EEE 391

Basics of Signals and Systems

Computer Assignment 1

due: 12 March 2019, Tuesday by 23:55 on Moodle

Consider the following periodic waveforms:

i) a square wave with period T_o, duty cycle 40%, and average value 0.5,

ii) a triangular waveform with period T_o and average value 4,

iii) a sawtooth waveform with period T_o and average value –3,

iv) a half-wave rectified sine function with period T_o and average value 2.5.

a) Sketch these waveforms as accurately as possible and label them as needed.

b) Find all of the Fourier series coefficients of these waveforms through analysis by hand and express them as compactly as possible.

c) If all of the Fourier series coefficients are used, the synthesis equation is as follows:

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{j2\pi k f_o t}$$

where $f_o = 1/T_o$ is the fundamental frequency of the waveform. However, infinite limits are not practical when trying to synthesize the signal on a computer. Try to approximate the periodic signal $x(t)$ by truncating the synthesis equation using different values of N:

$$x_N(t) = \sum_{k=-N}^{N} a_k e^{j2\pi k f_o t}$$

Calculate and plot the discrete version of the error signal $e_N(t)$ over one period as a function of N where

$$e_N(t) = x(t) - x_N(t)$$

Use N values of $1, 2, \ldots, 30$ and you may take $T_o = 5$ s where needed. Take the uniform sampling interval as $T_s = 0.2$ s so that 25 samples of the error signal are taken per period.

Repeat this for each type of waveform described above. For each waveform, try to plot all of the error signals on the same plot using different line styles or colors. Compare the errors of each waveform and interpret your results.

Submit the results of your own work in the form of a well-documented report on Moodle. Borrowing full or partial code from your peers or elsewhere is not allowed and will be punished. Please include all evidence (plots, screen dumps, MATLAB codes, MATLAB command window print-outs, etc.) as needed in your report. Append your MATLAB code at the end of your assignment, do not upload it separately. The axes of all plots should be scaled and labeled. Typing your report instead of handwriting some parts will be better. Please do not upload any photos/images of your report. Your complete report should be uploaded on Moodle as a single good-quality pdf file by the given deadline. Please DO NOT submit any hardcopies or files by e-mail or on memory stick/CD.