Assignment 1
Date handout: 24 November 2023
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Deadline: 8 December 2023

Assignment 1

Hand in a concise report, documenting and discussing the results and outcomes of the two questions a) and b) below. Add to the report a listing of the program used for question b).

a) Read chapters 1, 2 and 4 of the lecture notes on digital signal processing and make the exercise of chapter 2 (section 2.7). Make a sketch illustrating your answer.

b) Make a program (python or matlab) in which the following steps are taken

- Load the aircraft noise data file as provided on Brightspace (aircraft_flyover_microphone_assignment1) and plot the signal vs. time (figure 1) The sample frequency (F or f_s) amounts 40 kHz.

- Determine the spectrogram. Select an appropriate value for the duration (and thus corresponding number of samples) of the time snapshot T. Make a 2D plot of the spectrogram (figure 2). Motivate your choice for T. <u>Make sure you select a good range for the caxis</u>. Try to ensure that you highlight the relevant information as much as possible. When using matlab and the function spectrogram ([S,F,T,P] = spectrogram(..,…,..)), be aware that the output P is the power spectral density estimate in Pa^2/Hz.

- Calculate the effective pressure for consecutive snapshots of data of size T and plot the result in figure 1. The snapshot size T should be much smaller than the length of the full signal.

- Select the part of the signal between 10.500 seconds and 10.625 seconds (i.e. 0.125 second duration). Determine the power spectral density (in Pa^2 per Hz), using slide 48 of the presentation, for this signal for the frequency range between 0 and 40 kHz and also determine the one sided power spectral density values for the frequency range of 0 to 20 kHz. Plot these power spectral densities versus frequency in figure 3.

- Calculate the instantaneous OSPL (in dB) for each snapshot of data (of length T) and make a plot (figure 4). Do this both using the time domain signal and the frequency domain signal per snapshot and plot both results in one figure versus time spanning the full ~18 seconds.

- Calculate the instantaneous OASPL for each snapshot of data (of length T) and plot it in figure 4. **Note**: Realize that you only need to consider frequencies up to half of the sample frequency for the A-weighting. By multiplying the power spectral density in that range with a factor of two, you account for the acoustic energy that is assigned to the 'negative' frequencies between half the sample frequency and the sample frequency.

- Calculate the SEL of the noise event.