

Lab 1

Due Oct 6, In Class

In this lab we are interested in studying some basic signals and understanding the properties of systems.

1. Use Matlab to produce a plot of a discrete-time sinusoid with amplitude 2.0 and a period of $T = 7$. Submit only the plot.
2. Use Matlab to produce a plot of an exponentially-decaying sinusoid with the decay rate, amplitude, and period selected by you. Submit only the plot, not your code.
3. We know that discrete-time systems can be characterized on the basis of six properties: Memory, Causality, Invertibility, Stability, Time invariance and Linearity

Download Matlab file *lab1.m* from the course homepage. You are not expected to analyze or to understand the file; we will treat it as a black box. The file implements three discrete-time systems S_1, S_2 and S_3 :

$$y = lab1(sys, x)$$

with input $x(n)$ and output $y(n)$. *sys* is an integer 1,2,3 selecting the system, and x, y are vectors of length 201 corresponding to time $n = -100, \dots, 100$. The idea is that we want to experimentally determine the properties of each of the three systems by applying various inputs and observing the resulting outputs.

Here's what we'll do:

- (a) Apply delta functions (with various shifts, say $\delta(n), \delta(n - 50), \delta(n + 50)$) to determine memory, causality and time invariance. Based on your observations, argue whether invertibility is likely true or not.
- (b) Apply a constant signal $x(t) = 1$ to test for stability.
- (c) Pick two different signals $x_1(n), x_2(n)$ and see whether superposition applies, implying linearity.

Prepare a *brief* discussion outlining the probable properties of each of S_1, S_2, S_3 and very briefly how you came to your conclusions. Prepare a table to list the properties of each system something like

System	Memory	Causality	Invertibility	Stability	Time invariance	Linearity
S_1	Yes	Yes	No	Yes	Yes	No
S_2	No	Yes	Yes	No	Yes	Yes
S_3	No	Yes	Yes	No	Yes	Yes

4. Analyze the each of the following continuous-time systems in terms of the six basic system properties. In addition, summarize your conclusions in a table like the one above.
 - (a) $y(t) = x(t - 2) + x(2 - t)$
 - (b) $y(t) = [\cos(3t)]x(t)$
 - (c) $y(t) = \begin{cases} 0 & t < 0 \\ x(t) + x(t - 2) & t \geq 0 \end{cases}$

Submit the requested plots, analyses, and tables. Handwritten analysis and tables are fine. You are not required to submit your code.