EE305- Digital Signal Processing

Programming Assignment-1

Note: Use of in-built MATLAB functions is not allowed!!

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Q.1 Write a program to add two arbitrary discrete sequences x_1 and x_2, after performing the following transformations

    (a) Fold sequence x_1

    (b) Right shift modified sequence x_1 by 3 samples

    (c) Left shift sequence x_1 by 5 samples

    (d) Add the obtained sequences x_1 and x_2 from steps (a)-(c) after down-sampling and up-sampling by factor 2 and 3, respectively.

    Note: Plot the modified sequences after each operation.

Q.2 Write a program to perform linear convolution of two discrete sequences x_1 and x_2.

    Note: The program must handle any arbitrary sequences whether its a causal or arbitrary non-causal signal.

Q.3 Lets consider a signal $x_a(t) = \sin(7000\pi t)$, and perform the following experiments on it:

    (a) Determine the Fourier transform of $x_a(t)$ and plot it along with the signal.

    (b) Sample $x_a(t)$ with sampling period $T = 1/5000$ and $T = 1/2000$ to obtain $x_1[n]$ and $x_2[n]$. Determine and plot $X_1(\exp(j\omega))$ and $X_2(\exp(j\omega))$ along with $x_1[n]$ and $x_2[n]$.

    (c) Reconstruct $x_a(t)$ from $x_1[n]$ and $x_2[n]$.

    Note: Compute Fourier Transform if required without inbuilt or spectrum function in MATLAB.

Tips: You have to approximate the signal into a band-limited signal. You may not be able to construct a continuous time signal (at infinite time points). Hence, the continuous signal can be represented at discrete, but decimal time points. However, make sure that the discretization is much smaller than the sampling period.

Important: Label axis in each plot appropriately as per standard notations. Refer book for same. Use modular/functional level coding such that the codes can be reused as functions in other assignments (do not fix any parameters). There are various plotting functions in MATLAB, make sure you use the right one for continuous/discrete signals and their spectrum. Low-level MATLAB inbuilt functions e.g., ADD, SUM, MEAN can be used, but not advance routines like FFT, CONV etc.