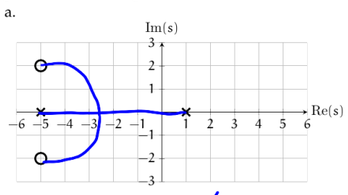
Exercises for Chapter rlocus

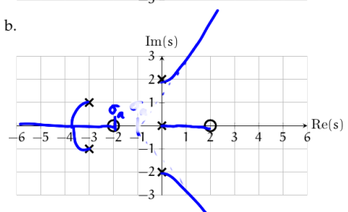
Exercise rlocus.burritosteve

Given the open-loop pole-zero plots below, sketch the root locus plots (use this sheet) for positive controller gain K.

a.



b.

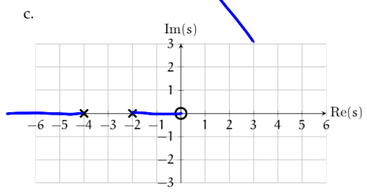


$$\sigma_a = \frac{\sum_i p_i - \sum_j z_j}{n_p - n_z} = \frac{-3 + i - 3 - i + 0 + 2i - 2i - 2 + 2}{5 - 2} = \frac{-6}{3} = -2$$

$$\theta_m = \frac{(2m+1)\pi}{n_p - n_z} = \frac{(2m+1)\pi}{3}$$

$$\theta_0 = \frac{\pi}{3} \qquad \theta_1 = \pi \qquad \theta_2 = \frac{5\pi}{3}$$

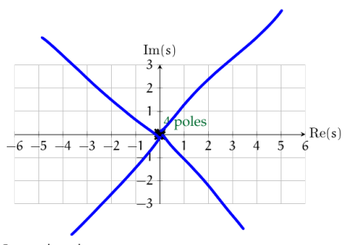
c.



$$\theta_m = \frac{(2m+1)\pi}{2-1} = (2m+1)\pi$$

$$\theta_0 = \pi \qquad \theta_1 = 3\pi \qquad \theta_2 = 5\pi$$

d.



$$\sigma_a = \frac{\sum_i p_i - \sum_j z_j}{n_p - n_z} = \frac{0 - 0}{4} = 0$$

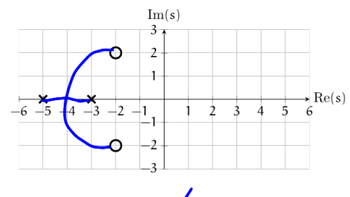
$$\theta_m = \frac{(2m+1)\pi}{4} \qquad \theta_0 = \frac{\pi}{4}$$

$$\theta_1 = \frac{3\pi}{4} \qquad \theta_2 = \frac{5\pi}{4} \qquad \theta_3 = \frac{7\pi}{4}$$

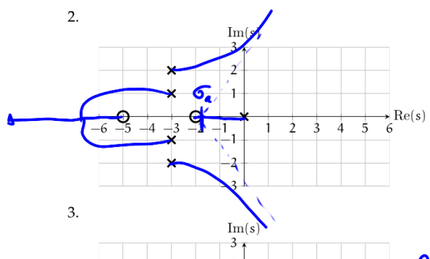
Exercise rlocus.dunnage

Given the open-loop pole-zero plots below, sketch the root locus plots (use this sheet) for positive controller gain K.

1.



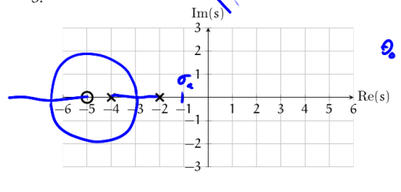
2.



$$\sigma_a = \frac{\sum_i p_i - \sum_j z_j}{n_p - n_z} = \frac{-3 + i - 3 - i - 3 + 2i - 3 - 2i + 2 + 5}{5 - 2} = \frac{7 - 12}{3} = \frac{-5}{3}$$

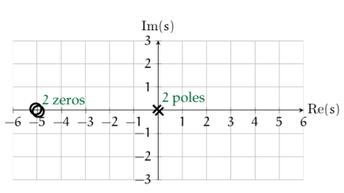
$$\theta_m = \frac{(2m+1)\pi}{n_p - n_z} = \frac{(2m+1)\pi}{3}$$

3.



$\theta_0 = \pi$

4.



rldesign

Root–locus design

In root locus design, our task is to place the dominant closed-loop poles such that the closed-loop system

1. is stable (Chapter stab),
2. has desirable transient response performance characteristics (Chapter trans), and
3. has desirable steady-state response characteristics (Chapter steady).

Several types of controllers can be designed using these techniques. The most basic is gain control (Lec. rldesign.P), which gives us a single parameter—the loop gain—for controller design. The others we consider here are of two main types: proportional-integral-derivative (PID) and proportional-lead-lag. The two are quite similar, but the latter can be implemented with passive circuits, whereas the former require active circuits.