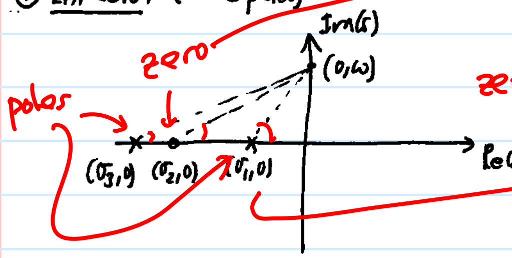
Again, we're mainly concerned here w/ phase margin; i.e., stability.

How does a RHP zero affect the PM?

$\Rightarrow$ compare a LHP zero w/ a RHP zero:

① LHP zero: (and 2 poles)



$$|H(j\omega)| = \frac{\sqrt{\omega^2+\sigma_2^2}}{\sqrt{\omega^2+\sigma_1^2}\sqrt{\omega^2+\sigma_3^2}}$$

$\frac{\omega-0}{0-\sigma_2}$

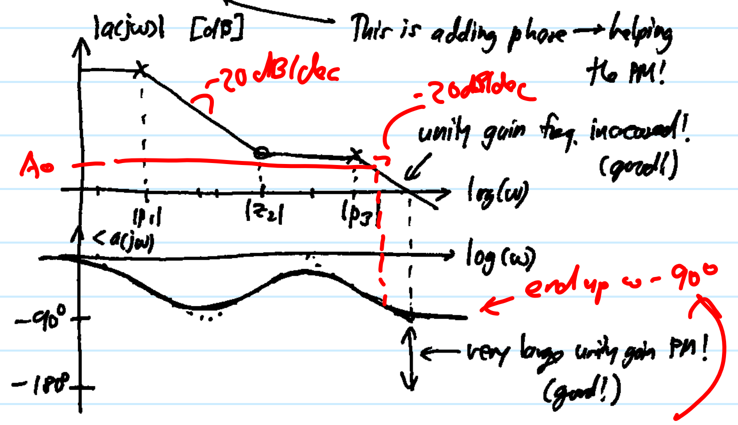
zero

$$\measuredangle H(j\omega) = +\tan^{-1}\left(\frac{\omega}{-\sigma_2}\right) - \tan^{-1}\left(\frac{\omega}{-\sigma_1}\right) - \tan^{-1}\left(\frac{\omega}{-\sigma_3}\right)$$

$$= \tan^{-1}\left(\frac{\omega}{|\sigma_2|}\right) - \tan^{-1}\left(\frac{\omega}{|\sigma_1|}\right) - \tan^{-1}\left(\frac{\omega}{|\sigma_3|}\right)$$

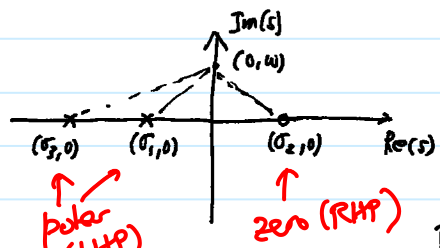
This is adding phase $\rightarrow$ helping the PM!

Thus:



A LHP zero can really improve the performance & stability of an op amp FB ckt.

② RHP zero: (and 2 poles)



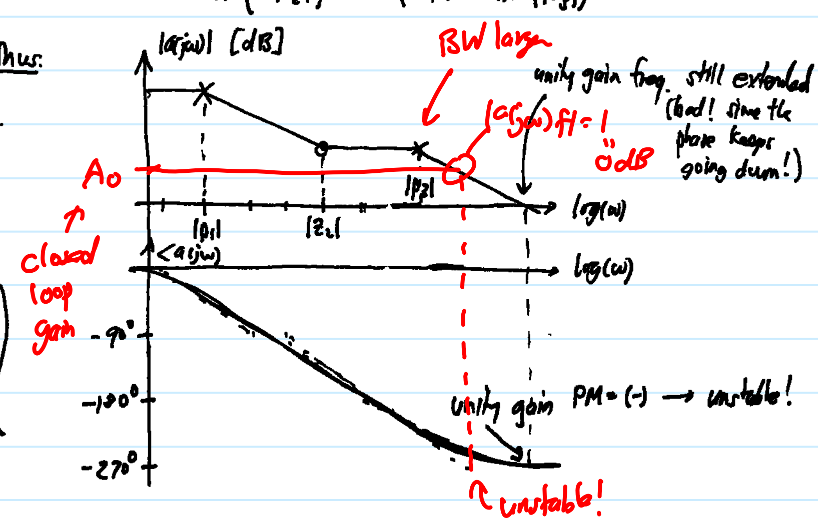
$$|H(j\omega)| = \frac{\sqrt{\omega^2+\sigma_2^2}}{\sqrt{\omega^2+\sigma_1^2}\sqrt{\omega^2+\sigma_3^2}}$$

now $\sigma_2 = (+)$

$$\measuredangle H(j\omega) = +\tan^{-1}\left(\frac{\omega}{-\sigma_2}\right) - \tan^{-1}\left(\frac{\omega}{-\sigma_1}\right) - \tan^{-1}\left(\frac{\omega}{-\sigma_3}\right)$$

$$= +\tan^{-1}\left(-\frac{\omega}{|\sigma_2|}\right) - \tan^{-1}\left(\frac{\omega}{|\sigma_1|}\right) - \tan^{-1}\left(\frac{\omega}{|\sigma_3|}\right)$$

Thus:



A RHP zero is detrimental because it:

① extends the ω_u

② while continuing to drop the phase

$\Downarrow$

instability!

Problem!

$\Rightarrow$ to solve, must first understand where the zero comes from!

$$\frac{(s-z_1)}{(s-p_1)(s-p_2)}$$

$s=z_1 \rightarrow 0$

$s=p_1 \rightarrow \infty$