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EE3025 ASSIGNMENT- 1

VARUN SM - EE18BTECH11030

Download all python codes from

https://github.com/Elonian/filter/tree/main/codes

and latex-tikz codes from

https://github.com/Elonian/filter/tree/main

1 Problem

The command

output_signal = signal.lfilter(b, a, input_signal)

in Problem (2.3) is executed through the following difference equation

$$\sum_{m=0}^{M} a(m) y(n-m) = \sum_{k=0}^{N} b(k) x(n-k)$$
 (1.0.1)

where the input signal is x(n) and the output signal is y(n) with initial values all 0. Replace **signal.filtfilt** with your own routine and verify.

2 Solution

Apply z transform for the given difference equation and compute H(z).

Using the time shifting property of Z transform

$$Z\{x(n-n_o)\} = z^{-n_o}X(z)$$
 (2.0.1)

let X(z) and Y(z) are the z-transforms of x(n) and y(n) respectively.

The H(z) is obtained as follows

$$H(z) = \frac{Y(z)}{X(z)} = \frac{\sum_{k=0}^{N} b(k) z^{-k}}{\sum_{m=0}^{M} a(m) z^{-m}}$$
(2.0.2)

From the coefficients b,a and from (2.0.2) H(k)

$$z = e^{-j\omega} \tag{2.0.3}$$

$$\omega = \frac{2\pi k}{N} \tag{2.0.4}$$

$$H(k) = H\left(z = e^{\frac{-2j\pi k}{N}}\right)$$
 (2.0.5)

Here N is the length of signal and k runs from 0 to N-1.

The in-built command **fft** evaluates X(k) for input signal x(n).

$$Y(k) = H(k)X(k)$$
 (2.0.6)

output signal y(n) is obtained from Y(K) using **ifft** command.

codes for the evaluating on the given input sound file.

codes/ee18btech11030.py

3 Verification

Time domain plots of y(n) obtained using signal.filtfilt and own filter function.

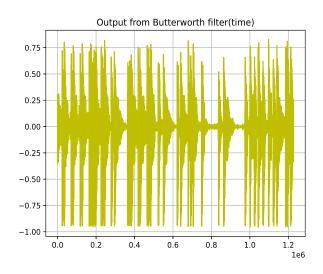


Fig. 0

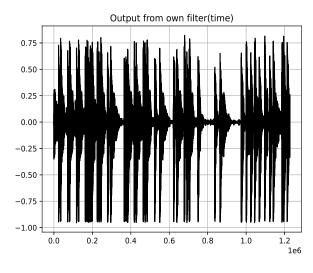


Fig. 0

Frequency domain plots of y(n) obtained using signal.filtfilt and own filter function.

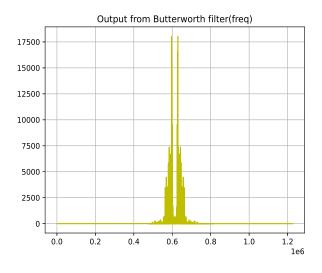


Fig. 0

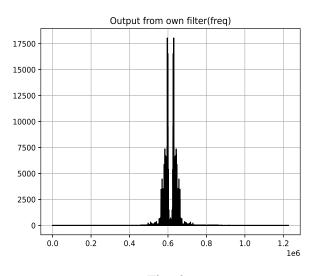


Fig. 0