Lecture S20 Muddiest Points

General Comments

Today, we concluded our discussion of sampling. We talked about *aliasing*, which occurs when a signal is sampled below its Nyquist rate. We also had a short demo of the effects of aliasing, which causes music (or any other signal) to be distorted.

Responses to Muddiest-Part-of-the-Lecture Cards

(10 cards)

1. ***If in the signal [picture of spectrum $X(f)$ with the higher frequency portions cut off] you don't store information in the outer parts, would aliasing still be a problem? (1 student)*** Throwing away the outer portions does cause information loss, but if you don't limit the bandwidth of the sampled signal, aliasing will occur, which also destroy information. Passing the original signal through an antialiasing filter first ensures that at least the low frequency part of the signal can be reconstructed exactly.

2. ***When you show a signal graph like this [picture of spectrum of sampled signal with aliasing], what are the axes? (1)*** The graph in question is the spectrum (i.e., the Fourier transform) of $y(t)$, which is the original signal $x(t)$ times the sampling pulse train. So the plot is of $Y(f)$; the axes are f and $Y(f)$.

3. ***In order for MP3 compression to work, doesn't some information get discarded? (1)*** Yes, MP3 is (as I understand it), a lossy compression scheme, which takes the sampled data points, and compresses the data to reduce the amount of data stored. There are also non-lossy compression schemes.

4. ***It's difficult to imagine how all this math translates into circuits. (1)*** In the case of sampling, it's far more important to understand what the limitations of sampling are than to be able to translate the ideas into circuits. Of course, someone must do this to make CD players, etc. work.

5. ***What would change in the sampling process if it was something other than music? Like data that isn't binary? (1)*** Sampling as in class today can be used for music, speech, or other types of analog data. Sampling is very common in research projects that need to record lots of data.

6. ***Wasn't another way to transmit binary phase modulation? Which method (phase modulation or what we talked about today) is better? (1)*** The discussion today was meant to motivate the relationship between bandwidth and duration. One would be unlikely to use pulses as we discussed today to send binary.

7. ***Could you conceivably do encryption w aliasing then? Send a signal that appears to be junk, but if sampled, the distorted signal would be right? (1)*** Perhaps, but it could be tough to make it work. Generally, encryption relies on more secure methods that would be harder to crack than this approach.

8. ***If an aliased signal looks like [picture of sampled spectrum with aliasing], what does this do to the reconstructed signal? (1)*** Good question. The reconstructed signal will be the same as the original signal at the sample points, but will be different in between. The reconstructed signal will *always* have a bandwidth less than or equal to half the sampling frequency. Aliasing occurs when the original signal has spectrum at frequencies above the Nyquist frequency. So generally, these higher frequency parts of the signal get reconstructed (incorrectly) as lower frequencies.

9. ***Cool demo! I like the Barenaked Ladies. (1)*** Thanks! I'm a big BNL fan — I've seen them in concert about 5 times. ***The demonstrations have been great! (1)*** Thanks again. I'm gradually adding more demos to lectures; I think they can be useful.