Lead & Lag Compensators

Consider a general controller of the form

$$K\frac{s+z}{s+p} \qquad \text{— } K, z, p > 0 \text{ are design parameters}$$

Depending on the relative values of z and p, we call it:

- a lead compensator when $z < p$
- a lag compensator when $z > p$

Why the name "lead/lag?" — think frequency response

$$\angle\frac{j\omega+z}{j\omega+p} = \angle(j\omega+z) - \angle(j\omega+p) = \psi - \phi$$

- if $z < p$, then $\psi - \phi > 0$ (phase lead)
- if $z > p$, then $\psi - \phi < 0$ (phase lag)