Neuroprothetics Exercise 1

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1 Signal generation

1.1 Signal plotting

According to the equation(1) the sound signals in the following situations are generated.
a) F_n = [50, 500, 5000], A_n = [2, 4, 2], t = 1s, sampling_rate = 12 kHz
b) F_n = [50, 500, 5000], A_n = [2, 4, 2], t = 1s, sampling_rate = 12 kHz , A_0 = 3 Hz

$$f(t) = A0 + \sum_{i=1}^{n} A_i \cdot \sin(2\pi Fi \cdot t) \tag{1}$$

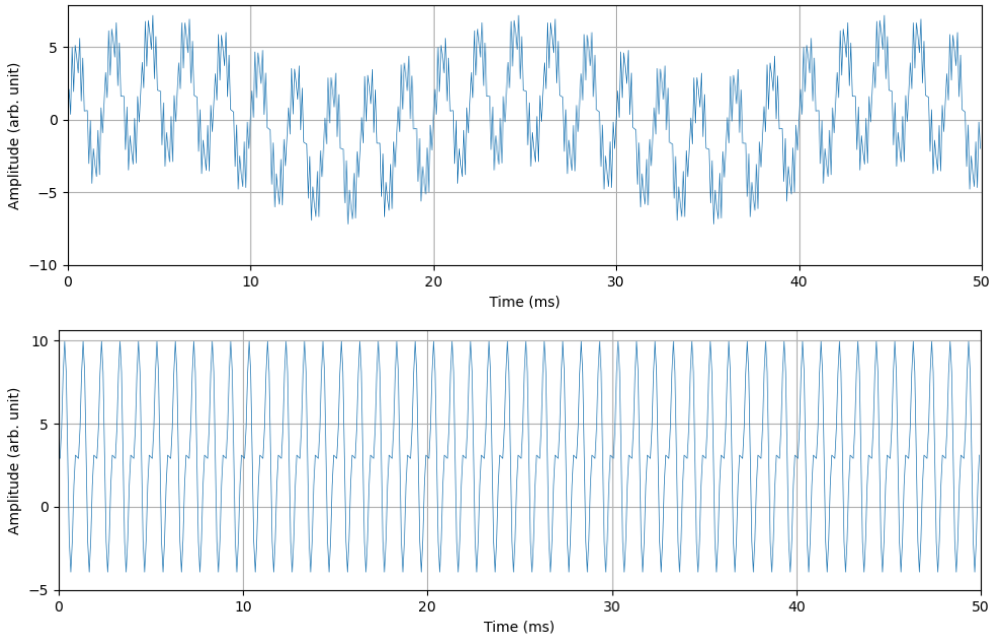

Figure 1: Time-domain plot of the generated signals. Top plot shows the signal generated in section 1.1 a), bottom plot shows the signal generated in section 1.1 b).

2 Spectrum

2.1 Spectrum plotting

Fourier Transform can convert a signal from the time-domain to the frequency-domain.

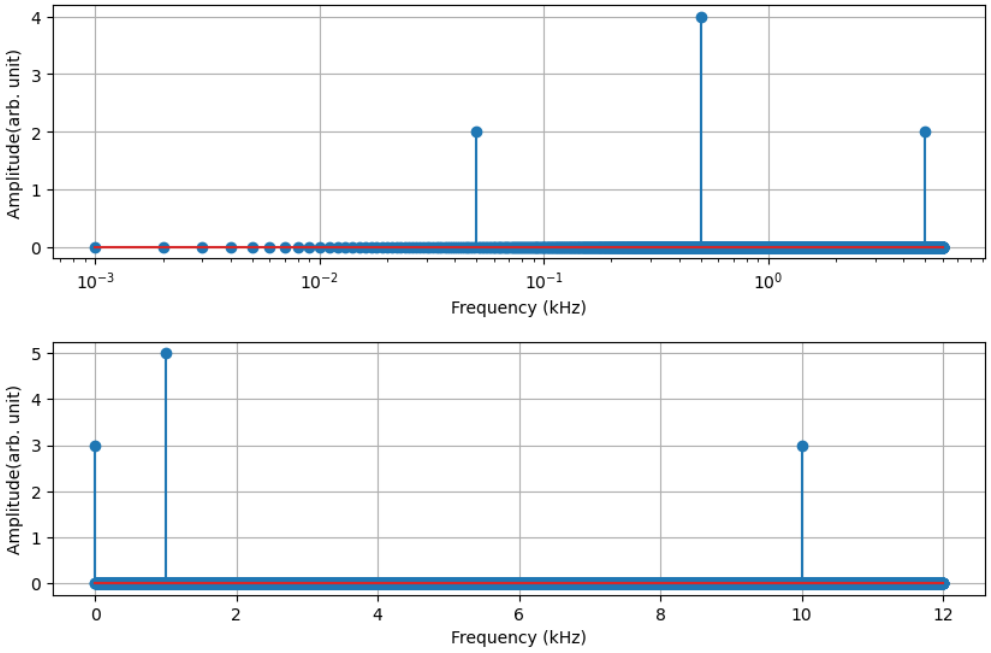

Figure 2: Spectra of the generated signals. Top plot shows the spectrum of the signal generated in section 1.1 a), bottom plot shows the spectrum of the signal generated in section 1.1 b).

2.2 Spectrum interpretation

a) the fisrt figure yes, but the second no. The reason is: The sampling rate is not enough to acquire the signals with 10kHz. The Nyquist Theorem states that in order to accurately reconstruct a continuous signal, it must be sampled at a rate of at least twice its highest frequency.
b) we use a logarithmic axis in the signal generated in section 1.1 b), because its frequencies are [50, 500, 5000]Hz, a logarithmic scale can make it easier to identify and analyze weak signals in the frequency domain.
c)