BREATH SOUND ANALYSIS

This analysis was performed as a part of the selection process for IITGN SRIP 2024 project titled 'Develop SpiroMask end-to-end' with project code 'IP0NB0000014'

Sofware used for the analysis: Audacity (Just a moment... (audacityteam.org))

Introduction

This project involves recording breathing sounds while wearing a N95 mask and analyzing the audio. Breathing sounds are recorded for 15-20 seconds. Their sampling rate is determined. A low-pass filter is applied onto the recording to filter out frequencies higher than the cut-off frequency. Amplitude vs. log-frequency of the recording is plotted to find out the average frequency of the breathing sound. Sampling rate of an audio recording is the number of times per second an analog audio signal is measured and converted into a digital signal. Filtering refers to selectively attenuating signals above or below a cut-off frequency. The frquency range of normal breath sounds extends upto 1kHz, but the majority of the power within this range is found betwoon 60 Hz and 600 Hz

Experiment Setup

The audio was recorded using a headset earphone with the microphone placed inside a N95 mask.

Recording the Audio

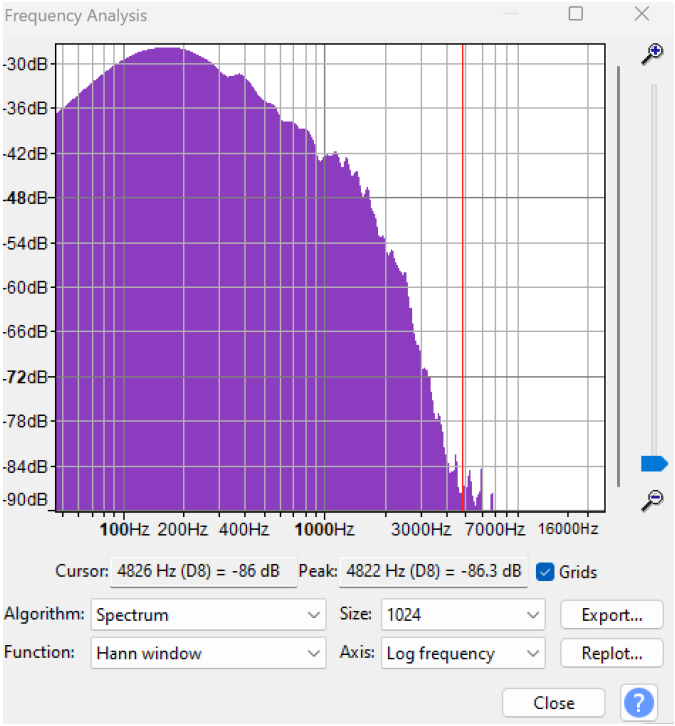
The audio file was recorded in .wav format and then imported into Audacity.

Finding the Sampling Rate

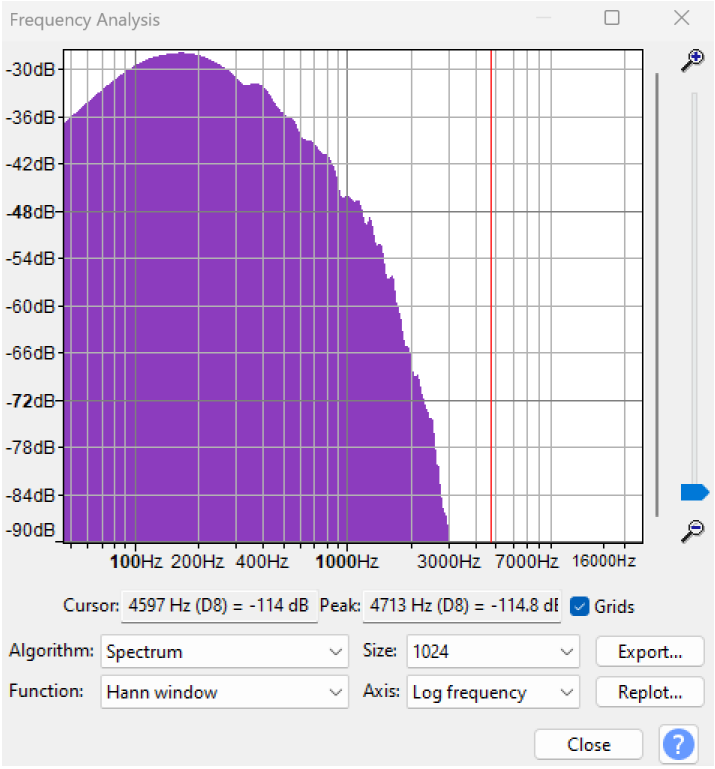
The audio was sampled at 48 kHz. The sampling rate information was provided in Audacity.

Filtering Higher Frequencies

A region of the audio was selected and a Fast Fourier Transform with Hann Window function was performed.



Then a low pass filter (Effects > EQ and Filters > low pass filter) with cut off frequency set 1000 Hz and roll-off set to 12dB was applied. FFT with Hann window function was applied.



Attenuation of higher frequency can be seen on comparing the plots before and after the application of the low pass filter.

Identifying the Frequency Range of Breathing

Upon analysis the following key frequencies in the audio were found:
168 Hz, 360 Hz, 1001 Hz, 1613 Hz, 2115 Hz.

This suggests that the breathing information is present around these frequencies. This is in agreement with the results in the study: 'The Relationship between Normal Lung Sounds, Age, and Gender (atsjournals.org) which says " the frequency range of **vesicular breathing sounds** extends up to **1,000 Hz**."

References

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1. Digital Signal Processing Basics: https://youtube.com/playlist?list=PL_QS1A2ZqaG7p50cd0AgLeG9Q3TN64vZJ&si=V74jFWhpiq6336x3
2. The Relationship between Normal Lung Sounds, Age, and Gender (atsjournals.org)