HW 6 ECE 425

Johnathan Schaff

For the sixth homework, the main part was to demonstrate the impact of adding noise to a user generated signal, and then filtering that noise to see the difference due to the filtering. I generated 6 outputs technically, due to the three stages associated with generation, noise addition, and filtering. For the first part of the assignment, I used the frequency of 8 kHz as specified in the problem. Analyzing the output, the noisy waveform is noticeably different compared to the original waveform. The noise appears as a static background hum throughout the duration of the waveform. The filtered output then reduces this noise by overall reducing the amplitudes of the noisy waveform. By creating a moving average of 0.10, the overall noise is reduced due to the total amplitude being decreased. This allows for the signal to maintain its same general structure and sound, but also gaining reduced noise in the process. The only downside is that the overall volume of the output is also noticeably less compared to the original waveform due to the decrease in the amplitude. However, for the first frequency, these results seem to indicate that the noise generation and the filtering were both successful in their intentions. For the second frequency at 44.1kHz, several differences were immediately distinguishable from the original lower frequency. The first difference came from the quality of the original waveform at the much higher sampling rate. Due to the nearly 6 times higher sampling rate compared to the first frequency, the waveform sounds much more like the original audio due to the larger number of points used to digitally construct the waveform. Secondly, the next difference came from how the noisy waveform sounded. Due to the overall higher frequency of the original waveform sampling, the noise also appears to be of higher frequency, and sounds different from that of the noise generated at 8 kHz. After generating the error values for both of the different frequencies. It seems that the relative error for the higher frequency sampling is noticeably lower compared to the lower frequency. This is likely due to the higher accuracy in the original sampling. Even though the noise is randomly added and the relative error will be different for every iteration of the code, the higher sampling will always generate a waveform will have a larger distribution to view due to the larger number of points. The overall error should be less to an extent as the frequency increases due to the increasing accuracy of the original digital waveform compared to the analog waveform. However, the noise will always have some small impact on it, so the relative error could likely be between a range of values depending on the frequency. This logic may also explain why the filter output for the higher frequency appeared to perform better, due to the lower overall relative error due to the overall higher amount of samples to compare to, which allows for better signal ac

Frequency	8kHz	44.1kHz
Relative Error	1.00788	0.51457

Appendix:
Code Output:

```
Press any key to begin recording
Recording Complete
MAX of Signal | 0.551544
MIN of Signal | -0.85
Part 1 Complete
Press any key to playback audio
Part 2 Complete
MAX of Noise | 0.1
MIN of Noise | -0.0889883
Part 3 Complete
Press any key to playback Noisy Waveform
Part 4 Complete
Part 5 Complete
Press any key to playback Filtered Waveform
Part 6 Complete
Part 7 Complete
Part 8 Complete
Relative Error | 1.00788
Part 9 Complete
Part 10: Next Frequency
Press any key to begin recording
Recording Complete
MAX of Signal | 0.718959
MIN of Signal | -0.85
Part 1 Complete
Press any key to playback audio
Part 2 Complete
MAX of Noise | 0.1
MIN of Noise | -0.0974958
Part 3 Complete
Press any key to playback Noisy Waveform
Part 4 Complete
Part 5 Complete
Press any key to playback Filtered Waveform
Part 6 Complete
Part 7 Complete
Part 8 Complete
Relative Error | 0.51457
Part 9 Complete
```