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Course: ECE 3210

Subject: Lab 7, Aliasing

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1 Introduction

In lab 7 we looked at the effects that Aliasing has on signals. Aliasing occurs when a continuous signal is inadequately sampled or processed, leading to a distortion of the signal's characteristics. To understand the significance of anti-aliasing measures, we simulated different sampling rates and frequencies. By simulating real-world scenarios, we can analyze the potential degradation in signal quality that can arise from the absence of proper anti-aliasing filters.

2 Theory

We did not need to derive any equations for this lab. We did require two equations to represent the aliased signals. We used the following equation to represent the aliasing of a sinusoid:

$$x[k] = A\sin(2\pi f_0 kT + \phi) \tag{1}$$

To alias the chirp signal we used the following equation:

$$c(t) = A\cos(\pi\mu t^2 + 2\pi f_1 + \phi) \tag{2}$$

3 Results

In Fig. 1 we can see an aliased sinusoid at 300 Hz followed by Fig. 2 which is the same sinusoid at higher frequencies sampled at the same rate. As the functions frequency increases the accuracy of our sampled data decreases.

In Fig. 3 we aliased a chirp signal. In this case we kept the function frequency constant but sampled the chirp signal at different rates. As the sample frequency decreased the number of waves grew and the distance between peaks shrunk.

4 Discussion and Conclusions

Fig. 2 as the signals frequency increases the sampled signal becomes less and less accurate. At 900 Hz the signal is almost unrecognizable as a sinusoid. As the frequency increased the pitch of the signal grew higher. When we compared the signal from 300-900 Hz and from 7700-7100 Hz the sounds were very close to one another. This is because of how the human ear perceives sounds. When we added the signals together the resulting sound was a pure tone. If anti-aliasing filtering were in place the aliasing effect we encountered would have been prevented.

In Fig. 3 we can see the aliasing effect of a chirp signal. At high frequencies the signal experiences little aliasing but at low sampling frequencies the signal begins to experience aliasing. Varying μ results in faster pitch changes while varying f_1 will determine the starting pitch.

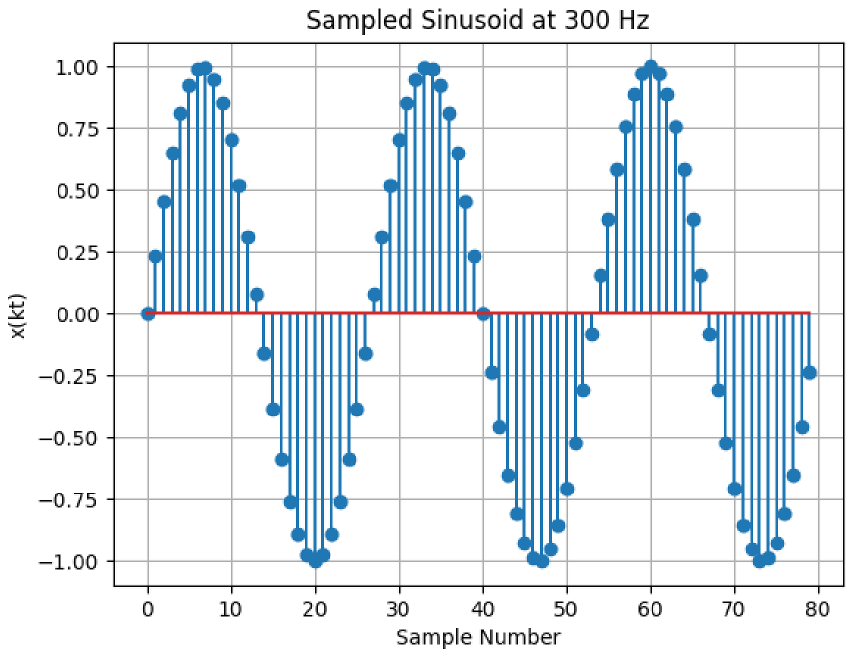

Figure 1: This figure shows a sinusoid sampled at a frequency of 8000 Hz. The sinusoid has a frequency of 300 Hz.

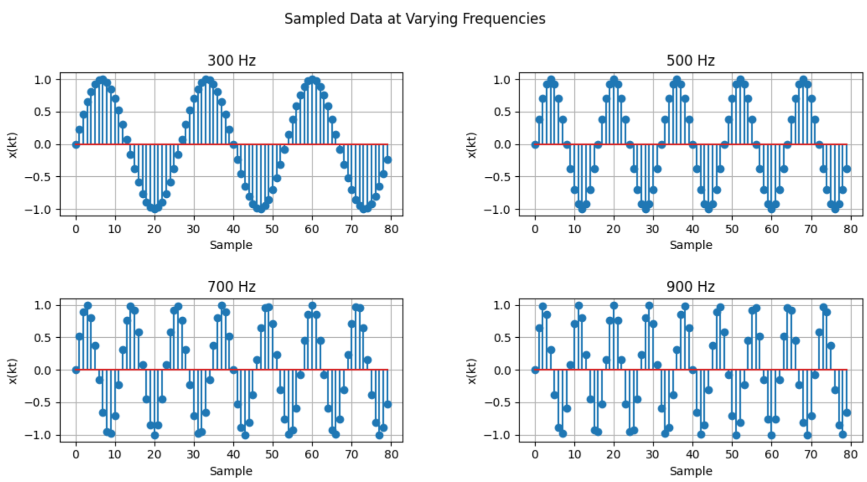

Figure 2: This figure shows a sinusoid sampled at a frequency of 8000 Hz. The sinusoid frequency was increased from 300 Hz to 900 Hz.

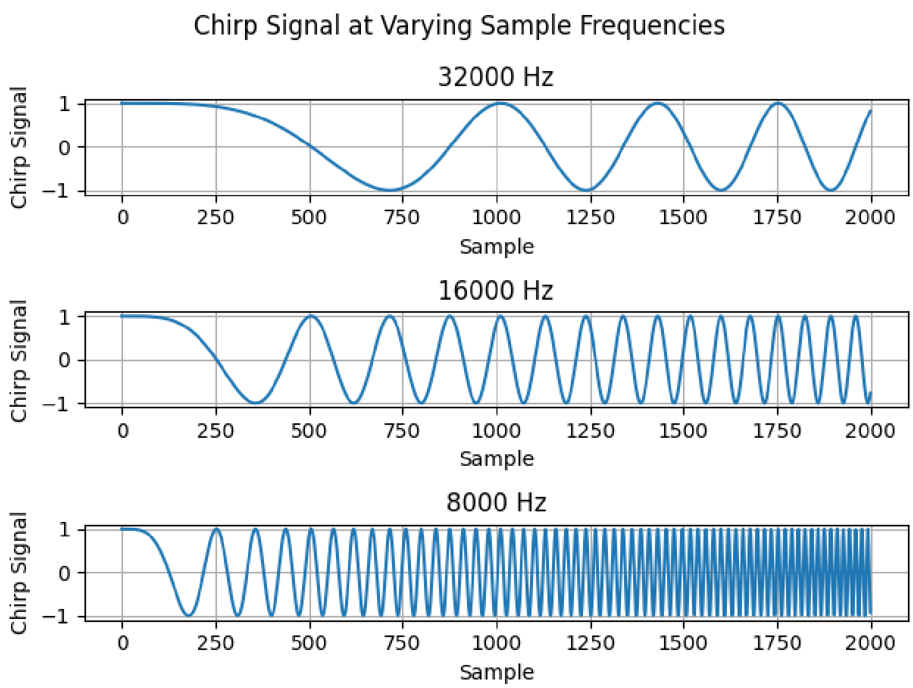

Figure 3: This figure shows the first 2000 samples of a chirp signal with a frequency of 100 Hz. The sampling frequency was decreased from 32000 Hz to 8000 Hz