Lab 4

School of Architecture, Civil and Environmental Engineering

EPFL, SS 2022-2023

http://disal.epfl.ch/teaching/signals_instruments_systems/
Lab 4 Outline

• Concepts:
  – Fast Fourier Transforms (FFT)
  – Frequency Response (Bode Plots)
  – Filtering

• Tools:
  – Matlab
Review – Frequency Response

• **Frequency response**: Quantitative measure of output spectrum of a system in response to stimulus (usually sine waves)
• **Magnitude and phase** of the output as a function of frequency
• For **linear systems**, if a **sine wave** injected to system at a **given frequency**, it responds at the **same frequency** with a certain magnitude and phase.
Review – Frequency Response

Input → Frequency Response → Output

This shows only magnitude response, phase might also be affected

https://www.soundguys.com/frequency-response-explained-16507/
Review - Bode Plots

### Gain (dB)
- Cutoff frequency
- -3.01 dB
- Slope: -20 dB/decade

### Phase (degrees)
- Passband
- Stopband

### Angular frequency (rad/s)
- 0.001 to 1000
Part 1: Filters

- Signal generation
  - $f(t) = \sum_i A_i \sin(2\pi f_i t)$
  - sin frequencies
  - sin amplitudes

- Filtering
  - Filter type
  - Order
  - Cut-off frequency

- Sampling

- Reconstruction
Signal generation

Filtering

Sampling

Reconstruction

- $f(x) = \sum_i A_i \sin(2\pi f_i t)$
- sin frequencies
- sin amplitudes

- Filter type
- Order
- Cut-off frequency
Part 2: Sound / Voice Signal & Filters
Feedback

• Please fill the feedback form for Lab-4