Control Systems, EE302

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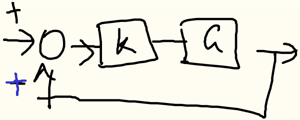
Root locus — generalized —: +ve feedback $\equiv k<0$

—: a general parameter

how do roots p vary (as p varies)



$k > 0.$

+ve feedback case

$\therefore$ $k < 0$ (-ve feedback

$\therefore$ +ve feedback

$\therefore$ $G(s) = \dfrac{n(s)}{d(s)}$

sign of leading coeff of n & d are diff

1 # branches ✓

2 symmetry about real axis ✓

3 Real axis segment: even number of poles/zeros to the right

4 start/end points

5 Behavior at ∞: asymptotes angle.

6 Breakaway/break in points ✓

7 $j\mathbb{R}$ intersections $k<0$ ✓

8 angle of departure/arrival at complex poles/zeros: even multiple of $180°$.

Given polynomial

$\boxed{d(s) + k\,n(s)}$, plot locus of roots as k varies

SISO

$0 \longrightarrow \infty$

$-\infty \longrightarrow 0$

$\frac{n(s)}{d(s)} = G(s)$

roots of $n(s)$ are when $G \to 0$ $= 0$. G has a "zero" at s a root of n.

roots of d are when G is unbounded

strictly proper $\equiv$ G has "zeros" at $s=\infty$

improper $\equiv$ G has "poles" at $s=\infty$.

$$s^3 + 3s^2 \pm 8p\, s + 2 = 0$$

$$\tilde{p} = 8p$$

p varies.

$$(s^3 + 3s^2 + 2) + p\,(s)$$

Study "complete" rootlocus of $\dfrac{8s}{s^3 + 3s^2 + 2}$

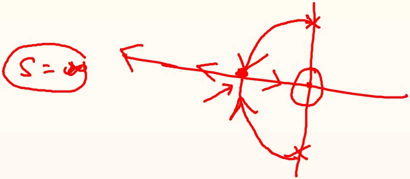
$p > 0$,

$p < 0$

$s^2 + 2\zeta \omega_n s + \omega_n^2$.

Keep ω_n fixed

& vary only ζ.



$$\underbrace{(s^2 + \omega_n^2)}_{d(s)} + \zeta \underbrace{(2\omega_n s)}_{n(s)}$$