PROGRAMMING ASSIGNMENT

SIGNALS AND SYSTEMS

Group Members

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INTRODUCTION

The purpose of this programming assignment is to find the frequencies present in recorded voice signals at different sampling frequencies (500 Hz, 2000 Hz, 16000 Hz) using the Discrete Fourier Transform. Python programming language has been used to do the following analysis.The goal is to implement the DFT formula, and plot the magnitude of the DFT against frequency for each recording, and analyze the frequencies present in all the recordings as they vary across sentences, group members, and sampling rates.

Google Colab Link

https://drive.google.com/file/d/1hDY6Gf-ua8_nxa_ZM97Muf_ysyHMgfoh/view?usp=sharing

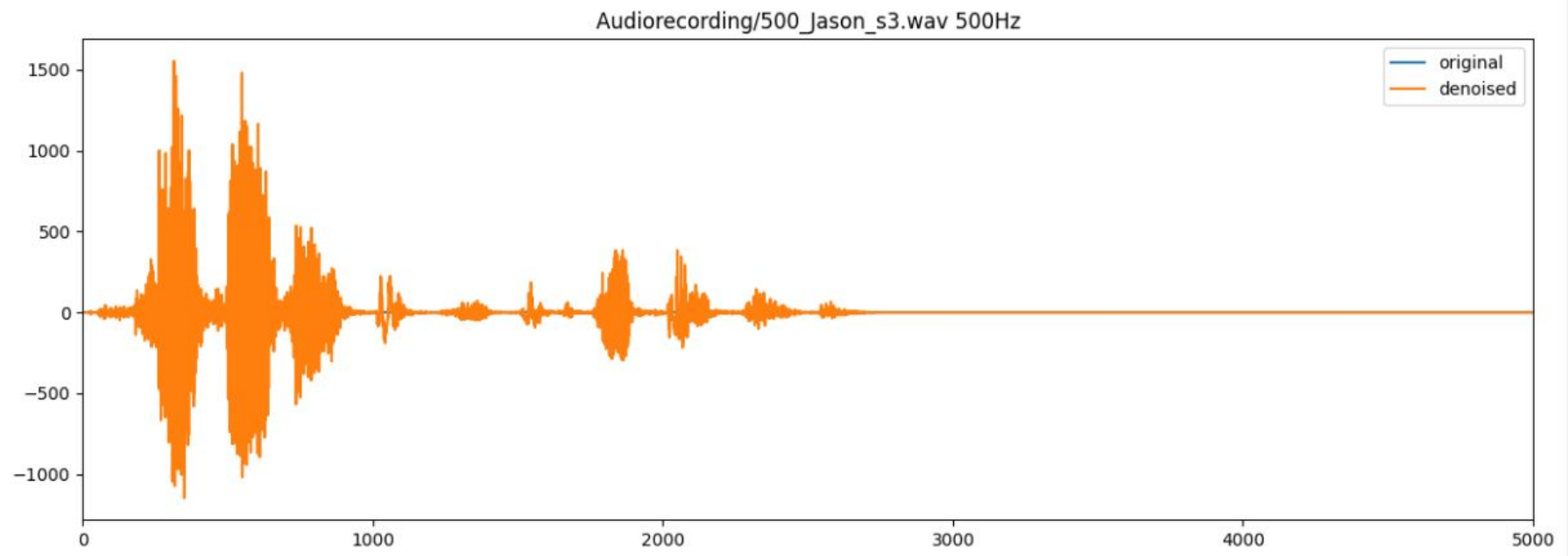
Methodology

The voice signal generated by each group member was recorded while reciting each of these sentences at three different sampling frequencies: 500 Hz, 2000 Hz, and 16000 Hz. This resulted in 48 recorded signals.Converted all the audio files to wav format. Further, audio samples were resampled to the three different frequencies, DFT plotted using both using formula and inbuilt function , both plots matched. For denoising one of the proposed solution that can be used is that we can create a high pass filter wherein we can allow frequencies above a desired level to pass. Frequencies below this desired level will contain background noises and will get filtered out.

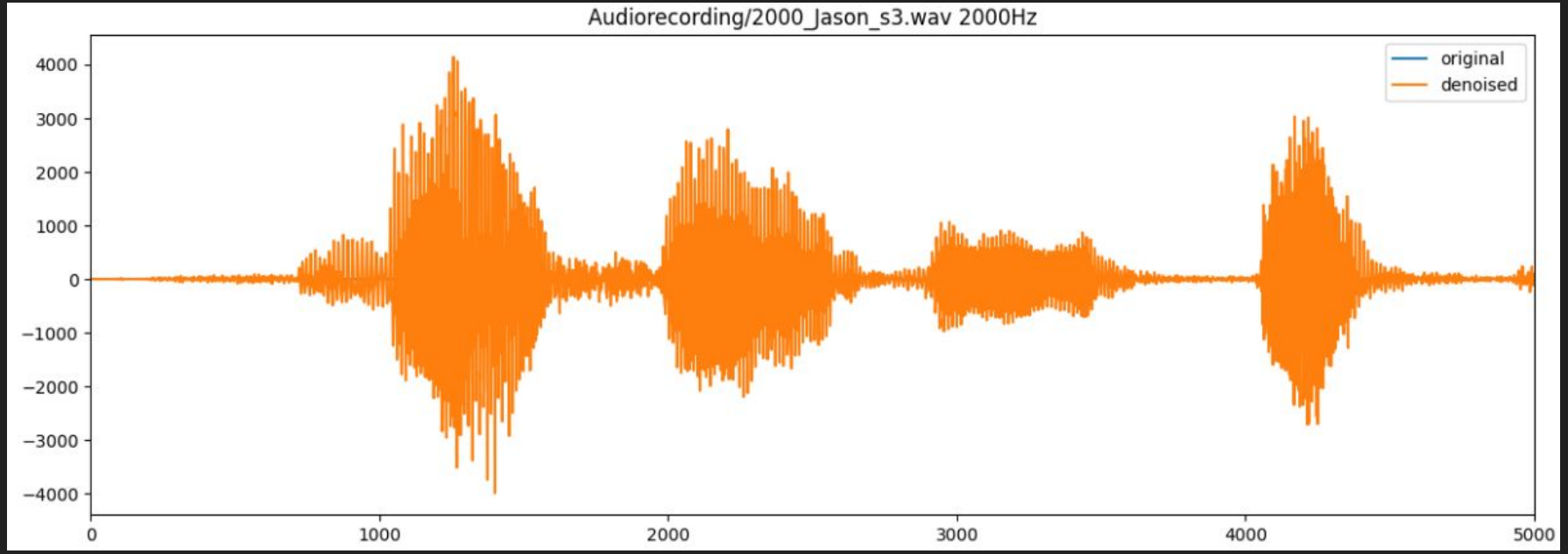
Results

The graphs displays the DFT magnitude for every frequency.The frequency resolution of the DFT is determined by the sampling frequency and the length of the signal. As the sampling frequency increases, the frequency resolution improves. Therefore, the DFT magnitude vs frequency graph of a signal sampled at 16000 Hz will have a higher frequency resolution compared to the same signal sampled at 500Hz or 2000Hz.A signal sampled at 500 Hz will have a higher degree of aliasing compared to the same signal sampled at 2000 Hz or 16000 Hz.Aliasing occurs when the sampling frequency is not high enough to capture the entire frequency content of the signal. The degree of aliasing depends on the sampling frequency relative to the Nyquist frequency, which is half of the sampling frequency.

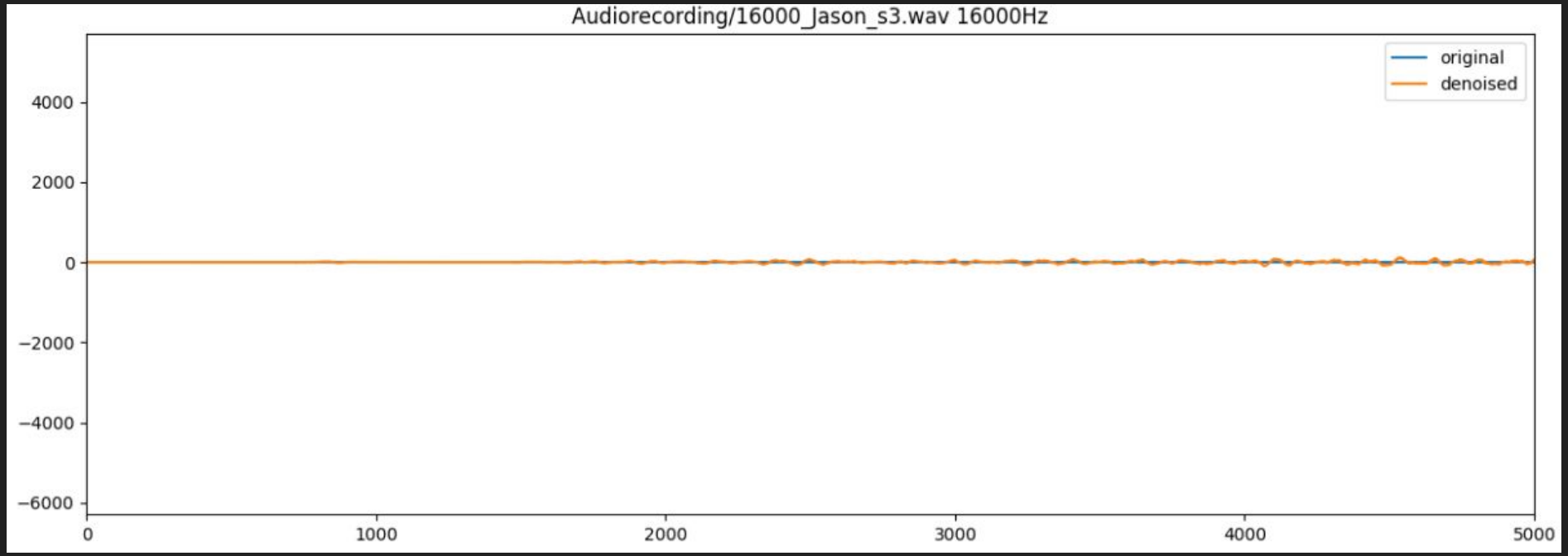
Sampling Frequency-500 Hz(Statement-3)



Sampling Frequency-2000 Hz(Statement-3)



Sampling Frequency-16000 Hz(Statement 3)



Contributions

Jason Daniel(B21CI019)- Resampled the recorded audio files in 500, 2000, 16000(Hz) also converted all the file in to wav format using python code from scratch.

Ruchit Kochar(B21CI38)- Implemented DFT from scratch. Read some articles on DFT and found a better/optimised implementation using mathematics called Fast Fourier Transform.

Rifa Khan(B21CI036)- Worked on the Denoising of the Audio signal. Used some inbuilt libraries and proposed the solution based on classroom discussion

Karina Chaudhary(B21CI022)- Report Making, and helped in implementing dft from scratch.