Assignment - 2
Introduction to Sampling and
Linear Time-Invariant Systems

January 28, 2020

Task 1

You are creating a radio advertisement for an investment company. At the end of the advertisement, you are required to speak the following disclaimer:

> "The returns on your investment are subject to market risks. Past performance does not imply future performance in any way. Contact your financial adviser for details on your investment options and possible risks involved."

An advertisement on a radio station costs you Rs. 1000 per second. Your job is to create a voice recording that says the disclaimer in a total cost of Rs. 10000.

For the project, you can sample a 15 second audio at a sampling rate of 44100 samples per second for the disclaimer using MATLAB's audiorecorder object. The relevant documentation for R2019b version is below:

https://www.mathworks.com/help/matlab/ref/audiorecorder.html

Once recorded, you can use audiowrite function to write the recorded sample in a .wav file.

https://www.mathworks.com/help/matlab/ref/audiowrite.html

Your task is to take the samples of this 15-second audio and turn it into a 10-second audio that costs around Rs. 10,000 and has the entire message. You can do so by playing back the audio quickly to finish it within 10 seconds.

You can use the sound card in your laptops to both sample and playback your voice. A sound card can be regarded as a combination of an analog-to-digital converter (ADC) and a digital-to-analog converter (DAC). Any sound card has at least the following inputs:

1. Line-In

2. Mic Input

3. Speaker Output

Your sound card's ADC samples the signal coming from Line-In and Mic Inputs, whereas the DAC converts samples to a continuous-time signal and send it to playback devices such as your laptop's speaker.

Task 2

Your task is to create an echo effect of the same voice recording you did in Task 1. An echo is produced if your ears receive the same voice after some time of speaking it. In other words, if the same voice signal is superimposed on itself after being delayed in time, the echo effect is produced.

Your job is to write MATLAB code for the following system:

$$y(t) = x(t) + x(t - 0.5),$$

where $x(t)$ is the input signal recorded. Note that the system is given in continuous-time notation so that you know that the reconstructed signal is expected to be equal to the sum of the original signal $x(t)$ and it's 0.5 seconds delayed version.

For task 1, you have already calculated $x[n]$ at a sample rate of 44100 samples per second. For this sample rate, you can figure out the number of samples n_d that you need to delay to produce a sampled version $x[n - n_d]$ of $x(t)$. You can add the resulting two sequences $x[n]$ and $x[n - n_d]$ to get $y[n]$ and convert it into $y(t)$ using the sound command.

1 Instructions

1. MATLAB code and related graphs. If graphs are easy to draw, you can sketch them using hand, clearly labelling different axes.

2. The collaboration between students is encouraged, but blind code sharing/copying is not allowed. If you are unable to explain anything in your code, it will be assumed you have copied it. So make sure you know every thing you have written in your code. I am least concerned about how you have learnt something as long as you have learnt it well.

3. The assignment should be submitted on an A4-sized assignment.

4. A template for the cover page of assignments is uploaded on piazza.