

EE 140

RHP Zero

CTN

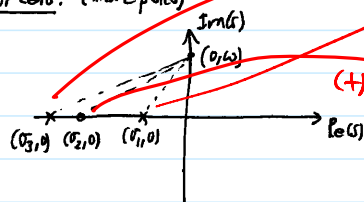
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Again, we're mainly concerned here w/ phase margin; i.e., stability.

How does a RHP zero affect the PM?

→ compare a LHP zero w/ a RHP zero:

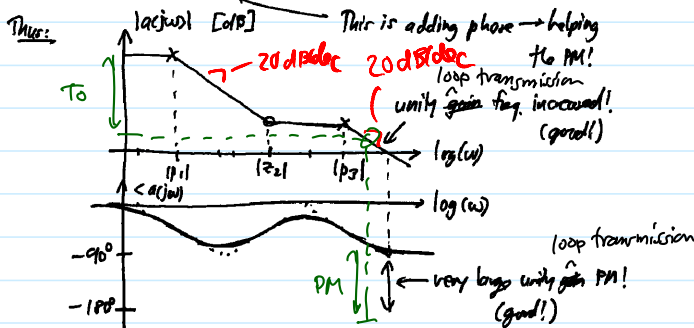
① LHP zero: (and 2 poles)



$$|H(j\omega)| = \frac{\sqrt{\omega^2 + \sigma_2^2}}{\sqrt{\omega^2 + \sigma_1^2} \sqrt{\omega^2 + \sigma_2^2}} \quad \omega = \frac{\omega}{0 - \sigma_2}$$

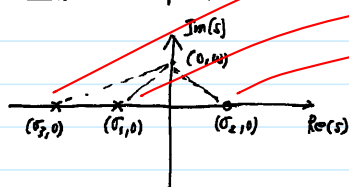
$$\angle H(j\omega) = +\tan^{-1}\left(\frac{\omega}{-\sigma_2}\right) - \tan^{-1}\left(\frac{\omega}{-\sigma_1}\right) - \tan^{-1}\left(\frac{\omega}{-\sigma_2}\right)$$

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



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

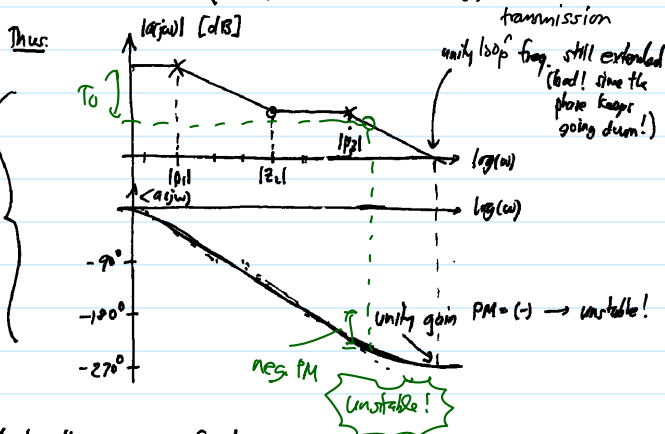
② RHP zero: (and 2 poles)



$$|H(j\omega)| = \frac{\sqrt{\omega^2 + \sigma_2^2}}{\sqrt{\omega^2 + \sigma_1^2} \sqrt{\omega^2 + \sigma_z^2}} \quad \text{near } \sigma_z = (+)$$

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

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



A RHP zero is detrimental because:

- ① extends the unit
- ② while continuing to drop the phase

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instability!

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Problem!

→ to solve, must first understand where the zero comes from!