Brief Summary of Chapters 6-9

Impulse Response

$h(t)$

$x(t) \rightarrow \boxed{h(t)} \rightarrow y(t) = x(t) * h(t)$

Step Response

$o(t) = \int_{-\infty}^{t} h(\tau)d\tau$

$\tilde{H}(s) = \mathcal{L}\{h(t)\} = \int_{0}^{\infty} h(t)\, e^{-jst} dt$

$H(f) = \mathfrak{I}\{h(t)\} = \int_{-\infty}^{\infty} h(t)\, e^{-j2\pi f t} dt$

Differential Equations

$$\sum_{n=0}^{N} a_n \frac{d^n y(t)}{dt^n} = \sum_{m=0}^{M} b_m \frac{d^m y(t)}{dt^m}$$

$\xrightarrow{\mathcal{L}}$

Transfer Function

$\tilde{H}(s) \xrightarrow{s = j\omega} \tilde{H}(j\omega)$

$\tilde{X}(s) \rightarrow \boxed{\tilde{H}(s)} \rightarrow \tilde{Y}(s) = \tilde{X}(s) \cdot \tilde{H}(s)$

$$\tilde{H}(s) = \frac{\tilde{Y}(s)}{\tilde{X}(s)} = \frac{b_M s^M + b_{M-1} s^{M-1} + \cdots + b_0}{a_N s^N + a_{N-1} s^{N-1} + \cdots + a_0}$$

Frequency Response

$\tilde{H}(j\omega) \xrightarrow{\omega = 2\pi f} H(f)$

$\tilde{X}(j\omega) \rightarrow \boxed{\tilde{H}(j\omega) = |\tilde{H}(j\omega)| e^{j\angle\tilde{H}(j\omega)}} \rightarrow \tilde{Y}(j\omega) = \tilde{X}(j\omega) \cdot \tilde{H}(j\omega)$

Sinusoidal Response at Steady-State

$x(t) = Ae^{j(\omega_0 t + \psi)} \rightarrow \boxed{\tilde{H}(j\omega)} \rightarrow y(t) = A|\tilde{H}(j\omega_0)| e^{j(\omega_0 t + \psi + \angle\tilde{H}(j\omega_0))}$

Transient Response

System Stability

Locations of System Poles

- Stable
- Marginally stable
- Unstable

Typical Systems

First order system

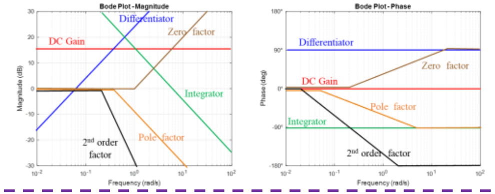
Second order system

- $\zeta > 1$
- $\zeta = 1$
- $0 < \zeta < 1$
- $\zeta = 0$

Decompose to a cascade form

- System without differentiator or integrator
- System with a differentiator
- System with an integrator

Bode Plots



Sampling and Reconstruction of Band-Limited Signals

Band-Limited Signals

- Sampling above Nyquist Rate
- Sampling Bandpass Signal below Nyquist Rate
  - Overlapping
  - Un-aliased

Reconstruction Filter