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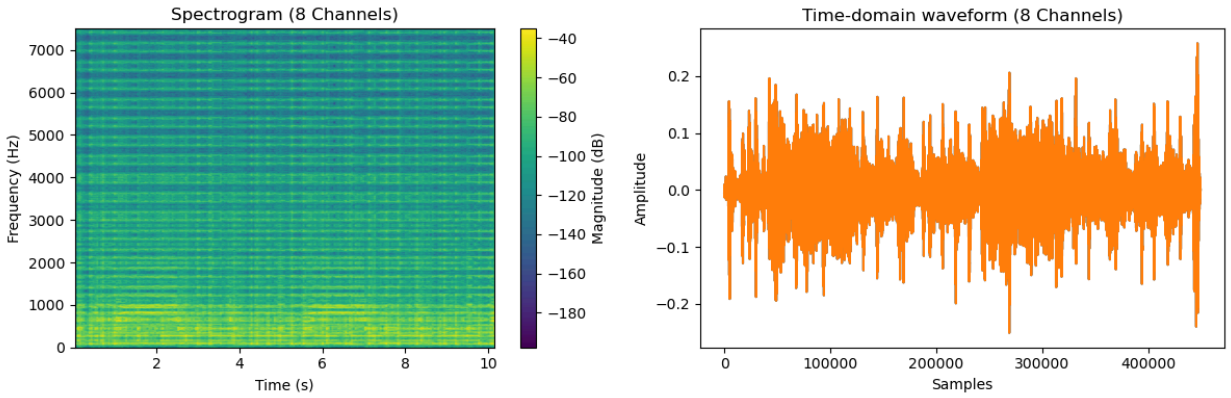
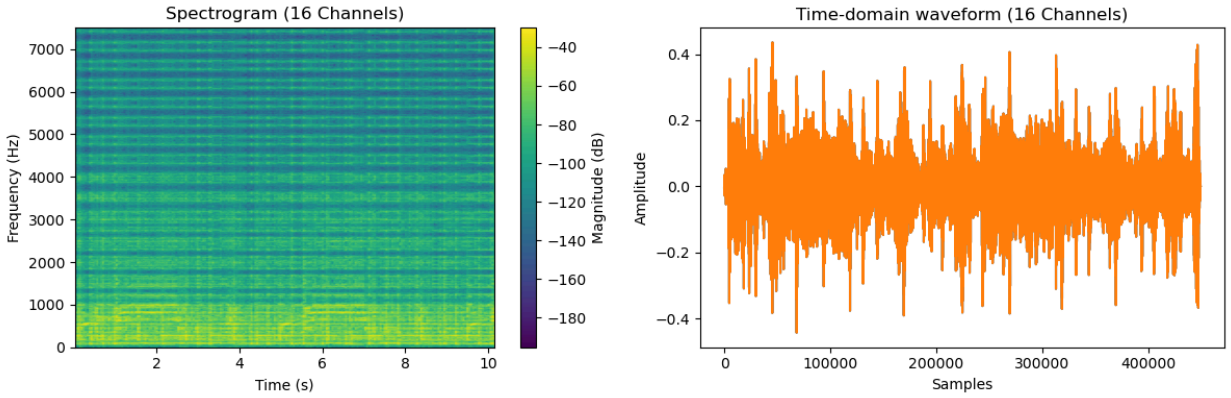
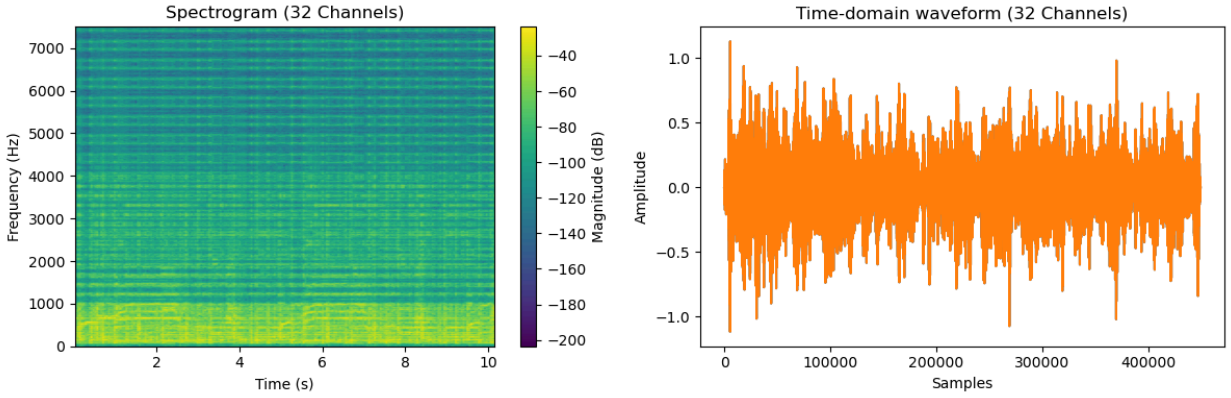
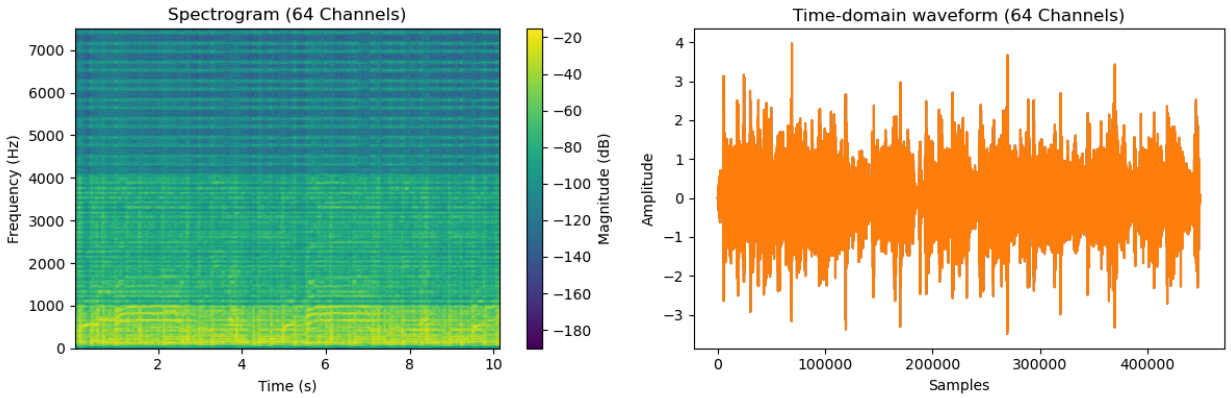
Coding Assignment 4

1) For this project, I utilized Option 1 presented to us in the project description. Based on the required specifications of the project in general, I first needed to calculate my input indices by utilizing about 60% of the available channels for the range of 100-1000 Hz and using the rest of the channels for the range between 1000-4000 Hz. Then, using the predefined code, calculated the filtered song by following the steps presented in Option 1. This includes using a Hanning window to reduce spectral leakage, calculating the Fourier transform of the signal, averaging the frequency bins to the specific number of distinct channel bands, then transforming the frequency-modified data inversely back to the time domain. Both the spectrogram and time-domain waveform were calculated for each certain amount of channels (8, 16, 32, 64). Each iteration of the number of channels also produced a .wav audio file with the data represented as what a cochlear implant would sound like with that number of available channels.
2) As the number of channels increased, as did the quality and loudness of the music. For example, when the 8-channel audio was playing, the song could barely be heard, and what was heard was extremely low clarity. The quality and loudness became slightly better for the 16-channel, but the song was still unrecognizable. For the 32-channel, the song actually became recognizable, but did still not sound as clear as the best option in the 64-channel, which was also the loudest.
3) The song I chose was “Listen to the Music” by The Doobie Brothers. I generated my spectrograms at around 0:55 - 1:05.
4) Included below are the spectrograms of each channel number, along with their time-domain waveform. The higher number of channels correlate to a generally higher intensity per frequency on the spectrograms. For example, 64 channels had the most yellow (greater magnitude) than did 32, 16, and 8 channels (which had the least amount of yellow visible. This correlated to a lower amplitude in the time-domain waveform for less channels, thus resulting in the audio being quieter for these channels as well. Additionally, there is more of a distinction between frequencies with greater intensity in the spectrograms with greater number of channels. There are distinct blue, green, and yellow sections whereas less channels show more of a mix of the intensity per frequency, since there is a greater range of frequencies between less channels.


Spectrogram (8 Channels)
Frequency (Hz)
Time (s)
Magnitude (dB)
Time-domain waveform (8 Channels)
Amplitude
Samples


Spectrogram (16 Channels)
Frequency (Hz)
Time (s)
Magnitude (dB)
Time-domain waveform (16 Channels)
Amplitude
Samples


Spectrogram (32 Channels)
Frequency (Hz)
Time (s)
Magnitude (dB)
Time-domain waveform (32 Channels)
Amplitude
Samples


Spectrogram (64 Channels)
Frequency (Hz)
Time (s)
Magnitude (dB)
Time-domain waveform (64 Channels)
Amplitude
Samples