EE386 Digital Signal Processing Lab **Jul-Dec 2021**

Experiment - 1 Report

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Problem 1. Generating Signals

(Using the built-in functions in Matlab, generate plots for the following signals for $1 < t < 1$ in different subplots:

1. $y1(t) = sin(20\pi\alpha t)$

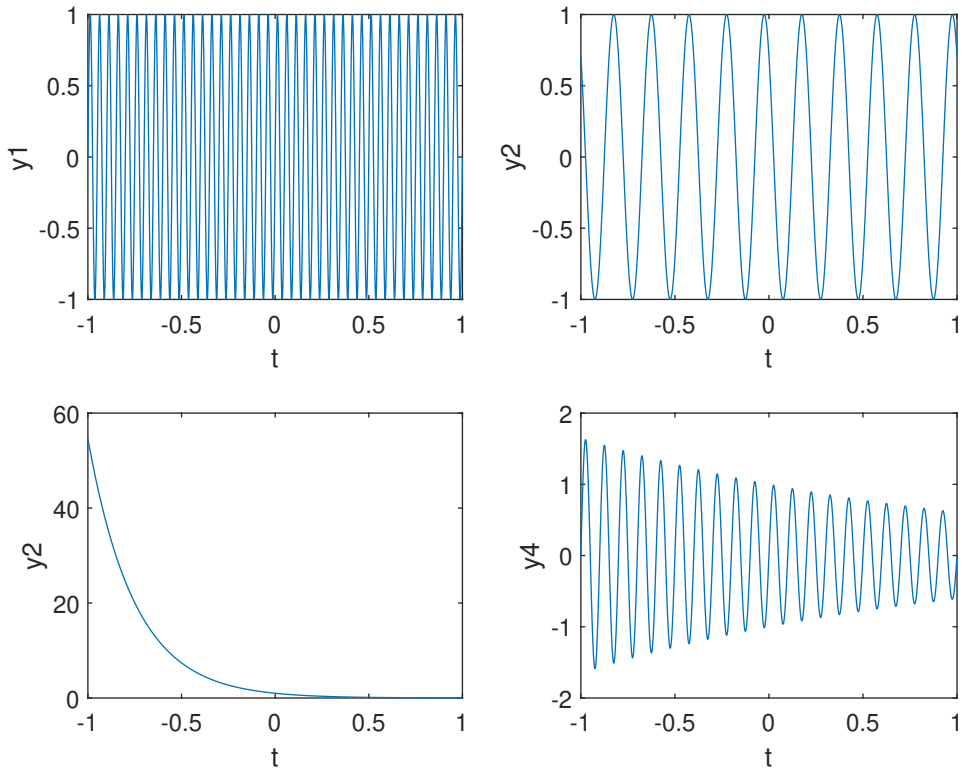
2. $y2(t) = cos(5\pi\alpha t + \pi/4)$

3. $y3(t) = e^{2\alpha t}$

4. $y4(t) = e^{0.25\alpha t} sin(20\pi t)$**)**

(Solution)

- Plotted functions using matlab and displayed using plot function after defining each function.



Problem 2. Operation on user-defined functions

(Create a user-defined function x(t) to generate a decaying exponential with as the time constant. Plot the following for $5 < t < 5$ in different subplots :

1. $x(t)$

2. $x(t)$

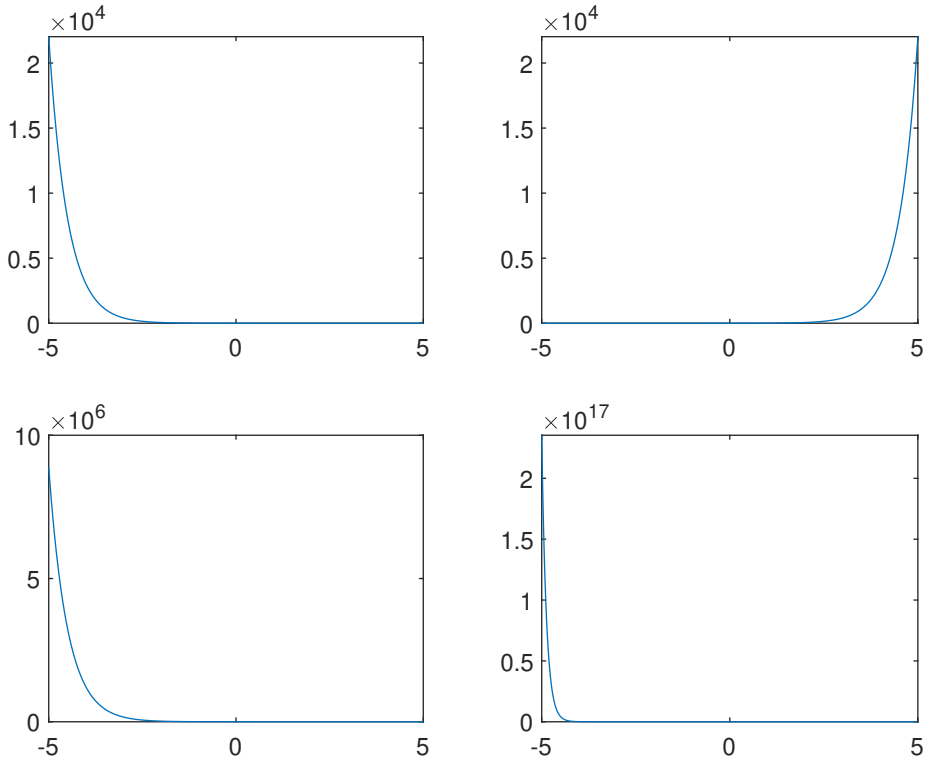
3. $x(t - 1.5\alpha)$

4. $x(2\alpha t)$

)

(Solution)

- Plotted functions using matlab and displayed using plot function and displayed each quantity in the graph w.r.t time using xlabel and ylabel.



3. Importing Signals

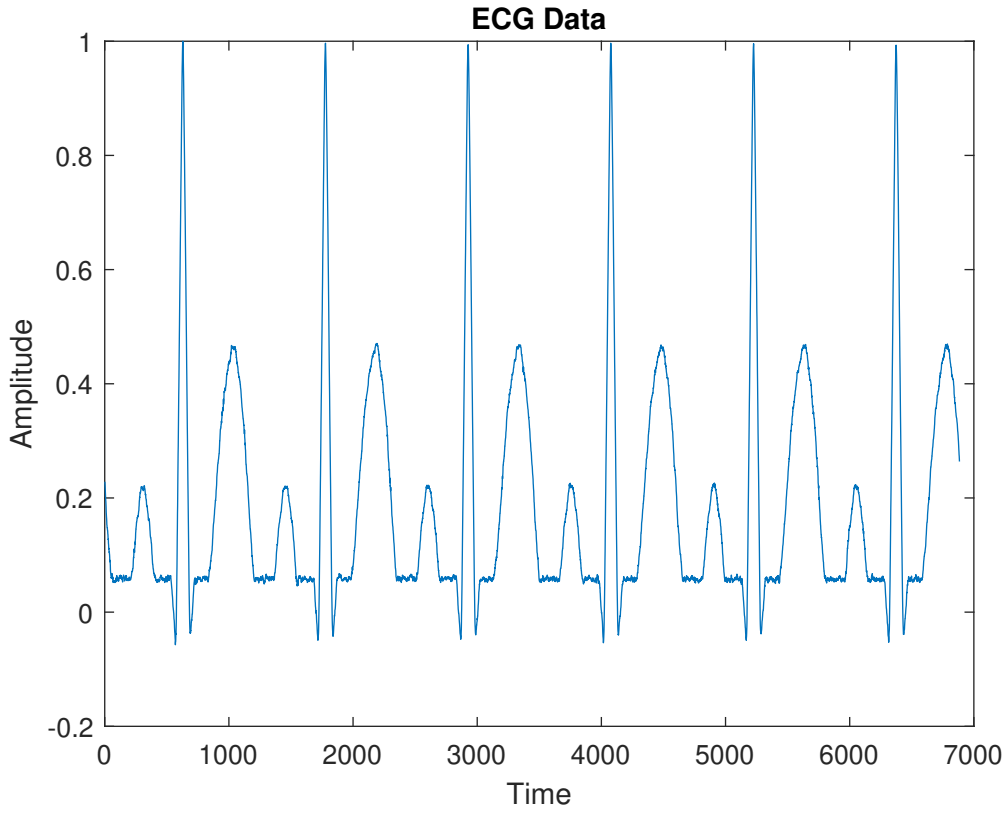
(1. Import the ECG data from ECGData.txt file and plot the data as a function of samples.

2. Import rainfall data from RainFallIndiaJan.txt and RainFallIndiaJuly.txt, which contain the average rainfall during the month of July, across India. Plot the distribution using histogram. Compute the mean and standard deviation of the rainfall in January and July.

3. Import track00.wav and play the audio.)

(Solution)

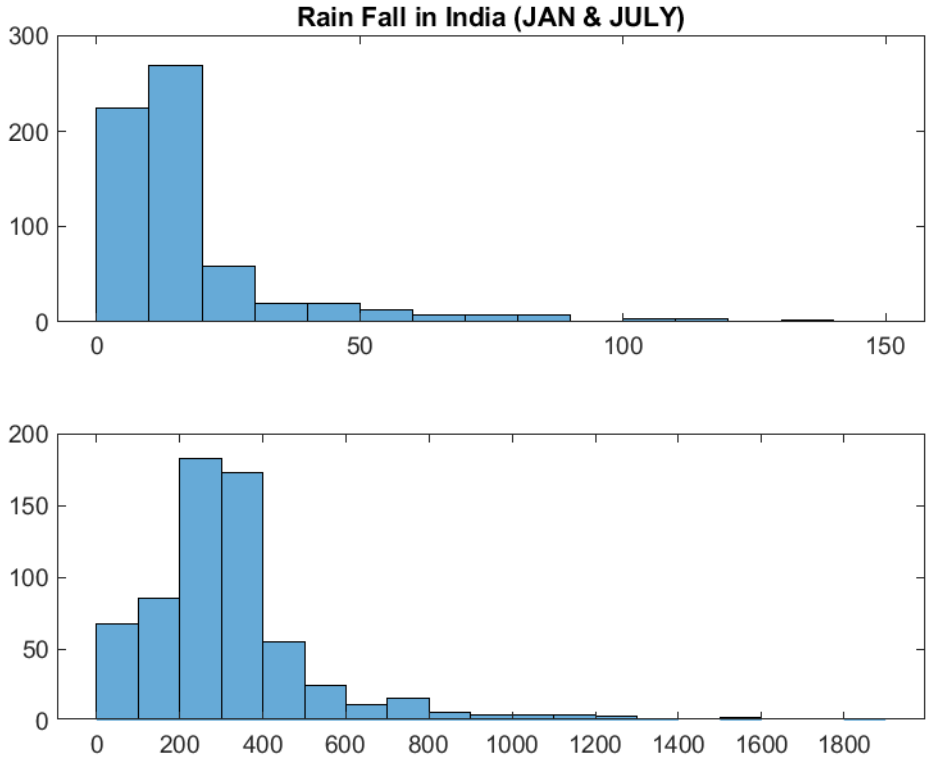
- Imported the ECG data from ECGData.txt file using readmatrix function in matlab.This function creates an array by reading column-oriented data from a file. The readmatrix function performs automatic detection of import parameters for the file. After importing the data, it was plotted using plot function and labelled using xlabel and ylabel.



(Solution)

for the 2nd part of the question, the rainfall data was 1st imported using readmatrix function and was plotted the distribution using histogram. The mean and standard deviation of rainfall was calculated using mean() and std() function.

in the 3rd part, the audio data was imported from the importdata() function which loads data from the file and audioread() function reads data from the file and returns sampled data, y, and a sample rate for that data, Fs.

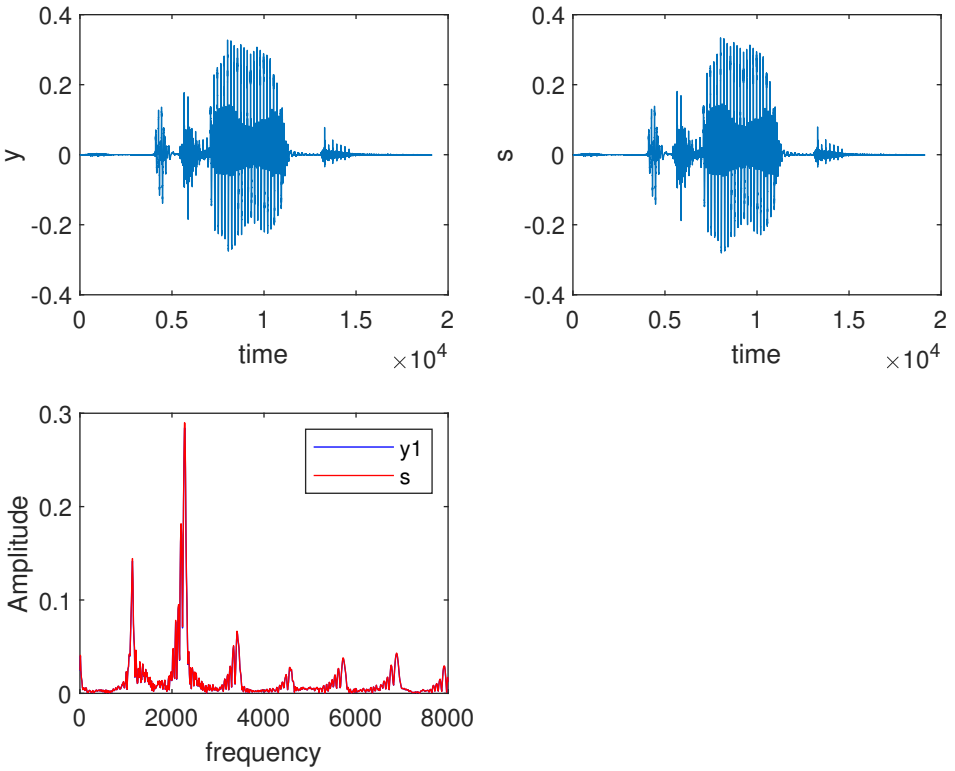


4. Amplitude Modulation

(Import the file speech.wav that contains the speech signal s(n) with Fs as the sampling frequency. Write a user-defined function to obtain
$y(n) = s(n)cos(2\pi F/Fs)$
Generate y(n) for a particular choice of $F = 250\alpha$ Hz. Plot s(n) and y(n). Can you notice the differences between the signals? If yes, explain why the speech signals sound different based on the plots. If no, comment why you think the speech signals sound different. Further, comment on what the result would sound like if F were to increase from F = 250 Hz. Compute, analytically, the Fourier transform of $y(t) = s(t)cos(2\pi F0t)$ in terms of the Fourier transform of s(t) and explain the observation.)

(Solution)

imported the audio file and performed amplitude modulation using fast fourier transform on it. The speech signals sound different based on plots because of frequency dependent term



cos(2*pi*F/Fs).

5. Signal Generation - 1

(Create 5000 samples of two sinusoids of 200α Hz and 220α with a time resolution of 0.001s. Append them (to make a 1×5000 array), and write it into a .wav file. Listen to it and write down your observations.)

(Solution)

The given sample and time resolution indicate 5s signal with 1KHz sampling frequency and the sinusoid signals of given frequencies are sampled and appended. The audiowrite(filename,y,Fs) writes a matrix of audio data, y, with sample rate Fs to a file. The filename input also specifies the output file format. The output data type depends on the output file format and the data type of the audio data, y. The signals are sampled based on given data and the final signal is written into .wav file. The sound is a tone heard in telephone.

6. Signal Generation - 2

(Generate a sequence containing the tones corresponding to Do Re Mi Fa So La Ti Do. Hint: Generate signals of the type $y(t) = sin(2\pi Ft)$, where F is the frequency that corresponds to each note. Append the signals together and save the resulting signal as a .wav file.)

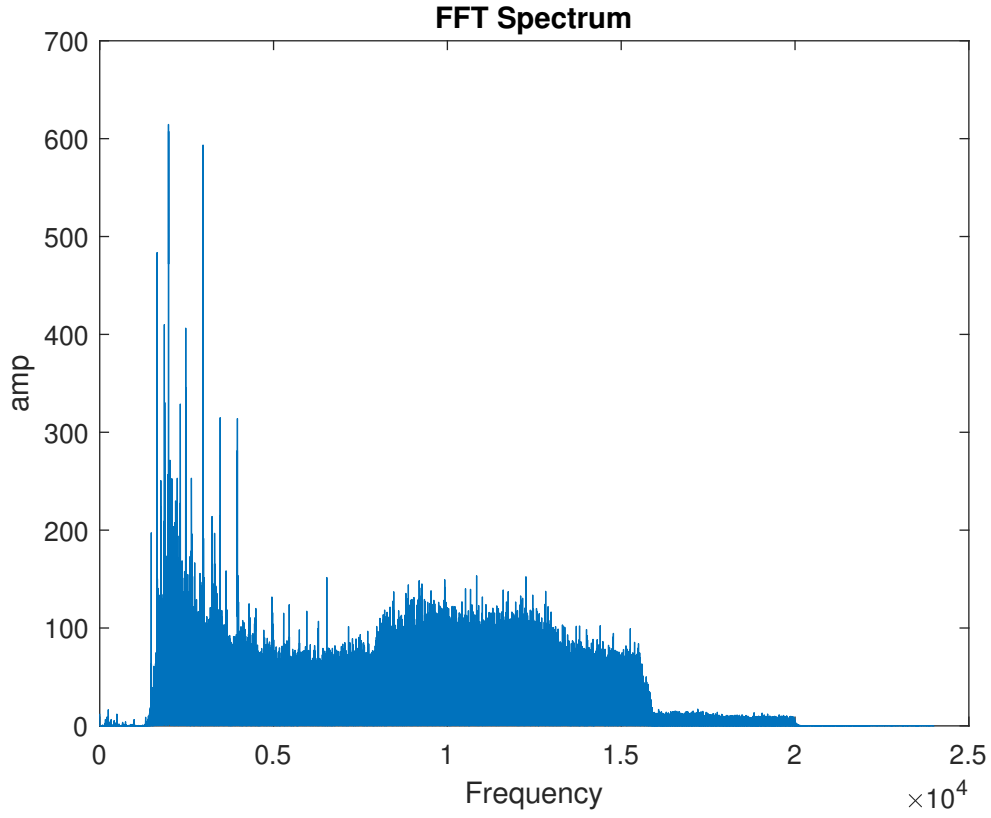
(Solution) **Methodology:** The tones are saved as sine signals and played one after other as per the frequencies defined for each note. Then a time vector is created to initialize the signal. The tones are generated and appended using for loop and saved in .wav file. Finally, the sine waves are played in a tone.

7. Convolution

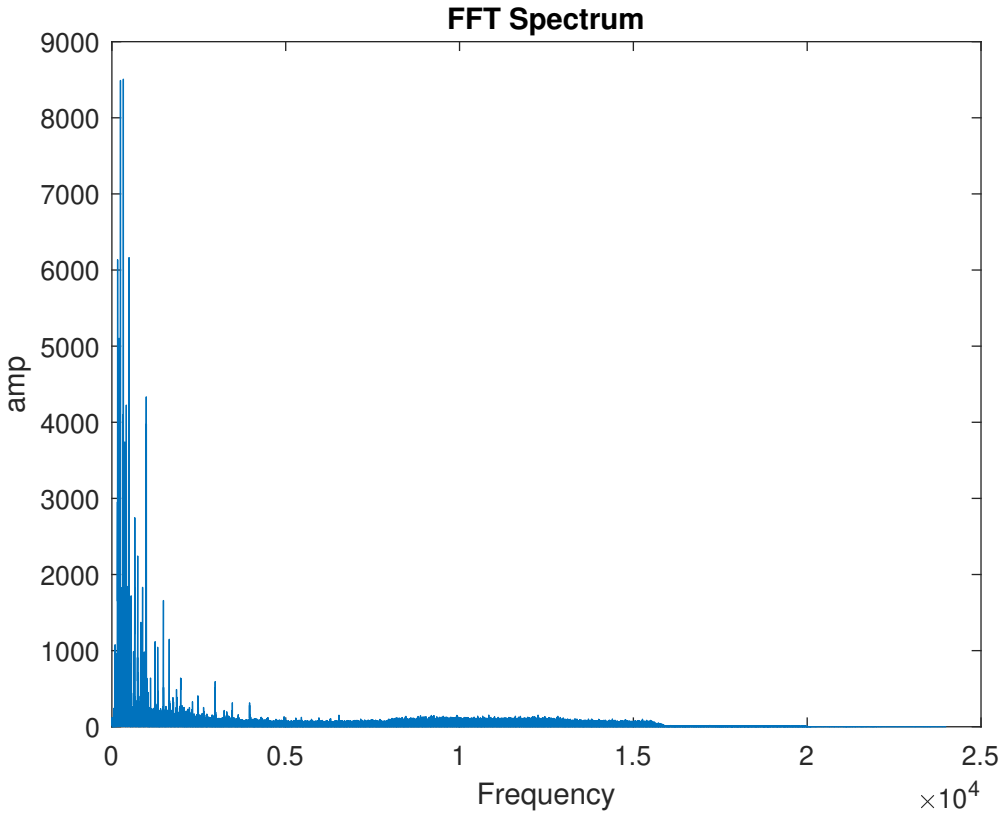
(Load the data Track00α.wav. Load the data from the text file ConvFile.txt and then convolve the two data streams. Store the result into a .wav file. What do you observe? Can you guess the type of filter being used?)

(Solution)

the audio dataand the filter coefficients are loaded and the convolution is performed using conv() function in matlab. The output is saved as .wav file .



(Solution)



A Code Repositories

Refrain from including any or all code in this document. Upload codes to your repository and include the links to executed nbviewer files here as – The codes to reproduce the results can be found in the GitHub repository `enter-url-here`.