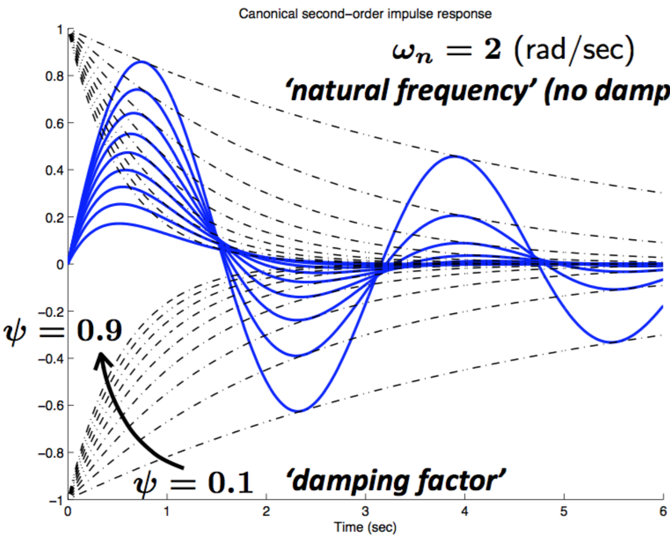
Contents

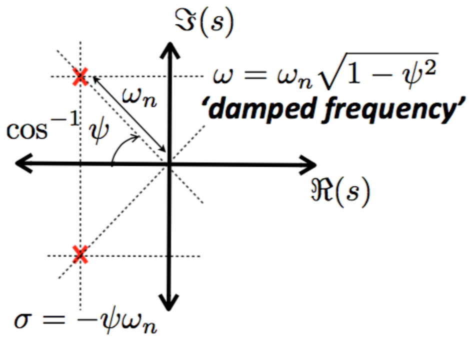
2 Pole-zero plot(2013 Q2, 2012 Q4)

- Pole plot and the correspond time domain step response

$$\ddot{y}(t) + 2\psi\omega_n\dot{y}(t) + \omega_n^2 y(t) = \omega_n^2 u(t) \quad \overset{\mathcal{L}}{\leftrightarrow} \quad G(s) = \frac{Y(s)}{U(s)} = \frac{\omega_n^2}{s^2 + 2\psi\omega_n s + \omega_n^2}$$

for $\boxed{0 < \psi < 1}$ the poles are $\dfrac{-2\psi\omega_n \pm \sqrt{(2\psi\omega_n)^2 - 4\omega_n^2}}{2} = -\psi\omega_n \pm j\omega_n\sqrt{1-\psi^2}$

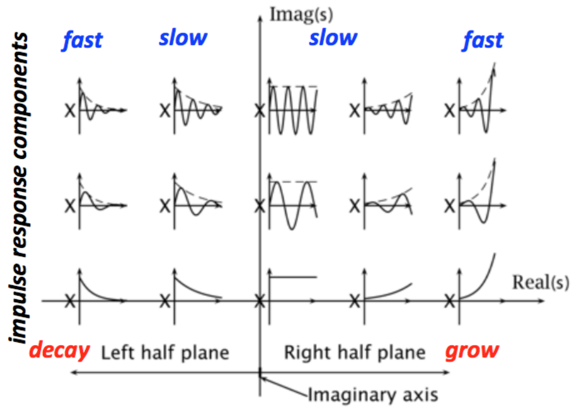




time-constant inc. as damping dec.

peak of oscillation inc. as damping dec.

frequency of oscillation inc. as damping dec.



- response due to poles with +ve real part *grows* and these are said to be **'unstable'**
- response due to poles with -ve real part *decays* and these are said to be **'stable'**
- response due to imaginary axis poles is bounded if not repeated, else response grows
- a stable response is ***dominated*** by **'slowest'** poles (i.e. closest to imaginary axis)