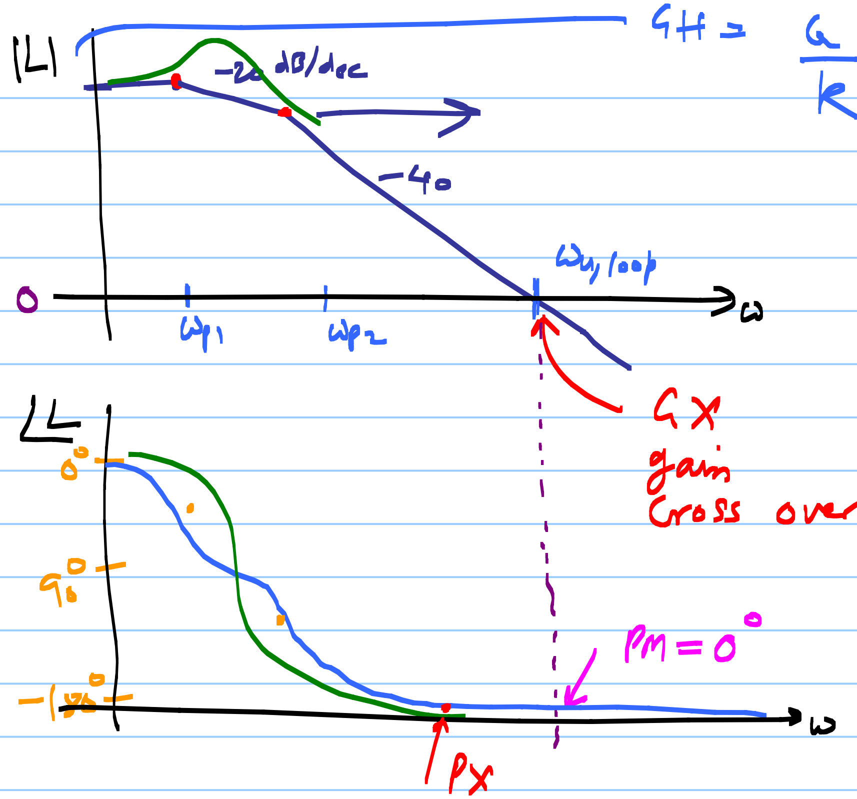
90° PM

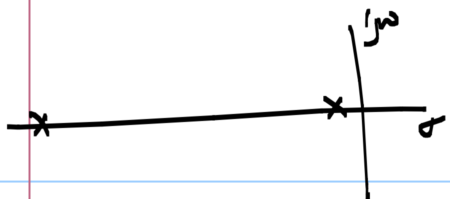


2 pole → unstable

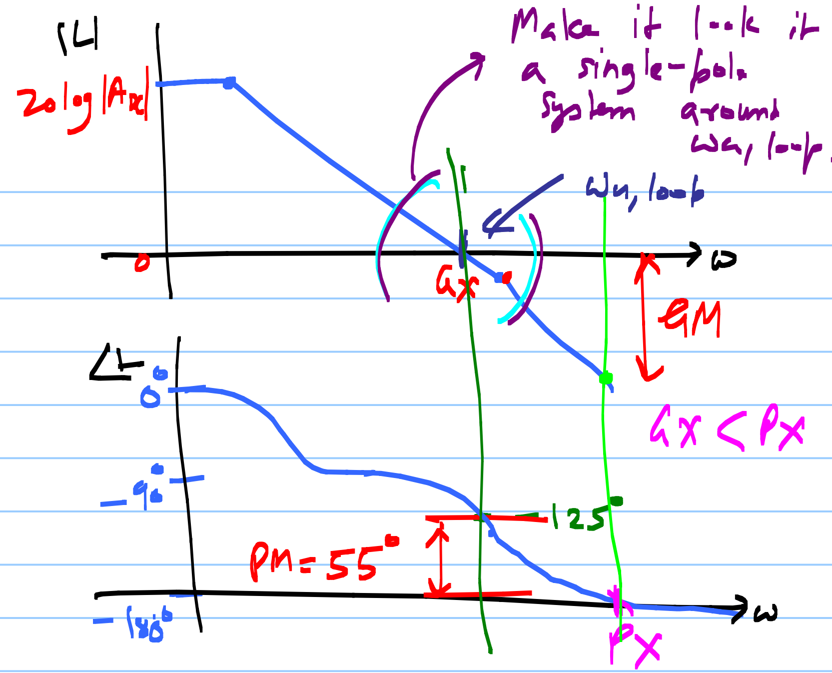
for stability

$G_X < P_X$





jω
σ



|L|
20 log |Ax|
0
Make it look it
a single-pole
system around
ωu, loop.
ωu, loop
ω
Gx
GM
Gx < Px
∠L
0°
-90°
-125°
PM = 55°
-180°
ω
Px

* for stability, the mag plot must have a slope of $-20\,dB/dec$ around the unity gain frequency (ω_u, loop)

* PM is a valuable metric to assess stability in higher order systems

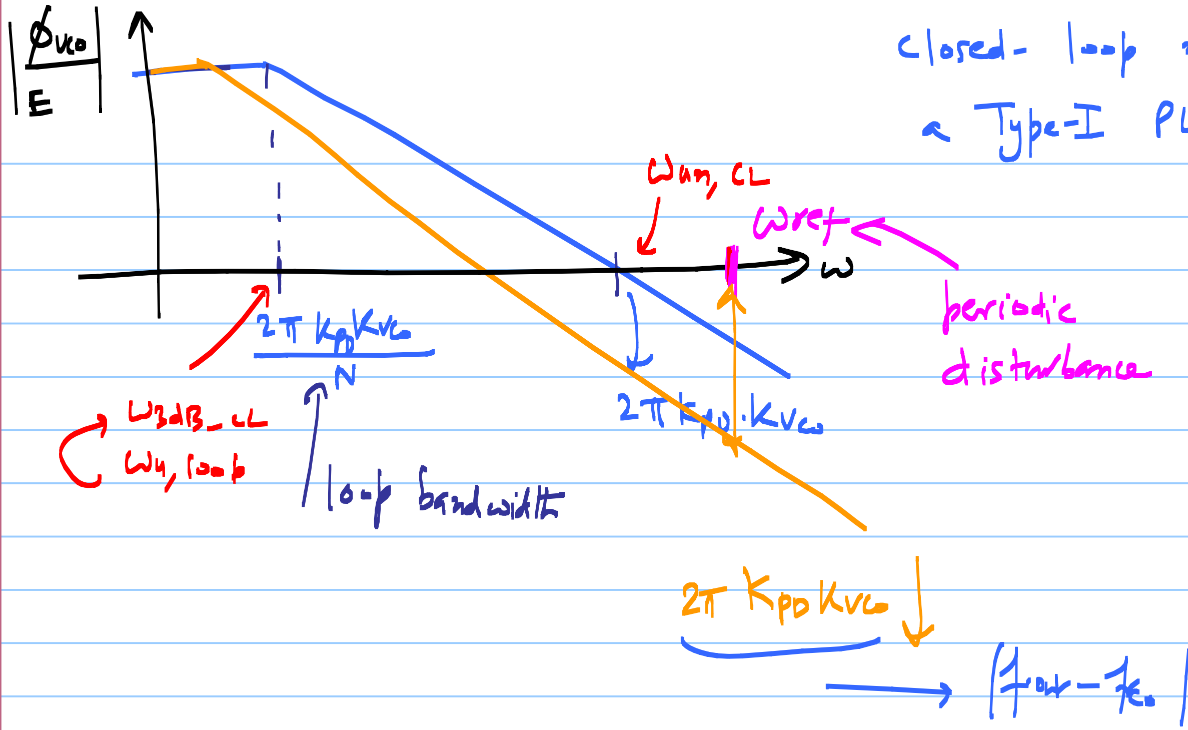
* To stabilize a higher pole system, it must be made to "look-like" a 1st order system around its unity gain crossover point.

$$H(s) = \frac{A_0}{\left(1+\frac{s}{\omega_{p1}}\right)\left(1+\frac{s}{\omega_{p2}}\right)}$$

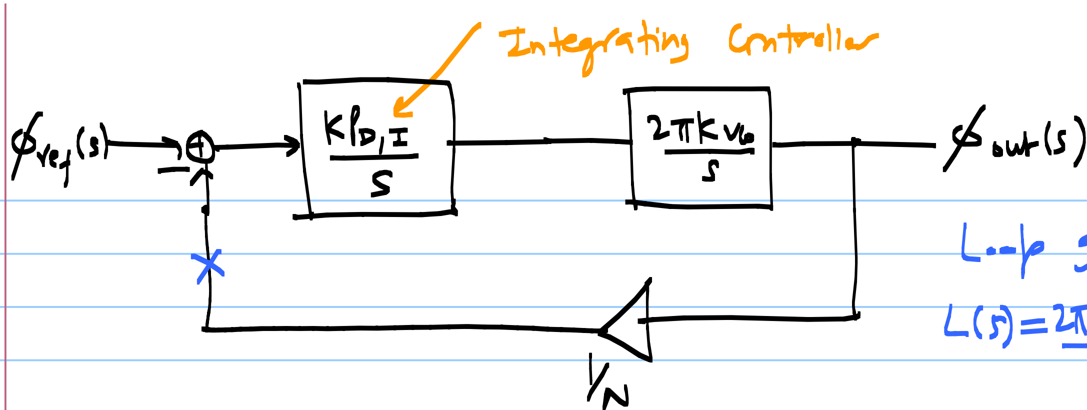
Matlab zpk

$$\frac{A_0(\omega_{p1}\omega_{p2})}{(s+\omega_{p1})(s+\omega_{p2})}$$

closed-loop response for a Type-I PLL



$\frac{K_{VCO}}{s}$



Loop gain

$$L(s) = \frac{2\pi K_{PD,I} K_{vco}}{N \quad s^2}$$ ← Type-II

Add a LHP zero