EECS 16B CSM

Bryan Ngo

Filters

Bode Plots

EECS 16B CSM

Bryan Ngo

Computer Science Mentors

2021-02-24



Overview

EECS 16B CSM

ryan ing

Bode Plots

1 Filters

Logistics

EECS 16B CSM

Diyan ive

Filter

Bode Plots

■ Pertinent facts

EECS 16B CSM

Bryan Ngo

Filter

Bode Plots

Filters

Why?

EECS 16B CSM

Bryan Ngo

Filters

- allows us to isolate desired frequency ranges
- color organ: basically just a visualizer
- sort of related to Fourier transform
- Afrotechmods video

Types

EECS 16B CSM

Bryan Ngo

Filters

- lacksquare low-pass: let in low ω
- \blacksquare high-pass: let in high ω
- \blacksquare band-pass: let in range of ω
- \blacksquare band-stop: block out range of ω

Transfer Functions

EECS 16B CSM

Bryan Ng

Filters

$$H(j\omega) = \frac{V_{out}}{V_{in}} = \frac{(j\omega)^{N_z}}{(j\omega)^{N_p}} \frac{\alpha_0 + (j\omega)\alpha_1 + \dots + (j\omega)^n \alpha_n}{\beta_0 + (j\omega)\beta_1 + \dots + (j\omega)^m \beta_m}$$
(1)

$$= K \frac{(j\omega)^{N_z}}{(j\omega)^{N_p}} \frac{\left(1 + j\frac{\omega}{\omega_{z1}}\right) \left(1 + j\frac{\omega}{\omega_{z2}}\right) \cdots \left(1 + j\frac{\omega}{\omega_{zn}}\right)}{\left(1 + j\frac{\omega}{\omega_{p1}}\right) \left(1 + j\frac{\omega}{\omega_{p2}}\right) \cdots \left(1 + j\frac{\omega}{\omega_{pn}}\right)}$$
(2)

- \blacksquare N_z : number of zeroes
- lacksquare N_p : number of poles
- lacksquare ω_{zn} : n-th zero
- lacksquare ω_{pn} : n-th pole



EECS 16B CSM

Bryan Ngo

Filters

Bode Plots

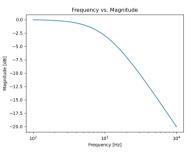
Definition

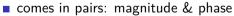
EECS 16B CSM

Bryan Ngo

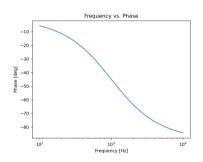
Hilters

Bode Plots





■ above: low-pass filter



Features

EECS 16B CSM

Bryan Ngo

Hilter

Bode Plots

magnitude

- *x*-axis: log frequency (Hz)
- y-axis: $|H(j\omega)|$ (dB or intensity)
- cutoff frequency: $|H(j\omega)| = \frac{1}{\sqrt{2}} = -3 \, \text{dB}$

phase

- *x*-axis: log frequency (Hz)
- y-axis: phase offset (° or rad)

Why?

EECS 16B CSM

Bryan Ngo

Filters

- allows us to characterize a filter very fast
- quick visual tool