ES 244: Signals, Systems, and Random Processes

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Assignment - 2

Instructions to submit:

- The submission has to be in the form of a zip file consisting of .m files for each question individually, proper readme file and Report with perfect explanations and plots.
- Zip file should be named as '*rollno_assignment2*'.
- Each question should consist of it's own individual .m file with proper commenting and should be named as '*QX_rollno*'(where X is the question no.).
- There will be deduction of marks if this format is not followed for submission.

Q.1) Provided here is a parabolic periodic function with period $T_o = 2$

$$x(t) = \{\, t^2/2 \text{ for } 0 <= t < 1,\ 0 \text{ otherwise}\}$$

a) Plot this function using MATLAB and plot the magnitude line spectra for this signal.
b) List out the magnitudes of 3f, 5f, and 7f (where f is the fundamental frequency of the given signal) components.
c) Say y(t) is a rectangular pulse signal as shown below with period To = 5

$$y(t) = \{2 \text{ for } 0 <= t < 3,\ 0 \text{ otherwise}\}$$

Now z(t) = x(t) + y(t), find the magnitude spectrum of z(t) and show that it is equivalent to the summation of magnitude spectrums of x(t) and y(t).

Q.2) Say x(t) is a signal with period To = 2 sec and each period has the form of *u(t) - 2u(t-1)* + u(t-2). Approximate x(t) to x'(t) with 30 harmonics and plot x'(t) using MATLAB. Also plot the magnitude line spectrum for x'(t).

Q.3) Consider the following signals,

a) 1 + sinc(300πt)
b) 1 + cos(2000πt) + sin(4000πt)
c) 10sin(40πt)cos(300πt)

Now convert this continuous-time signal into a discrete-time signal using the sampling theorem. Make sure that there is no aliasing.

Q.4) Find out the FT of the given signal in MATLAB without using the FFT built-in function and plot the phase and magnitude graph for the given signal. Compare your results with the built-in function FFT.

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t = 0:1/100:10-1/100;                  % Time vector
x = sin(2*pi*15*t) + sin(2*pi*40*t);    % Signal
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Q.5) Consider the following signal:

$$x(t) = r(t+1) - 2r(t) + r(t-1)$$
$$y(t) = dx(t)/dt$$

a) Obtain X(Ω) and Y(Ω), plot their magnitude and phase spectrums, and comment whether X(Ω) and Y(Ω) are real or imaginary.
b) Determine from the above spectra which of these two signals are smoother. Use MATLAB integration function *int* to find the Fourier transforms. Plot $20 \log_{10}|Y(\Omega)|$ and $20 \log_{10}|X(\Omega)|$ and decide. Would you say in general that computing the derivative of a signal generates high frequencies or possible discontinuities?