Homework #1, ENGN 100-300, F15. Due **Tue. Sep. 29, in class**

Notes

- You must write the Engineering Honor Pledge on your exams in this class for them to be graded. To review the honor pledge, visit https://sites.google.com/a/umich.edu/engin-honorcode .
- This is an individual assignment, not a group project. Refer to the course syllabus for the collaboration policies.
- For unstapled solutions, only the first page will be graded.
- This homework is worth 25 points, for the first 6 problems. The "challenge problems" are optional, but each one you solve correctly will add to your score (up to 25) so if you make a mistake on one of the basic problems then you could get those points back with a correct solution to one of the challenge problems. So attempting all the challenge problems is in your best interests both educationally and in terms of points.

Basic Problems

1. [5] A sinusoidal signal is sampled at $S = 8192$ Hz and a few of the samples recorded are $x(7/S) = 50,\ x(8/S) = 80,\ x(9/S) = 30$. Determine the frequency of the sinusoid.

2. [5] List three practical limitations of the arccos method for frequency estimation.

3. [5] A sinusoidal signal is sampled at 4000 Hz yielding the digital signal $x[n] = 7\cos((\pi/4)n + \pi/9)$. What was the period of the original (analog) sinusoid?

4. [5] A student drops a ball from 9 different heights and measures the velocity of the ball when it hits the ground for each height. To display the resulting data as a scatter plot that looks like a straight line, should she use a semilog plot or a log-log plot? Explain.

5. [5] This problem is to check your understanding of `Matlab` array indexing. Try to do it *without* using `Matlab`. What would `Matlab` display if you enter the following: `x = [10:5:50]; k = [3 1 2]; disp(x(k))`

6. [0] Skim this online article about college. [link]. Email the link to your parents if you want (optional).

Challenge problems

7. [5] Refer to the arccos plot in the lecture notes for Lab 2. Considering this plot and the arccos method for finding the frequency of a sinusoid, what is the *highest* possible frequency that will be computed by the arccos method if the sampling rate is $S = 44.1$ kHz?

8. [5] A signal is sampled at $S = 1000$ Hz and the samples are $x(7/S) = 50,\ x(8/S) = 20,\ x(9/S) = 30$. Could this signal be a pure sinusoid?

9. [5] A signal $x(t)$ is known to be sinusoidal with frequency 100 Hz. It is sampled by an A/D converter, and the following two sequential values are observed: $x(0.001) = 10$, $x(0.002) = 7$. Determine the value of $x(0.003)$.

10. [5] A signal is sampled at $S = 44.1$ kHz and four of the sample values recorded are $x(1/S) = 10,\ x(2/S) = 40,\ x(3/S) = 30,\ x(4/S) = 0$. Could this signal be a sinusoidal signal? If so, give its frequency. If not, explain why not.