Exercise 6.1

In the lecture, we saw that the correlation-based methods can be interpreted as a feedforward comb filter. This filter is given by

$$e(n) = x(n) - ax(n - \tau) \tag{1}$$

where $x(n)$ is the input signal and $e(n)$ is the output signal.

(a) Compute the frequency response and the amplitude response. Sketch the latter for a delay of τ, 2τ, and 3τ. What is the consequence of this for pitch estimation?

Exercise 6.2

On Moodle, you can download the viola signal `09viola.flac` and the speech signal `roy.wav`. We would like to estimate the fundamental frequency/pitch of these signals.

(a) Implement the comb filtering pitch estimation method as a function in, e.g., MATLAB. The function should have the following input:

- a segment of data and
- the lower and upper limits for the fundamental frequency in cycles/sample.

The output of the function should be the estimated fundamental frequency.

The above function can estimate the fundamental frequency for a segment of data. We now wish to analyse entire audio files.

(b) Write a function that takes in an audio file and displays the estimated fundamental frequency track in cycles/second (Hz). The function should have the following input

- Filename of the audio file,
- the segment length in seconds,
- the overlap between segments as a percentage,
- the lower and upper limits for the fundamental frequency in cycles/sample

The output of the function should be the estimated fundamental frequencies as a function of time.