Theory

Pre-lab Question: Consider a movie shot at 30 frames per second. The scene being shot is of a getaway car accelerating from a stopped position. The rear hubcap on the side of the car facing the camera has a single red spot 12” from the axle. When the car reaches what speed will the red dot begin to appear to stay still relative to the actual motion of the wheel? At what speed(s) will it appear to rotate backwards?

Analysis

Sampling Pure Tones

Question 1:

- For your 440Hz wave, what is the minimum sampling rate at which you no longer experience aliasing?
- What is the ratio of the sampling rate to the original frequency?
- Does this ratio stay the same when you go to a higher/lower original frequency and adjust the sampling rate to the minimum sampling rate at which you no longer experience aliasing for the higher/lower frequency?

Question 2: Keeping the acquired signal’s frequency $f$ fixed, describe visually and audibly what happens when the sampling rate $sf$ is:

- Less than $f$
- Equal to $f$
- Greater than $f$ but less than $f$ times the ratio found in Question 1
- Greater than $f$ times the ratio you found in Question 1.

Aliasing Noise

Question 3: Describe how the filtered and unfiltered signals differ, both visually and audibly.

Question 4: To what frequency do you have to lower the noise until it no longer aliases?
Question 5: Keeping the noise to the frequency discovered in the previous question, what was the maximum frequency that you had to adjust the frequency of the low-pass filter before you saw noise in the Filtered graphs?

Question 6: Rounding to the nearest whole number, what was the ratio of the sampling rate to the filter frequency?

Question 7: Will the ratio of sampling frequency to filter frequency be the same for any of the new values you pick and adjusted for? Explain why or why not.

Signal Reconstruction

Question 8: Describe how the two types of reconstructions look and sound?

Question 9: What is the sampling rate you need to make the “connect the dots” wave sound and look like the reconstructed wave when frequency is set to 440Hz? What is ratio between this sampling rate and the frequency? Is this ratio consistent as you change the frequency?

Sampling Arbitrary Signals

Question 10: For your voice recordings played at a high sample rate and adequate filter settings, what is the lowest filter and sampling rate at which it no longer sounds clear?

Question 11: For the piece played with voice settings, briefly describe how the voice and music differ? Why do you think they differ so?

Question 12: To what value do you have to raise the sampling rate and filter settings so that the music sounds clear?

Conclusion

Question 13: Given what you discovered in the previous questions, what can you conclude about how sound is processed on the cellphone (Think back to what it sounds like when you speak with someone and when you’ve been put on hold and hear music).