Second-Order Systems

Characteristic eq.: \( a s^2 + bs + c = 0 \), \( a > 0 \). Roots \( s_1 \) and \( s_2 \).

**Overdamped:** \( c > 0 \) and \( c < 0 \) are different.

Underdamped:

**Char. Eq.**

\( \sqrt{a^2 - \omega_0^2} \)

\( S > 0 \)

\( \omega_0^2 - \alpha^2 \)

**S-plane**

**Time response**

\( \chi_c(t) \)

\( \chi_c(t) \)

Critically damped:

\( -\alpha = s_1 = s_2 \)

\( \omega_0^2 - \alpha^2 \)

Two roots at \( s = 0 - \alpha \)
Underdamped: 3 cases: $\alpha < 0$, $\gamma = 0$, $\alpha > 0$.

\[ \omega_0^2 - \alpha^2 = \omega_d^2 \]

No real roots!!

\[ \omega_0^2 = \omega_d^2 \]

\[ \omega_d^2 = \omega_0^2 - \alpha^2 \]