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

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

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

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

let $X(z)$ and $Y(z)$ are the z-transforms of $x(n)$ and $y(n)$ respectively.
The $H(z)$ is obtained as follows

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

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

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

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

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

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 $x(n)$.

$$Y(k) = H(k)\, X(k) \tag{2.0.6}$$

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.

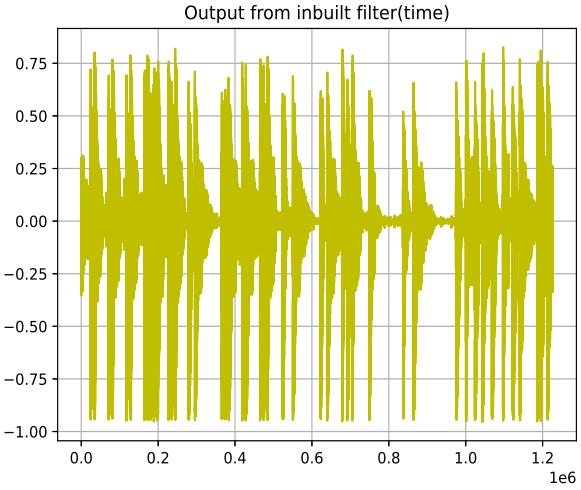

Fig. 0

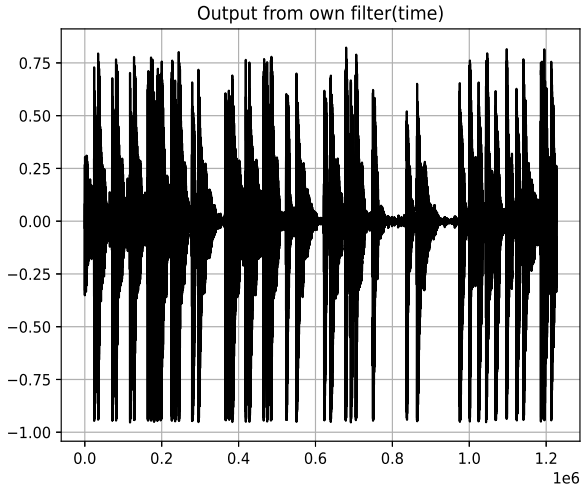

Fig. 0

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

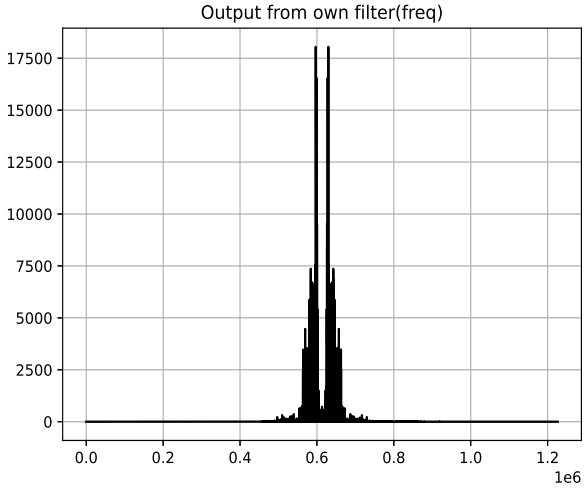

Fig. 0

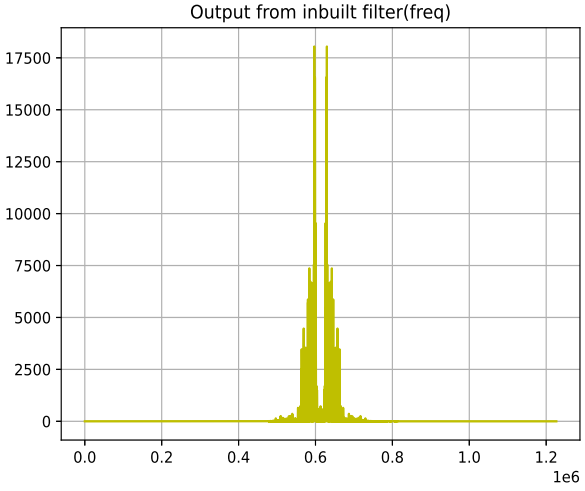

Fig. 0

Below codes generate the .dat file which will be used by .c files while implementing using FFT algorthim

codes/ee18btech11030_dat.py

codes for implementing in c

codes/ee18btech11030.c

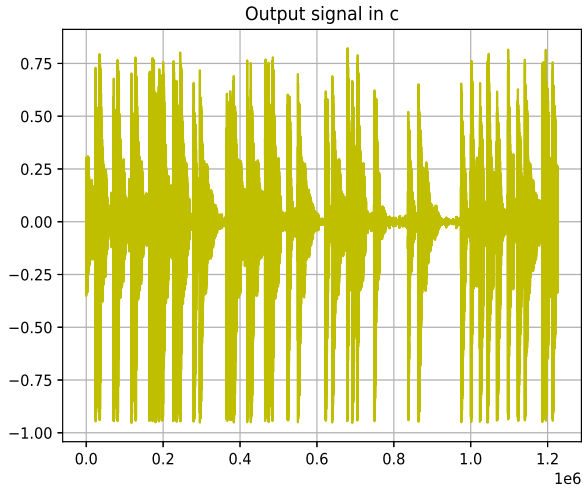

Fig. 0